

Customizable Vision System

XG-X2000 Series

User's Manual

Read this manual before use.
Keep this manual in a safe place for future reference.



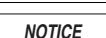
Introduction

The XG-X2000 Series uses a 2-way programming approach (either on the controller or on a PC) to build inspection programs. The controller can be used to carry out adjustments in the field, add vision units and perform product changeovers. A PC can be used to establish inspection methods and build new programs with original operation menus and other essential GUI elements. The available PC programs are the XG-X VisionEditor development environment and the XG-X VisionTerminal log data collection program.

Notations used in this manual

Symbols

The following warning symbols are used to ensure safety and to prevent human injury and/or damage to property when using the system.

 DANGER	It indicates a hazardous situation which, if not avoided, will result in death or serious injury.
 WARNING	It indicates a hazardous situation which, if not avoided, could result in death or serious injury.
 CAUTION	It indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
 NOTICE	It indicates a situation which, if not avoided, could result in product damage as well as property damage.
 Important	It indicates cautions and limitations that must be followed during operation.
 Point	It indicates additional information on proper operation.
 Reference	It indicates tips for better understanding or useful information.

Trademarks

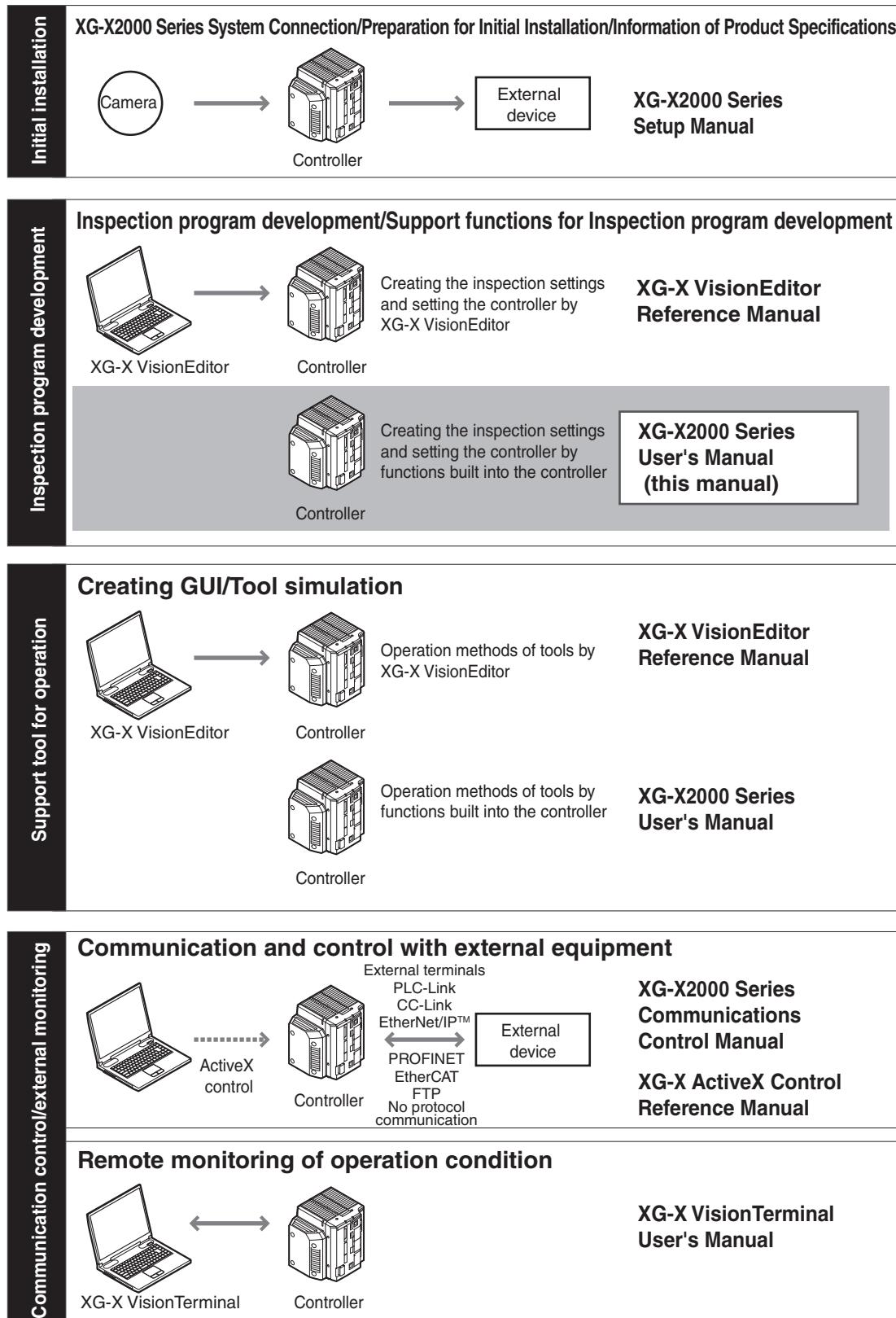
- Intel and Intel Core are trademarks of Intel Corporation in the U.S. and other countries.
- Microsoft and Windows are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.
- EtherCAT® is a patented technology licensed from Beckhoff Automation GmbH of Germany and is a registered trademark.
- Other company names and product names are registered trademarks or trademarks of their respective companies. The TM mark and ® mark are omitted in this manual.

This manual and related manuals

This manual describes the basic operation of the XG-X2000 Series (hereafter referred to in this manual as "the controller"), as well as related information and product specifications. Read this manual thoroughly in order to understand how the controller works and to maximize the performance of the controller.

Always keep this manual in a safe place for future reference.

Please ensure that the manual is passed to the end user.



Safety information for XG-X Series

Safety Precautions

 DANGER	<ul style="list-style-type: none"> Do not use this product for the purpose of protecting the human body or any part thereof. Because this product was not designed for use in an explosion-proof area, it must never be used in an explosion-proof area.
 CAUTION	<ul style="list-style-type: none"> Before starting or operating the system, check to make sure all system functions are working properly. If any Keyence product fails, take all safety precautions to prevent damage before using the system again.
 NOTICE	<ul style="list-style-type: none"> If the system is operated beyond its published specifications or if the system is modified, its functions and performance cannot be guaranteed. Please note that when the system is used in combination with other instruments, its functions and performance may be degraded. Do not subject the controller or connected devices to a sudden change in temperature. There is the risk of condensation occurring.

General cautions for the controller

 CAUTION	<ul style="list-style-type: none"> Do not use with any power voltage other than 24 VDC. Doing so may cause fire, electric shock, or product malfunction. Do not disassemble or modify the unit. Doing so may cause fire or electric shock.
---	--

Operating environment and conditions

 CAUTION	<p>To use the system properly and safely, avoid installing this unit in the following locations. Doing so may cause fire, electric shock, or product malfunction.</p> <ul style="list-style-type: none"> Locations that contain moisture or dust, or that are poorly ventilated. Locations where the system is exposed to direct sunlight or temperature increases. Locations where there are flammable or corrosive gases. Locations where the unit may be directly subjected to vibration or impact. Locations where water, oil or chemicals may splash onto the unit. Locations where static electricity is present or electric discharge may occur.
 NOTICE	<ul style="list-style-type: none"> Keep this unit and cables away from high-tension cables and power lines. Otherwise, noise may cause malfunction or accidents. Bundle cables with spiral tubing material. Direct bundling will concentrate the cable load on the bindings, which can result in cable damage or short circuit. The controller and optional devices are precision components. To maintain performance, do not subject them to vibration or shock.

Measures to be taken when an abnormality occurs

 CAUTION	<p>In the following cases, turn the power OFF immediately. Using the unit in an abnormal condition may cause fire, electric shock, or product malfunction. Contact your local Keyence office for repair.</p> <ul style="list-style-type: none"> If water or debris enters the system If the system is dropped or the case is damaged If smoke or a burning smell emits from the controller
---	---

Usage

 NOTICE	<ul style="list-style-type: none"> Before making any connections/disconnections, be sure to turn off the power of this unit and connected devices. Failure to do so may result in a malfunction of the controller or connected devices. Do not turn the power off while you are programming. Otherwise, all or part of the program settings may be lost. Do not block the ventilation holes. Otherwise, the inside temperature may rise and a malfunction may occur. Do not allow an excessive amount of sunlight or bright indoor light to enter the camera for a long period of time. Doing so may cause damage to the CCD inside the camera.
--	---

Maintenance

NOTICE

- Do not clean with benzene, thinner, or alcohol. Doing so may cause discoloration or deformation of the unit.
- Do not use a wet rag. If the unit has any dirt on it, wipe it off with a cloth moistened with a mild detergent, then wipe with a dry cloth.

Cameras

NOTICE

A special camera is used. Note that commercially-available cameras cannot be used.

Precautions on Regulations and Standards

CE marking

KEYENCE evaluates compliance with the requirements of the EU directive according to how products fulfill the below conditions. KEYENCE has confirmed that this product meets these requirements. When this product is used in EU nations, take note of the following precautions.

EMC Directive

- Applicable standard EN61326-1, Class A
- This product is intended to be used in an industrial environment.
- Be sure to connect the ground terminal to a grounding.
- Use cables shorter than 30 m to connect the controller unit and its external devices.
- When connecting the CC-Link unit CA-NCL20E, attach a ferrite core (OP-84364, optional) within 300 mm on the CA-NCL20E side of the CC-Link dedicated cable.
- When connecting to an LJ-V input unit CA-E100LJ/E110LJ, for the head cables, attach the following ferrite core (furnished accessory of CA-E100LJ/E110LJ) to them within 200 mm from the LJ-V input unit's head connector.
Model: ZCAT2035-0930A-BK (manufactured by TDK)

Remarks: These specifications do not give any guarantee that the end-product with this product incorporated complies with the essential requirements of the EMC Directive. The manufacturer of the end-product is solely responsible for the compliance of the end-product itself according to the EMC Directive.

FCC Canada Regulations

This product complies with the following EMI regulation specified by the FCC.

- Applicable regulation FCC Part 15 Subpart B Class A
- This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1)This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
- FCC CAUTION
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

KC mark (Republic of Korea)

Class A device

This product is an industrial electromagnetic wave generating device (Class A) and is intended for use in establishments other than domestic.

A 급 기기 (업무용 방송통신기자재)

이 기기는 업무용(A 급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

Differences between the XG-X2000 Series Controllers

This manual covers the XG-X2000 Series, which includes the XG-X2900/X2800/X2800LJ/X2700/X2500/X2200/X2000 models. All references, unless otherwise stated, pertain to the XG-X2700. Additionally, all screen images in this manual are taken from the XG-X2700. The differences between each model are listed below.

- The image processor used in the XG-X2900/X2800/X2800LJ/X2700 is faster than the XG-X2500/X2200/X2000. Actual speeds will vary depending on the contents of the program. Processing speed should be evaluated by uploading the program to the actual model to be used.
- The image memory of the XG-X2900 is eleven times larger, the XG-X2800/X2800LJ/X2700/X2500 four times larger, and the XG-X2200 two times larger, respectively, than the XG-X2000.
- For more details on differences between the models, refer to "Controller Specifications" (Page 9-26).

The camera models and maximum number of cameras that can be connected to the controller and the camera input unit used for the connection

The figures in the chart are the maximum number of cameras that can be connected to the camera port on the controller, and the figures in the brackets are the maximum number of cameras that can be connected by using the maximum number of camera input units.

		Camera Connection	XG-X2000	XG-X2200	XG-X2500	XG-X2700	XG-X2800	XG-X2800LJ	XG-X2900
Area camera	XG-035C/035M, XG-S035C/S035M, XG-H035C/H035M	Camera port on the controller or CA-E100, CA-E100L ^{*4}	2 (4)	2 (4)	2 (4)	2 (4)	(4)	×	(4)
	CA-HX048C/HX048M		2 (4) ^{*1}	2 (4) ^{*1}	2 (4) ^{*1}	2 (4) ^{*1}	(4) ^{*1}	×	(4) ^{*1}
	XG-200C/200M, XG-S200C/S200M, XG-H200C/H200M		×	2 (4)	2 (4)	2 (4)	(4)	×	(4)
	CA-HX200C/HX200M		×	2 (4) ^{*1}	2 (4) ^{*1}	2 (4) ^{*1}	(4) ^{*1}	×	(4) ^{*1}
	XG-H500C/H500M		×	×	2 (4)	2 (4)	(4)	×	(4)
	CA-HX500C/HX500M		×	×	2 (4) ^{*1}	2 (4) ^{*1}	(4) ^{*1}	×	(4) ^{*1}
	CA-H2100C/H2100M		×	×	×	2 (4)	(4)	×	(4)
Line scan camera	XG-HL02M	CA-E100L	×	×	×	×	(4) ^{*2}	×	(4) ^{*2}
	XG-HL04M		×	×	×	×	(4) ^{*2}	×	(4) ^{*2}
	XG-HL08M		×	×	×	×	(4) ^{*2}	×	(4) ^{*2}
	CA-HL02MX	CA-E200L	×	×	×	×	(4) ^{*2}	×	(4) ^{*1 *2}
	CA-HL04MX		×	×	×	×	(4) ^{*2}	×	(4) ^{*1 *2}
	CA-HL08MX		×	×	×	×	(4) ^{*2}	×	(4) ^{*1 *2}
3D Camera	XR-HT40M/HT15M	CA-E100T	×	×	×	×	(2) ^{*2}	×	(4) ^{*2}
LJ-V Series head	LJ-V7020/7020K/ 7060/7060K/7080/ 7200/7300	CA-E100LJ	×	×	×	×	(4) ^{*2 *3}	(2) ^{*3}	(4) ^{*2 *3}
		CA-E110LJ ^{*5}	×	×	×	×	(4) ^{*2 *3}	×	(4) ^{*2 *3}

*1 Supports LumiTrax light and MultiSpectrum light (CA-HL**MX only supports the LumiTrax Specular Reflection Mode of the LumiTrax light).

*2 The line scan camera and LJ-V Series head cannot be connected at the same time as the 3D camera. Additionally, the line scan camera and LJ-V Series head cannot be used at the same time as an area camera for which LumiTrax light or MultiSpectrum light is enabled.

*3 For one camera input unit, up to two LJ-V Series heads (limited to the same model) can be connected. However, the capture timing and number of capture lines of the LJ-V Series heads connected to the same camera input unit will be the same.

*4 In addition to the line scan camera, the area camera can also be connected to the CA-E100L. In that case, the encoder input can also be used as a trigger signal.

*5 The CA-E110LJ is a camera input unit that also supports the luminance output type LJ-V Series Sensor Heads whose model name ends with the letter B.

Compatibility of Inspection Program Files

Notes concerning the uploading of programs configured for a camera not connected to the controller

Before uploading or copying a program file, make sure the cameras set in the program match the camera models actually connected to the controller.

Program file compatibility between different model controllers

Program files created for one XG-X Series controller are compatible with other XG-X Series controller models.

If the program specifies a camera the controller does not support, or if the camera is not connected, a camera connection error will occur and the program will not run.

Programs may also fail to load on controllers due to insufficient processing and internal image memory.

This can occur when loading a program created on the workspace of a different controller.

For details on workspaces and controller models, refer to the XG-X VisionEditor Reference Manual.

Compatibility of program data

- The XG-X Series settings data (program settings, global variables, global settings, and libraries) contains the version of the controller or XG-X VisionEditor that created the data and available functions are also restricted by the version recorded in the settings data.
- As settings data is upward compatible, it can be loaded by the same or later versions of the controller or XG-X VisionEditor. However, settings data is not downward compatible. Therefore, the settings data cannot be loaded by a controller or XG-X VisionEditor version that is older than the version recorded in the settings data.
- You can change and save the version information by opening the version of XG-X VisionEditor that is the same as recorded in the settings data or later. For details, refer to the XG-X VisionEditor Reference Manual.

Changes to XG-X2000 Series by Version

This manual covers Ver. 1.3 of the XG-X2000 Series.

Reference The firmware version of your controller can be checked by selecting "System Information" on the Global menu (Page 6-45) in Setup Mode.

Functions Added or Changed in XG-X2000 Series Ver. 1.3

Additions/Changes Related to Supported Hardware

- EtherCAT communication is now supported when the CA-NEC20E is used.

Additions/Changes Related to the Units

- The OCR2 unit was added.
- A function that aids in the setting of the Resultant Image variable was added in [Images/Reference Unit] of the Contour Region Generator unit.
- The preview display is now set to be enabled at the moment the Resultant Image Preview screen is opened in [Contour Grouping] of the Contour Region Generator unit.
- The inversion of the specified color can now be done by batch for all the contour groupings in [Contour Grouping] of the Contour Region Generator unit.
- In Inspect Region of the Multi-Profile Defect unit and Contour Region of the Contour Region Generator unit, the value of [Smoothing Range (%)] was changed from integer form to decimal form. Furthermore, the lower limit value was changed from 1 to 0.000.
- [Contour Length] was added to the result data of the Multi-Profile Defect unit.
- [Standard Deviation] was added to the measurement items of the Height Measurement unit.

Additions/Changes Related to the Commands

- It is now possible to call the edit unit menu of the Capture unit by using the BU and DO commands.
- With regard to the CA/CD/CW/CR commands, the OCR2 unit is now supported.
- The TZW and TZR commands were added.
- With regard to the PS/LK/WH/UC/UA/UD commands, the case of using personal identifier User IDs with User Accounts is now supported.
- With the exception of some commands, commands can now be executed in the Setup Mode.

Other Specification Additions/Changes

- The default assignment for the MENU button of the handheld controller was changed from [Image viewer] to [Image strip].
- It is now possible to start the Retest function from Run Mode. (The Retest function is started after stopping Run Mode and switching the system to Setup Mode.)
- [Closely space characters] was added to the properties of the following Screen Parts:
Value, Text, Display Program/Recipe Name, Inspection Date, Inspection Time
- The response of the zoom operation performed by means of the mouse wheel for images of 5 megapixels or greater was improved.
- [Edit Flowchart in Run Mode] was added to the Function menu.
- It is now possible to flip through the pages of the Flow Display by pressing [FUNCTION button + Up/Down key] on the handheld controller.
- A "bird's-eye view" display function was added to the Flow Display.
- When a program setting is saved (i.e. exported), the wsx.xml file is now also included in the workspace folder.
- It is now possible to register personal identifier User IDs to the User Accounts and log in with a personal User ID. (User account setting is performed in the XG-X VisionEditor.)
- It is now possible to expand the number of integer digits of [Y] in the Target Classification function from 6 digits to 10 digits.
- It is now possible to synchronize the time of the controller to that of the time server on the network by using the SNTP protocol.

Functions Added or Changed in XG-X2000 Series Ver. 1.2

Additions/Changes Related to Supported Hardware

- The following controller model is now supported:
XG-X2900
- The following cameras are now supported:
CA-HL02MX, CA-HL04MX, CA-HL08MX
- The camera input unit CA-E200L is now supported.
- The illumination expansion unit CA-DC60E is now supported.
- When the CA-DC60E is used, the following lights are now supported:
CA-DRM5X, CA-DRM10X, CA-DRM20X, CA-DWX10X, CA-DZW10X, CA-DZW30X, CA-DZW50X

Additions/Changes Related to Capture

- MultiSpectrum Mode capture is now supported.
- LumiTrax Specular Reflection Mode capture is now supported.
- The behavior of the image capture buffer when multiple Capture units are placed in the inspection flow was improved.
- The maximum number of lines for Continuous capture of the XG-HL02M and XG-HL04M was expanded to 16384.

Additions/Changes Related to the Units

- The following units were added:
Color Grouping, Multi-Profile Defect, Contour Region Generator, Defect Extraction Operation
- In the color extraction function, the MultiSpectrum function is now supported.
- In the Color unit, the MultiSpectrum function is now supported.
- [Gain] was added to the Defect unit.
- The [Line Camera Setting Navigation] was added to the Capture unit.
- The [Line Calculation Tool] was added to the Capture unit.
- The [Re-test Operation] of the Branch unit was changed to [Controlled Branching].
- [Distance from Reference Line] was added to the measurement result of Defect Detection of the Profile Measurement unit and the Continuous Profile Measurement unit.
- The [High-Speed Scratch Defect Extraction] mode was added to the Scratch Defect Extraction filter.

Additions/Changes Related to the Commands

- With regard to the WI/RI commands, the MultiSpectrum function is now supported.
- With regard to the CL command, the maximum number of lines for Continuous capture of the XG-HL02M and XG-HL04M was expanded to 16384.

- With regard to the CL command, the CA-HL02MX, CA-HL04MX and CA-HL08MX are now supported.
- It is now possible to output the screen captures of the controller to an FTP server by using the BC command.
- With regard to the OW/OR/OPW/OPR commands, the output of screen captures to an FTP server is now supported.

Additions/Changes Related to the System Settings

- [Unit Type] can now be selected as the form of unit naming displayed in the Flowchart.

Additions/Changes Related to the Screen Editor Feature

- The parts, such as the Value part, Text part and so on, can now be hidden.

Other Specification Additions/Changes

- The unit addition menu for the Vision Tools category is now displayed in 2 columns.
- With regard to the functions related to robot vision, the number of digits for the decimal part of the angle data can now be set to 3 digits.
- In [Target FTP Server Settings], the function for initializing the IP Address, User ID and Password of the FTP server to connect to was added.
- In [Camera-Trigger-Light Configuration Settings], it is now possible to change the assignment of the lights across cameras.
- Terminologies in the languages other than Japanese have been revised.

Functions Added or Changed in XG-X2000 Series Ver. 1.1

Added 3D Measurement Features

- Profile Measurement unit was added.
- Continuous Profile Measurement unit was added.
- 3D Geometry unit was added.
- [From Result Data] was added to the extraction methods for Height Extraction.
- [From Result Data] was added to the specification methods for Zero Plane Specification.
- [Free-form Plane] was added to the specification methods for Zero Plane Specification of Height Measurement.
- The [Detected Plane] setting was added in the display options of Height Measurement.
- [Profile Image] can now be displayed in the image display.
- [3D Object] can now be displayed in 3D display.
- The 3D display types [Zero Plane 1], [Zero Plane 2], [Zero Plane (Surface)], [Zero Plane (Convex)] and [Zero Plane (Concave)] were unified to [Zero Plane] and they can now be selected as an option in [Display Options].
- The following commands were added:
MCC, MCW, MCR, PMW, PMR, PRW, PRR

Other Added Features

- The feature to enable and disable a camera was added in the camera settings.
- [Change Page] buttons were added to the view toolbar in the LumiTrax settings of the capture unit.
- [No Interpolation of Dead Angle Data] was added to Profile Capture Settings of LJ-V in the capture unit.
- The variable settings can now be accessed from the Select Image Variable dialog.
- The selected image can now be displayed in the Select Image Variable dialog.
- [HIRATA] was added as a manufacturer in Robot Connection Settings.

Contents

Introduction	2
Notations used in this manual.....	2
This manual and related manuals.....	3
Safety information for XG-X Series.....	4
Safety Precautions	4
Precautions on Regulations and Standards ..	5
Differences between the XG-X2000 Series Controllers.....	6
Compatibility of Inspection Program Files	7
Changes to XG-X2000 Series by Version	8
Contents.....	11

Chapter 1 Basic Operations

Introduction	1-2
Product Overview	1-2
Overview of the XG-X2000 Series Machine Vision System.....	1-3
Controller Operation Flow	1-4
Operation Flow.....	1-4
Controller Operation Modes	1-5
Interface.....	1-6
Run Mode	1-6
Setup Mode	1-7
Basic Operations.....	1-8
Overview of Basic Operations	1-8
Basic System Operation	1-9
Operation Using the USB Handheld Controller	1-9
Operating Using the Mouse.....	1-10
Operating Using the Touch Panel	1-10
Entering Characters.....	1-12
Changing the Screen Display (VIEW Toolbar).....	1-13
Using the Touch Menu.....	1-18
Using a USB HDD.....	1-19

Chapter 2 Measurement Condition Setting

Measurement Condition Setting	2-2
Overview of Measurement Condition Setting..	2-2
1.Creating a Program.....	2-3
2.Placing Units in a Flowchart.....	2-7
3. Changing the Settings of a Unit (Edit Unit Menu)	2-14
4.Saving the Settings (Save Program)	2-17
Managing Programs	2-18
Image Acquisition	2-24
Capture	2-25
Vision Tools	2-37
Vision Tools List	2-38
Area.....	2-40
Pattern Search	2-44
ShapeTrax3.....	2-52
ShapeTrax2.....	2-66
PatternTrax.....	2-78
Edge Position	2-88
Edge Width	2-97
Edge Pitch.....	2-106
Edge Angle	2-114
Edge Pairs.....	2-121
Defect.....	2-130
Blob	2-143
Grayscale Blob	2-153
Profile Position.....	2-166
Profile Width	2-178
Profile Defect.....	2-189
Multi-Profile Defect.....	2-202
Intensity	2-220
Color	2-225
Color Grouping	2-230
OCR2	2-235
OCR	2-255
2D Code Reader	2-274
1D Code Reader	2-291
Position Adjustment	2-306
Position Adjustment Unit	2-307

Contents

Flowchart Functions	2-310
Program Branch Unit	2-311
Loop Function Unit.....	2-313
Break Unit	2-314
End Unit	2-315
Operations	2-316
Overview of Operation	2-316
Calculation Unit.....	2-317
Calculation Notation.....	2-320
Operation Function List.....	2-327
Image Operation Unit	2-373
Defect Extraction Operation Unit	2-394
Contour Region Generator Unit	2-399
Calibration Unit	2-407
Image Stitching Unit	2-418
Timing	2-422
Pause Unit.....	2-423
Timer Start Unit	2-424
Timer End Unit	2-425
Terminal I/O Delay Unit.....	2-426
Variable Delay Unit	2-428
User Menu Unit	2-430
Display	2-431
On-Screen Graphics.....	2-432
Output	2-446
Parallel Terminal Output Unit	2-447
Data Output Unit	2-449
Image Output Unit	2-458
Commands.....	2-464
Command Execution Unit	2-465
Common Setting Items	2-467
Register Image	2-468
Select Image.....	2-471
Region Settings.....	2-473
Color Extraction	2-483
Image Enhance.....	2-489

Chapter 3 Run

Features Available in Run Mode	3-1
Starting/Ending Inspections	3-2

Chapter 4 Options

Measurement-Related Settings

(Options Menu).....	4-2
Overview of the Options Menu.....	4-2
Specifying the Unit(s) to be Used for Total Status and Camera Judgment Outputs (Judgment Settings).....	4-3
Changing the Variable Settings (Variable Settings).....	4-4
Specifying the Model of the Connected Camera (Camera Selection)	4-11
Changing the Settings for Capturing Asynchronously to the Flow (Image Capture Buffer Settings).....	4-12
Setting the Scaling Correction Values for Each Camera (Scaling)	4-18
Specifying the Units which Are to Be Used As Unit Total Error Output (Error Output) ..	4-19
Changing Operations for When the Unit Is Being Set (Unit Edit Startup Settings).....	4-20
Registering All of the Registered Image Information which Is to Be Referenced from Registered Images (Update Registered Image Information) ..	4-21
Registering the Reference Position Information of the Position Adjustment Units in the Program All at Once (Update Reference Position Information) ..	4-22
Setting the Server Information for FTP Output (Target FTP Server Settings).....	4-23
Locking / Unlocking Group-Lock (Lock/Unlock Group-Lock).....	4-24

Controller Display Screen Settings

(Screen Editor)	4-25
Overview of the Creation of Display Templates	4-26
Creating Display Templates.....	4-27
Screen Display Style	4-34
Screen Parts.....	4-42

Chapter 5 Utility

Utility Overview	5-2
Checking the Image Archive/Using Measurement Results for Retesting (Image Viewer)	5-3
Analyzing the Operation Results (Statistics) ..	5-15
Editing the Flowchart in Run Mode (Edit Flowchart in Run Mode)	5-22
Verifying the Communication Status/Operating Status	5-23
Verifying the Connection Status of Input and Output Terminals (I/O Monitor & Diagnostics)	5-23
Verifying the Status of RS-232C Communication (RS-232C Monitor)....	5-23
Checking the Ethernet Communication Status (Ethernet (TCP/IP) Monitor).....	5-24
Monitoring the Encoder Input Status (Encoder Monitor).....	5-24
Checking the PLC-Link Communication Status (PLC-Link Monitor & Diagnostics)	5-25
Checking the EtherNet/IP Communication Status (EtherNet/IP Monitor & Diagnostics)...	5-26
Checking the PROFINET Communication Status (PROFINET Monitor & Diagnostics)....	5-27
Checking the CC-Link Communication Status (CC-Link Monitor & Diagnostics)	5-28
Checking the EtherCAT Communication Status (EtherCAT Monitor & Diagnostics).....	5-29
Changing a Variable Value (Update Variables).....	5-31
Storing and Viewing Detected Target Types (Target Classification).....	5-34
Changing the Login User (Change Login User)	5-41
Logging Handheld Controller Operations (Modification Log (Start/Stop)).....	5-42
Managing the Files in the SD Cards and the USB HDD (File Management).....	5-43
Checking the Controller Memory Usage (Current Resource Allocation)	5-49

Chapter 6 Global

Overview of the Global menu.....	6-2
Changing the Controller Settings (System Settings)	6-4
Changing the Camera Common Settings (Camera Common Settings)	6-9
Changing the Terminal Input / Output Settings (Terminal Block & Parallel Port)	6-11
Changing the Encoder Filter Settings (Encoder)	6-13
Changing the Network Settings (Ethernet (TCP/IP)).....	6-14
Changing the FTP Client/Server Settings (FTP).....	6-16
Changing RS-232 Network Settings (RS-232C)	6-18
Changing the PLC-Link Settings (PLC-Link)	6-19
Changing the CC-Link Settings (CC-Link).....	6-23
Changing the EtherNet/IP Settings (EtherNet/IP).....	6-27
Changing the PROFINET Settings (PROFINET).....	6-31
Changing the EtherCAT Settings (EtherCAT)	6-34
Changing the VNC Server Function Settings (VNC)	6-37
Using SNTP to Automatically Synchronize the Controller's Clock (SNTP)	6-38
Sharing an OCR Library Among Programs (Library Specification).....	6-39
Defining the Custom Instruction (Custom Instruction Settings).....	6-40
Review the Information of the Controller (System Information)	6-45

Chapter 7 Capture Mode

Overview of Capture Modes.....	7-2
Capture Modes Available with This Controller ..	7-3
Capturing Images Using Lights from Multiple Directions (LumiTrax Mode)....	7-4
Capturing Images by Changing Light Emission Patterns (LumiTrax Specular Reflection Mode) ..	7-5
Capturing Images Using Multiple Light Colors (MultiSpectrum Mode)	7-6
Capturing Images Using a Single Light Color with MultiSpectrum Light (Standard Lighting Mode)	7-7
LumiTrax Mode.....	7-8
Switching to LumiTrax Mode	7-9
Capture (LumiTrax Mode) (Area Camera Only).....	7-11
Other Changes When LumiTrax Mode is Used.....	7-25
LumiTrax Specular Reflection Mode.....	7-29
Switching to LumiTrax Specular Reflection Mode.....	7-30
Capture (LumiTrax Specular Reflection Mode) (When Using an Area Camera).....	7-32
Capture (LumiTrax Specular Reflection Mode) (When Using a Line Scan Camera)	7-44
Other Changes When LumiTrax Specular Reflection Mode is Used.....	7-54
MultiSpectrum Mode.....	7-59
Switching to MultiSpectrum Mode	7-60
Capture (MultiSpectrum Mode) (Area Camera Only).....	7-62
Other Changes When MultiSpectrum Mode is Used.....	7-75
Extracting Colors in MultiSpectrum Mode	7-79
Standard Lighting Mode (MultiSpectrum light).....	7-85
Switching to Standard Lighting Mode Using MultiSpectrum Light	7-86

Chapter 8 Functions for Special Applications

Measurement Using 3D-compatible Cameras... 8-2	
Overview of Measuring With a 3D-Compatible Camera	8-3
Preparing the Camera (When 3D Camera is Used)	8-8
Preparing the Camera (When Using an LJ-V Series Head)	8-11
Capture (When 3D Camera is Used)	8-14
Capture (When Using an LJ-V Series Head) ..	8-22
Height Measurement.....	8-36
Profile Measurement	8-49
Continuous Profile Measurement	8-80
3D Geometry	8-111
Height Extraction.....	8-154
Checking the Workpiece Profile (3D Observation).....	8-156
Other Available Functions for Measuring by Means of 3D-compatible Cameras ...	8-160
Correcting the 3D Camera.....	8-167

Measurement Using Line Scan Cameras 8-169	
Preparing a Line Scan Camera.....	8-170
Capture (When Line Scan Camera is Used) ..	8-175
Viewing a Graph of the Line Scan Camera Capture Conditions (Linescan Calibration).....	8-184
Notes on Adjusting the Line Scan Interval ..	8-186

Retaining and Using Different Settings for Each Type (Recipe Function) 8-194	
Overview of the Recipe Function	8-195
Before Using the Recipe Function	8-200
Specifying a Recipe Target	8-201
Adding Recipe Settings	8-203
Changing Recipe Settings	8-204
Editing Recipe Settings.....	8-205
Other Functions Related to Recipes	8-208

Chapter 9 Appendix

Selecting the Lens	9-2
Main Specifications.....	9-18
Common System Specifications	9-18
Controller Specifications	9-26
XG-X VisionEditor Specifications	9-32
Troubleshooting	9-33
Error Messages.....	9-35
INDEX.....	I-1

Chapter 1

Basic Operations

Documentation for the installation and configuration methods of the controller, software, and CAD data can be downloaded from the following URL.

www.keyence.com/xgx_support

Introduction

▶ Introduction

Basic Operations

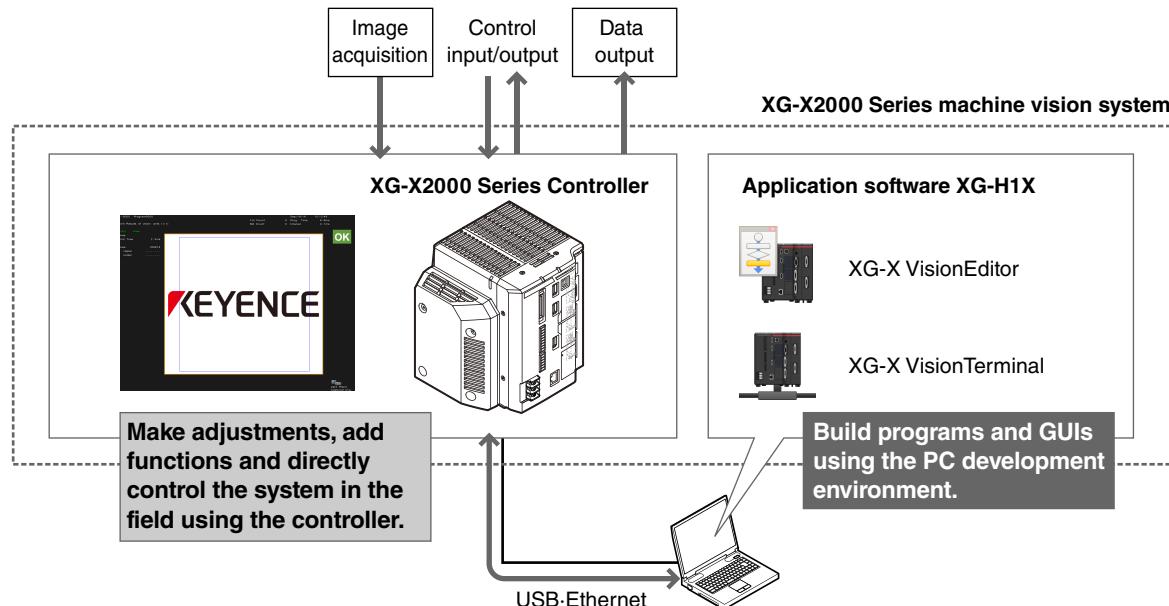
Product Overview

This chapter provides information for understanding the system configurations using this product.

- Overview of the XG-X Series Image Processing Sensors (Page 1-3)
- Controller Operation Flow (Page 1-4)
- Interface (Page 1-5)

Overview of the XG-X2000 Series Machine Vision System

The XG-X2000 Series uses a 2-way process (either on the controller or on a PC) to build inspection programs. The controller can be used to carry out adjustments in the field, addition of units and product changeovers. A PC can be used to establish inspection methods and build new programs with original operation menus and other essential GUI elements. The available PC programs are the XG-X VisionEditor development environment and the XG-X VisionTerminal log data collection program.



XG-X2000 Series Controller (this product)

This is an execution environment with a built-in multi-core DSP. In addition to running user-developed programs, the USB handheld controller, mouse, and touch panel can be used to check and edit inspection flowcharts and display screen setting. This allows for instant adjustments and program changes as they become necessary.

XG-X VisionEditor

XG-X VisionEditor is fully integrated development software especially designed for the customizable vision system XG-X2000 series. Through a function that creates programs and various utilities that are compatible with all processing of the XG-X2000 Series, VisionEditor provides total support from development and debugging of programs that contain customized menus and screens to verification of operations after being installed on-site with simulations.

XG-X VisionTerminal

XG-X VisionTerminal is software especially designed for the customizable vision system XG-X2000 series. The XG-X VisionTerminal offers a remote desktop function that allows you to check monitor output from the XG-X2000 Series on your PC and control the handheld controller and mouse from your PC.

The XG-X VisionTerminal also allows for data logs to be collected from the XG-X2000 Series connected to your PC.

Controller Operation Flow

This section explains the flow of operations required to execute measurements using this product, and the basic common operations that are required to operate this product.



- The optional USB handheld controller (OP - 87983) or mouse (OP-87506) is required to operate this product.
- Depending upon the version of the setting files and system settings, the usable functions and operable items might be different.
- Some operations may be restricted depending on the user account settings (Page 5-41).
- If the default function assignments to the handheld controller have been modified, some operations may be disabled or perform differently from the explanations outlined in this manual. For more details on assigning operations to the handheld controller, refer to "Controller Global Settings" in the XG-X VisionEditor Reference Manual.

Operation Flow

The standard operations for inspection using this product are as described below.

Prepare for Measurement (Setup Manual)

- Connect cameras, a monitor, etc. to this product.
- Prepare lenses, lights, etc. that are suitable for the workpiece.



Set Measurement Conditions in Setup Mode (Page 2-1)

- Set the capture conditions such as shutter speed and register the image that will serve as the reference for setting on the capture unit.
- Add/edit measurement units according to the purpose of the inspection to create a flowchart.
- In addition to the measurement conditions, specify the position adjustment, measurement result calculation and output method.



Run (Page 3-1)

- Perform a measurement in Run mode and check whether the desired judgment can be obtained correctly with the measurement conditions that were set.
- By using the image viewer in Setup mode, you can re-run a test on a saved image to reproduce the measurement result or re-run a test using different measurement conditions.



Start Actual Operations

- Switch the product to Run mode and start the actual inspection operations.

Reference

- Change the controller system settings (Page 6-1) and use the various utilities (Page 5-1) as necessary.
- Also refer to the XG-X2000 Series Setup Manual, XG-X VisionEditor Reference Manual, and XG-X2000 Series Communications Control Manual.

Controller Operation Modes

The controller has the following operating modes: "Setup mode" for configuring the flowchart, screen settings, etc. and "Run mode" for running inspections.

Run Mode (Page 3-1)

Run mode is typically used for performing inspections, control from external devices and output processing based on a program file.

Setup Mode (Page 2-1)

Setup mode is typically used for changing the program settings (Flowchart editing) and performing inspections based on a program file.



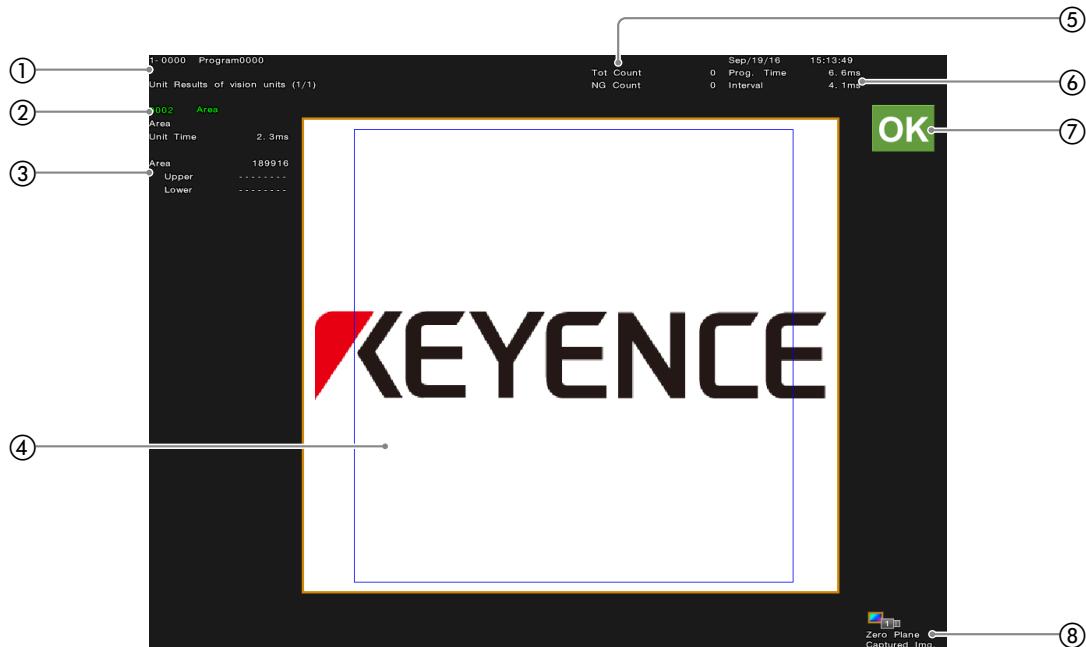
Point The processing count and output processing are not performed in Setup mode.

Interface

Run Mode

Following is an example of a standard Run mode screen.

- Point** Depending on the settings of the Screen Editor (Page 4-25) and the logged-in user account (Page 5-41), some functions may not be displayed.



(1) Program No. display

Displays the program number which is currently being processed.

(2) Unit display

Displays the ID and name of the unit which is currently displayed.

(3) Measurement result display

Displays the measurement results, limits and judgments of the unit which is currently displayed.

(4) Camera image

Displays the image which was input from the camera.

(5) Total count / NG count display

Displays the total measurement count in Run mode, and the number of total status NG judgments. The measurement and judgment results from the Setup mode are not reflected. The maximum total count is 1,000,000,000. Subsequently the count returns to 1.

(6) Date/time, measurement time, trigger interval display

- Date/time:** Displays the capture start time for the capture unit which was executed first in the flowchart that was most recently executed.

- Measurement time:** Displays the measurement processing time (time from trigger input until image processing is completed) of the currently running program that was most recently executed.

- Trigger interval:** Displays the calculation of the shortest possible trigger interval that can be input according to the result of the most recent execution of the current program. (This is valid only when [Trigger] is selected for the Screen Update mode.)

- Point**

- Because some processes are not applied in the Setup mode, it is necessary to switch to Run mode in order to obtain a reliable measurement time and trigger interval.
- The displayed value is a reference value calculated by assuming normal settings and operating status. The value may vary depending on the program contents and operating status.

(7) Judgment result display

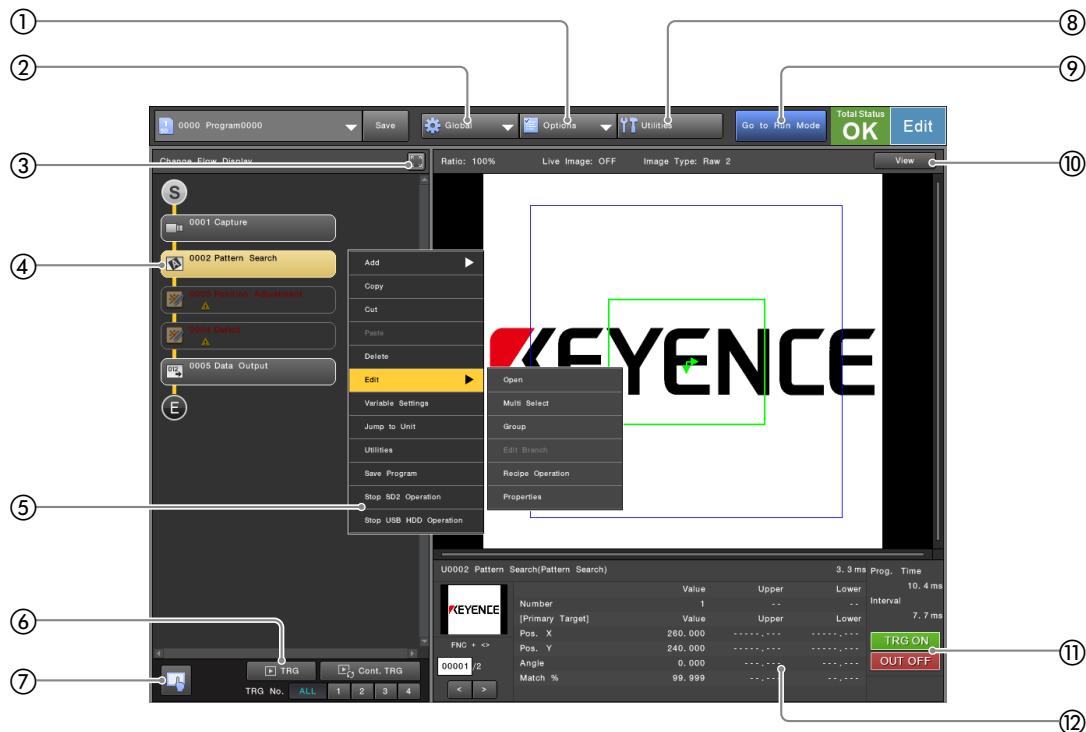
This area displays the total status judgment result of the current program.

(8) Information display

This area displays information such as the camera which is connected to the controller, the display type and the displayed image.

Setup Mode

Following is an example of a screen during flowchart editing (Page 2-1).



(1) Options menu

The variable settings, screen editor and other settings can be changed. For more details, see "Chapter4 Options" (Page4-1).

(2) Global menu

The system settings of this product can be changed. For more details, see "Chapter6 Global" (Page6-1).

(3) Flowchart zoom button

This button hides the image display and shows the flowchart on the entire screen.

(4) Flow editor

The current flowchart is displayed. For more details, see "What is a "Flowchart""? (Page 2-7).

(5) Function menu

The menu options available depend on the current screen or the item selected. For more details, see "Function Menu Items Displayed During Flowchart Editing" (Page 2-10) and "Function Menu Items Displayed During Unit Editing" (Page 2-16).

(6) Trigger input button

This button enters a trigger.

- Triggers can be entered continuously by selecting "Cont. TRG".
- The trigger No. to enter can also be specified.

(7) Touch menu button

This button displays the Touch menu (Page 1-18) (only when using the mouse or touch panel).

(8) Utilities button

This button opens the utilities for efficiently configuring the measurement condition settings. For more details, see "Chapter5 Utility" (Page5-1).

(9) Go to Run Mode button

This button switches the operation mode to Run mode.

(10) VIEW toolbar button

This button shows/hides the VIEW toolbar (Page 1-13).

(11) Trigger/output status display

The enabled/disabled statuses of trigger input and terminal and/or communication output are displayed.

(12) Information display

This area displays the information of the unit currently being edited, settings guide, etc.

Basic Operations

Introduction

► Basic Operations

Overview of Basic Operations

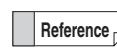
The main operations on the controller are performed by selecting the displayed items on the controller screen and entering the necessary setting values using the USB handheld controller, mouse or touch panel.

This section explains the operations that are common for all controller functions.

- Basic System Operation (Page 1-9)
- How to Use the VIEW Toolbar (Page 1-13)
- How to Use the Touch Menu (Page 1-18)

Basic System Operation

It is possible to select the displayed items on the controller screen and enter the necessary setting values for the primary controller operations using the USB handheld controller, mouse or touch panel.



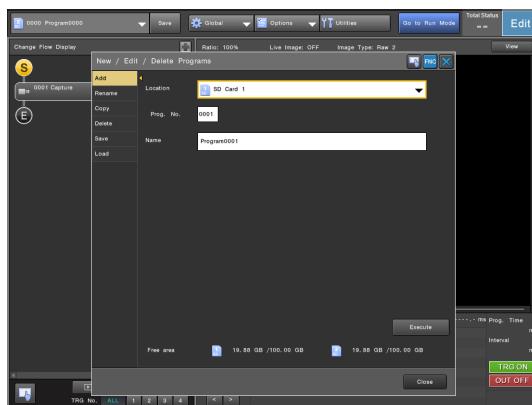
- Unless stated otherwise, the descriptions in this document are based on operation using the handheld controller. Refer to "Operating Using the Mouse" (Page 1-10) for mouse-specific operations and "Operating Using the Touch Panel" (Page 1-10) for touch panel-specific operations.
- This manual describes the process of selecting and confirming items as "Select, Choose or Click (item name)".

Operation Using the USB Handheld Controller

Selecting Items

The following section describes how to select and/or enter settings.

1 Move the 8-way key on the handheld controller right and left or up and down to highlight the item to set.



2 Press the No. 0 (ENTER) button.

This selects the item highlighted from Step 1.



To cancel the operation

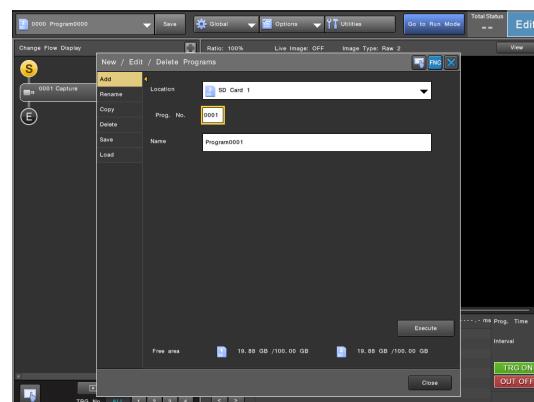
Press the No. 2 (ESCAPE) button on the handheld controller to cancel the last select operation.

Entering Values

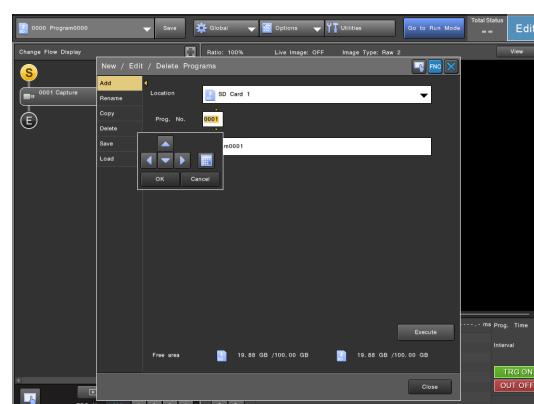
To enter values for the settings, use the procedure described below.

1 Select the field to enter a value into.

The numerical input screen appears.



2 Select the digit to edit and then use the up/down keys to specify the value.



- When using the mouse or touch panel, use the on-screen left/right buttons to specify the digit and up/down buttons to specify the value. Or, left-click to enter the value using numeric keys.
- When using the mouse, the value can also be specified by scrolling the mouse wheel.

3 After entering the value, select [OK].

This confirms and enters the specified value.

To cancel in the middle of changing the value

In Step 3 above, select [Cancel] instead of [OK].

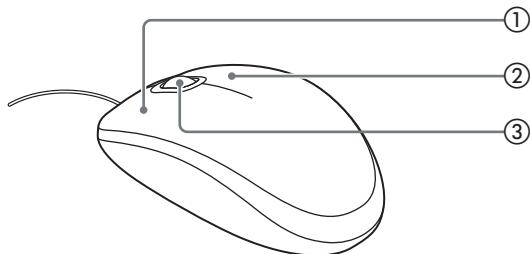
To reset a value on the [Limits] screen to “-----”

Select the value to reset and then select [Clear].

Operating Using the Mouse

A dedicated mouse (OP-87506) can optionally be connected and used to operate the controller instead of using the USB handheld controller.

Reference The mouse pointer speed can be changed in the System Settings (Page 6-7).



① Left button

This button is used to select an item.

② Right button

This button is mainly used to open the function menu.

③ Wheel

Scrolling the wheel scrolls down a list or changes the zoom ratio of the camera image.

Selecting Items

The following section describes how to select and/or enter settings.

1 Hover the mouse pointer over the setting item to be edited.

2 Left-click the mouse.

This selects the item on which the mouse pointer was placed in Step 1.

Reference It is also possible to switch the roles of the left and right mouse buttons (Page 6-7). This manual is written based on the default settings. If the mouse buttons have been switched, the terms "left mouse button" and "left click" in this manual should be read as "right mouse button" and "right click", respectively.

Dragging

Dragging means sliding the mouse cursor while holding down the left mouse button. This action is used for changing the size of a region or scrolling the displayed image.

Operating Using the Touch Panel

The Keyence CA-MP120T touch panel can optionally be used to operate the controller instead of using the USB handheld controller.

Selecting Items

Instead of pressing the 8-way key to select an item and then pressing the No. 0 (ENTER) button on the handheld controller, directly touch the item which you want to select on the touch panel screen.

Displaying the touch menu

The touch menu is used for touch panel operation of the functions that are frequently used in Run mode (Page 1-18). To display the touch menu, tap a location on the panel where no dialog box is shown, or tap at the top right of each screen, or tap (display touch menu) at the bottom left of the panel.

Displaying the Function Menu

Tap (function menu) at the top right of each screen.

Closing the displayed screen and returning to the previous screen

Instead of pressing the No. 2 (ESCAPE) button on the handheld controller, tap (cancel) on the screen you wish to close.

Zooming In/Out of the Displayed Image

The displayed image can be zoomed in and out by pinching out or in on the touch panel screen. The zoom ratio can be set from $x^1/100$ (1%) to $x25$ (2500%). If using multiple image displays, each display has its own zoom settings.

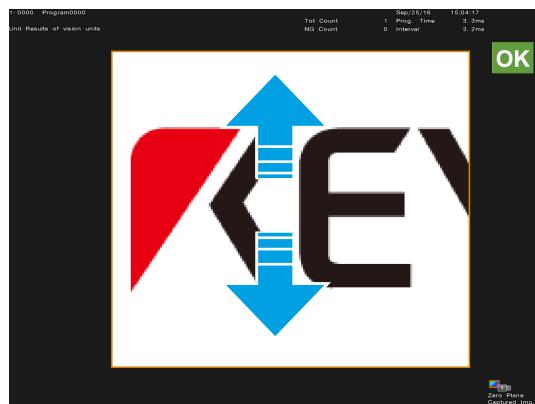
This is convenient when aligning with the measuring object and finely specifying the measuring region.



- If multiple image displays are present, select the display to operate before zooming in or out.
- Depending on the content of the program setting, there are cases where the zoom ratio may be fixed or where auto tracking of the center on a magnified display cannot be changed. For more details, refer to "Screen Editor" in the XG-X VisionEditor Reference Manual.

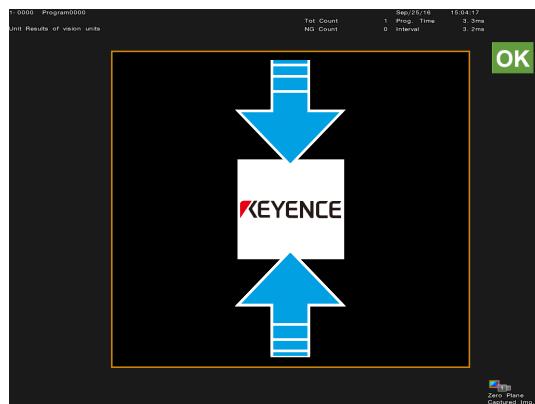
Zooming In on the Image Display

**Tap the screen with two fingers close together, then spread your fingers apart to zoom in on the display.
(This is referred to as "pinching out".)**



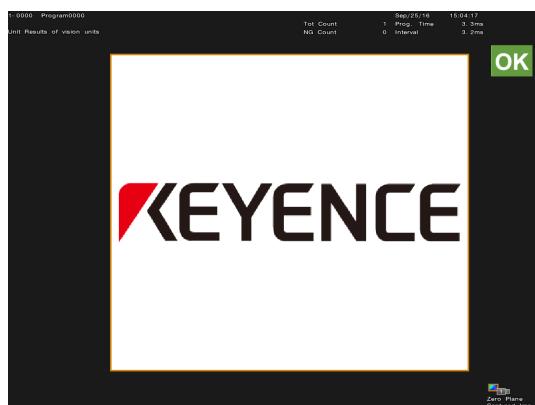
Zooming Out on the Image Display

Tap the screen with two fingers at separate locations, then bring your fingers towards each other to zoom out. (This is referred to as "pinching in".)



Fitting the Image to the Entire Screen (Fit Display)

Press and hold the image display to automatically fit the full image to the size of the image display.

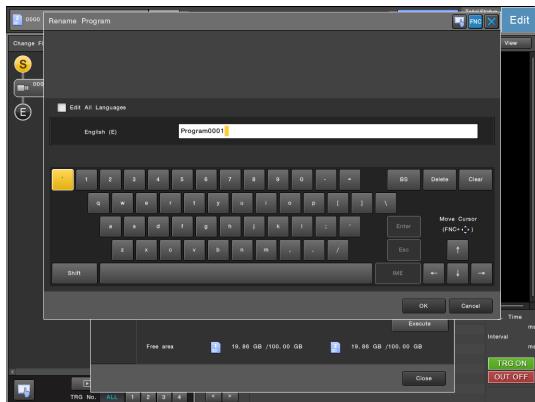


Entering Characters

To enter characters for setting names etc., follow the procedure described below.

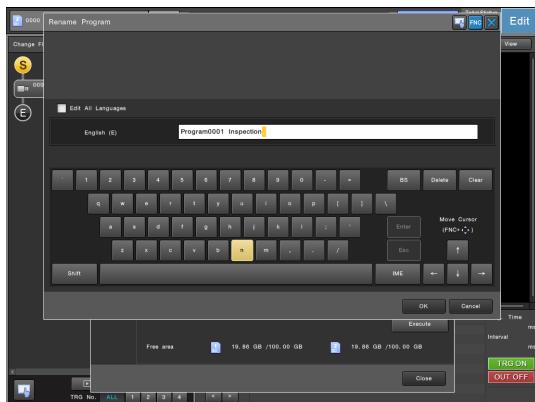
1 Select the field into which you wish to enter characters.

The character input screen appears.



2 Enter the characters using Romaji input.

The list of conversion candidates predicted based on the characters input appears.



3 Select the conversion candidate you wish to use.

4 When character input is complete, select [OK].

If you wish to enter the string for a different language that will automatically be switched to and displayed when the display language of the controller is changed, check the "Edit All Languages" box on the character input screen.

- Multi-language input fields will appear. Select and enter characters into the desired language field.
- Selecting a language will automatically switch to the corresponding input mode.

Changing the Screen Display (VIEW Toolbar)

The VIEW toolbar allows the displayed screen to be changed as described below.

- Changing the Menu Opacity (Menu Opacity) (Page 1-14)
- Displaying Live Image Feed (Page 1-14)
- Fitting the Image to the Entire Screen (Page 1-14)
- Zooming In/Out on the Displayed Image (Page 1-14)
- Scrolling the Image (Page 1-15)
- Changing the Displayed Unit/Page (Change Unit/Page) (Page 1-16)
- Changing the Display Template (Change Screen) (Page 1-17)
- Changing the Displayed Image Type (Change Display Type) (Page 1-17)
- Changing the Screen to Operate (Change Image Display) (Page 1-17)
- Checking the Intensity Profile Graph (Profile Display) (Page 1-17)

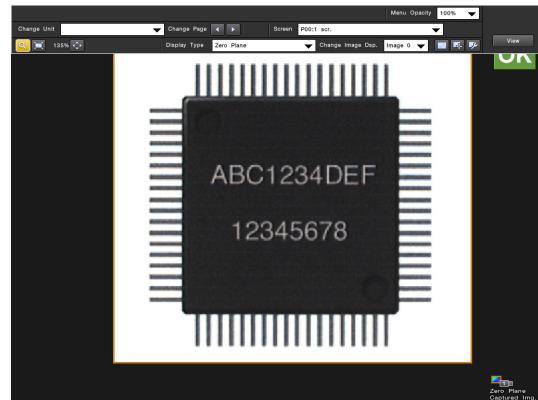
 Point

- Some features on the VIEW toolbar may be unavailable or the operation may be different from explanations in this manual, depending on program file settings and the controller state. For more details, refer to "Controller Global Settings" and "Screen Editor" in the XG-X VisionEditor Reference Manual.
- Using the VIEW toolbar during operation does not affect the inspection being performed.

Using the VIEW Toolbar

- 1 Press the No. 5 (VIEW) button on the handheld controller.**

The VIEW toolbar appears on the top of the screen.



- 2 Select the desired item and change the display options.**

 Point

If multiple screens and image displays are available, the operation target screen must be chosen by changing the focus (Page 1-17) before changes are made.

- 3 To close the View Toolbar, press the No.5 (VIEW) button on the handheld controller.**

The VIEW toolbar closes.

 Reference

The VIEW toolbar can also be closed by pressing the No. 2 (ESCAPE) button.

Changing the Menu Opacity (Menu Opacity)

This function can be used to change the transparency of menus and screens so that what is going on in the background (behind the menu) can be seen. Menus are opaque at 100% and become more transparent as the number decreases (90%, 75%, 50%, 25%).

Select the opacity from [Menu Opacity] on the right of the VIEW toolbar.

The menu will be displayed using the selected opacity.

Point Image displays cannot be made transparent.

Reference The menu transparency can be changed by holding down the No.1 (FUNCTION) button or No.7 Back button on the handheld controller and then pressing the No.6 (MENU) button.

Displaying Live Image Feed

By selecting [Live Image] on the VIEW toolbar in Setup mode, you can display a live image feed of the captured image (camera image) on the screen. This is useful when positioning the workpiece to the camera because images are updated in real-time without trigger input.

To stop the live image feed

Select [Live Image] again on the VIEW toolbar.

Fitting the Image to the Entire Screen

If you select  (fit) on the VIEW toolbar, the size of the captured image (camera image) displayed on the screen will be adjusted automatically such that the entire image fits in the center of the screen.

This is useful for quickly checking the entire image after zooming in/out or scrolling.

Zooming In/Out on the Displayed Image

The image displayed can be enlarged or shrunk as desired. The zoom ratio can be set from x1/100 (1%) to x25 (2500%). When using multiple image displays, each display has its own zoom settings.

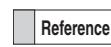
This is convenient when aligning with the measuring object and finely specifying the measuring region.



- The VIEW toolbar can be used to zoom in or out while running inspections.
- Depending on the content of the program setting, there are cases where the zoom ratio may be fixed or where auto tracking of the center on a magnified display cannot be changed. For more details, refer to "Screen Editor" in the XG-X VisionEditor Reference Manual.

1 Select  (zoom in/out) on the VIEW toolbar.

The  appears on the screen.

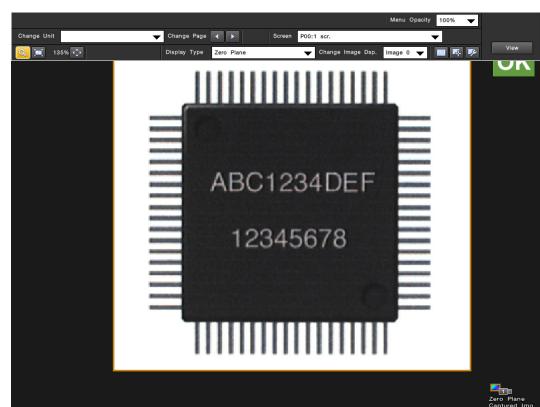


If multiple image displays are available, select the display to operate after selecting the zoom icon.

2 Place the  over the center of the area to zoom in on.

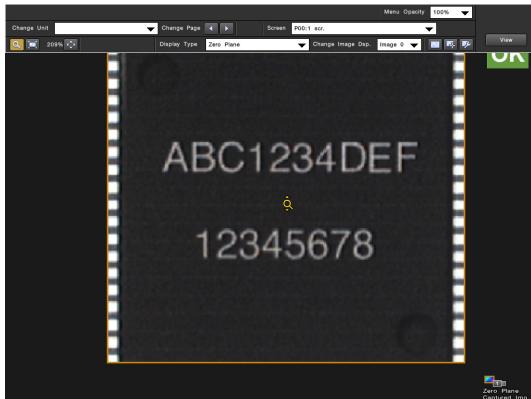
3 Press the No. 0 (ENTER) button.

When  changes to , the displayed image can be zoomed in/out.



4 Move the 8-way key up and down to zoom in or out on the image.

Moving the 8-way key up zooms in, while moving down zooms out.



- 5 When you have zoomed to the desired magnification, press the No. 2 (ESCAPE) button on the handheld controller to keep the current zoom settings.
- 6 Press the No. 2 (ESCAPE) button once more to exit the zoom function.

Point Other settings cannot be edited while the is displayed. Use the No. 2 (ESCAPE) button to exit the and/or close the VIEW toolbar before performing other settings.

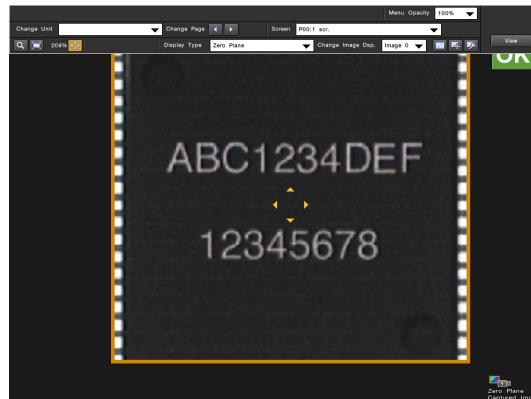
Scrolling the Image

When using a high resolution camera or displaying a magnified image, the entire image cannot be displayed on the screen. To see areas of the image currently not displayed, scroll the image using the procedure below.

Reference The VIEW toolbar can be called to use the scroll function even when an inspection is running.

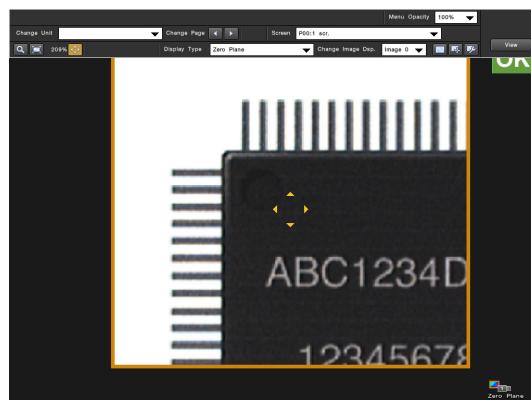
1 Select (scroll) on the VIEW toolbar.

When the appears on screen, the displayed image can be scrolled.



Point If multiple screens and image displays are available, the operation target screen must be chosen by changing the focus (Page 1-17) before changes are made.

2 Move the 8-way key up, down, left or right to scroll around the image.



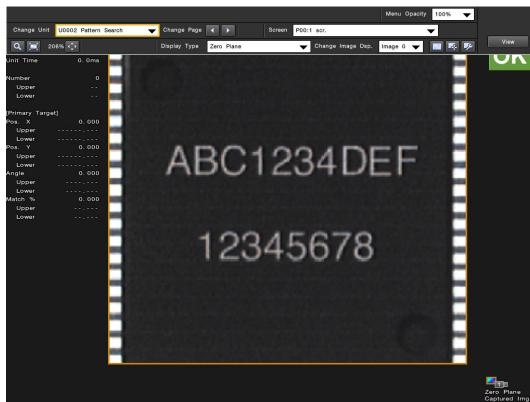
3 Press the No. 2 (ESCAPE) button on the handheld controller to stop scrolling.

Point

- Other settings cannot be edited while the is displayed. Close or close the VIEW toolbar to edit other settings.
- Press the No. 0 (ENTER) button to zoom in/out while scrolling. Pressing the button again will return to the scroll display.

Changing the Displayed Unit/Page (Change Unit/Page)

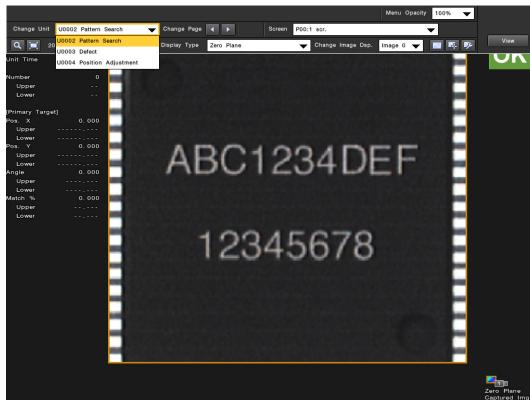
This function changes the display target unit and the displayed page. This is useful because the display target can be changed even when the handheld controller is being used to interact with an on-screen menu.



If multiple screens and image displays are available, the operation target screen must be chosen by changing the focus (Page 1-17) before changes are made.

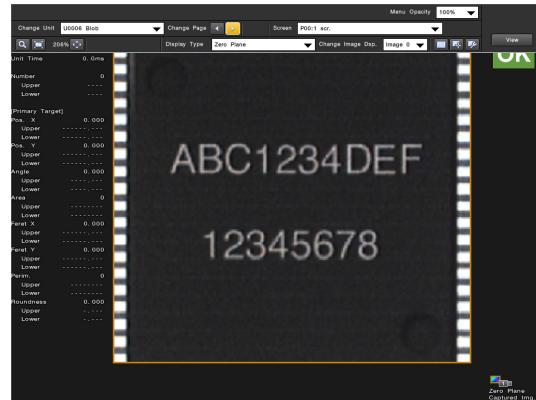
Changing the Displayed Unit

Select the target unit in "Change Unit" on the VIEW toolbar.



Changing the Displayed Page

Select or in "Change Page" on the VIEW toolbar to change the pages of the currently selected display pattern.



Changing the Display Template (Change Screen)

This function changes the display template to display on the screen.

A maximum of 100 display templates, P00 to P99, can be set. Each display template can be set to display arbitrary image displays, measurement and setting items and so on as desired.

Select the screen to change to from [Screen] on the VIEW toolbar.

The screen display changes to the selected screen.



To cycle through screens, press and hold the No.7 Back button and then press the No.4 (SCREEN) button on the handheld controller.

Changing the Displayed Image Type (Change Display Type)

This function can be used to change the type of image displayed on the screen.

Select the image type from [Display Type] on the VIEW toolbar.

- **Raw 1:** Displays the raw image as it is without any regions or processing.
- **Raw 2:** Displays the raw image as it is with the inspection region shown.
- **Grayed image:** Displays the image showing the effects of color extraction in the inspection region for the selected unit.
- **Filtered image:** Displays the image showing the effects of filter processing in the inspection region (or full image depending on the dialog) for the selected unit.
- **Filtered image 2** (only available when showing or editing the flowchart): Displays the image showing the effects of filter processing in the inspection region for the selected unit (the regions and results of other units that reference the same image variable are also displayed at the same time).
- **Contrast image:** Displays a color representation of the distribution of the defect level for defect detection or the contrast level for Grayscale Blob measurement. If the currently selected vision tool unit is not Defect or Grayscale Blob, the type displayed is [Filtered image] (except for ShapeTrax3 and ShapeTrax2), and [Current Feature] (when the displayed image is a captured image) or [Registered Feature] (when the displayed image is a registered image) (ShapeTrax3 and ShapeTrax2).

The screen display changes to the selected display type.



Point If multiple screens and image displays are available, the operation target screen must be chosen by changing the focus (Page 1-17) before changes are made.



Reference The image display type can also be changed by pressing the No. 4 (SCREEN) button on the handheld controller.

Changing the Screen to Operate (Change Image Display)

When multiple screens are available, this function specifies the target for the VIEW toolbar operations. If the target is set to a display showing an image from the image archive that includes archived result data, the results displayed will be the ones associated with the archive image.

Select the target screen for the VIEW toolbar operations from [Change Image Dsp.] on the VIEW toolbar.

The target frame will move to the selected image display, indicating that display is the target for the VIEW toolbar operations.



Reference The target can also be set by pressing and holding the No.1 (FUNCTION) button or No.7 Back button and then moving the 8-way key up or down on the handheld controller.

Checking the Intensity Profile Graph (Profile Display)

Displays the intensity distribution in any position of a currently displayed image in a profile graph in the horizontal and vertical directions. Maximum and minimum values of intensity are displayed together with the graph.

Check the profile graph and/or change the profile display setting using the profile function buttons that are displayed on the right of the VIEW toolbar.

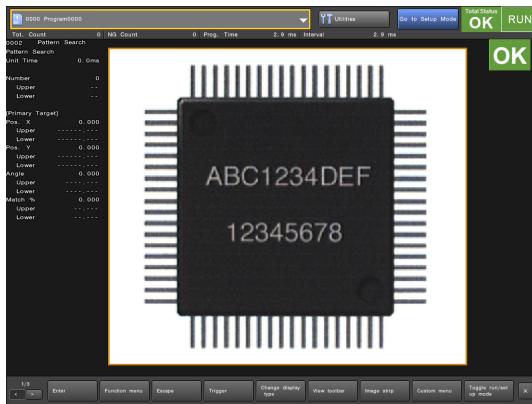
- (Display Profile): Switches the display of profile ON/OFF.
- (Move Profile): Specify the profile you wish to move and then specify the destination position. After moving the profile, select [End Move] on the top left of the screen.
- (Profile Settings): Displays the [Profile Settings] screen, where the profile display setting can be changed.

Using the Touch Menu

You can either click on the screen using the mouse or use the touch menu that appears when the touch panel screen is tapped to perform basic controller operations.

Displaying the touch menu

To display the touch menu, tap a location on the panel where no dialog box is shown, or tap  at the top right of each screen, or tap  (display touch menu) at the bottom left of the panel.



The touch menu is used for touch panel operation of the functions that are frequently used.

- A total of nine buttons are displayed on a screen, and you can configure up to three screens that can be navigated by selecting  / .
- The functions available in the touch menu can be assigned using the XG-X VisionEditor (9 functions per screen x 3 sets).
- A menu is also displayed at the top of the screen in Run mode. Functions for changing the program, opening the utilities, switching to Setup mode, etc. are available in the menu.

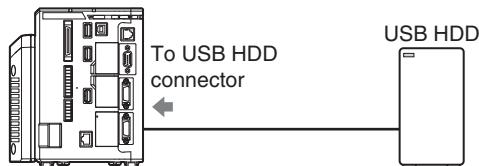
Touch menu function list

The following functions can be assigned to the touch menu:

- Enter
- Escape
- Open View toolbar
- Open the function menu
- Open the image strip
- Open the image viewer
- Change the image display type
- Change the target
- Change the display template
- Save the program
- Issue all triggers
- Edit flowchart in Run mode
- Switch between Run/Setup modes
- Reset
- Capture screen
- Change the menu opacity
- Execute Command
- Issue PROFINET alarm

Using a USB HDD

Users can connect a USB HDD to save the inspection results, captured images, etc.



USB HDD supported on the controller

Refer to the XG-X2000 Series Setup Manual.

The USB HDD needs to be initialized (formatted) on the controller before use (Page 5-48).

What You Can Do Using the USB HDD

The following functions become available when a USB HDD is connected to the controller.

- Setting the Items for Result Output to the USB HDD (Page 2-457)
- Outputting Images to the USB HDD (Page 2-463)
- Saving Archived Images to the USB HDD (Page 5-4)
- Exporting the Archived Image to the USB HDD Using the HS Command (Save Archived Image)
- Checking Past Images on the Image Strip



It is not possible to store program files or write/read program files to/from the USB HDD.

Connecting the USB HDD

Refer to the XG-X2000 Series Setup Manual.

Removing the USB HDD

Refer to the XG-X2000 Series Setup Manual.



The USB HDD can also be removed by selecting [Stop USB HDD Operation] from the Function Menu.

Chapter 2

Measurement Condition Setting

Documentation for the installation and configuration methods of the controller, software, and CAD data can be downloaded from the following URL.

www.keyence.com/xgx_support

Measurement Condition Setting

▶ Measurement Condition Setting

Image Acquisition

Vision Tools

Position Adjustment

Flowchart Functions

Operations

Timing

Display

Output

Commands

Common Setting Items

Overview of Measurement Condition Setting

The standard operations for measurement condition setting are as described below.

Preparing a Program (Page 2-3)

- Create a new program or switch to an existing program.

Placing Units in a Flowchart (Page 2-7)

- Place a measurement unit, etc. according to the purpose of the inspection and create a flowchart.
- Units for position adjustment, performing various calculations and output are also available.
- It is also possible to add controls such as conditional branching and delay as required.

Changing the Unit Settings (Page 2-14)

- Register the capture conditions such as shutter speed and the reference image for setting on the capture unit.
- Change the measurement unit settings to specify the inspection method and judgment conditions.
- Change also the settings of the units other than those for measurement according to the purpose of the inspection and inspection environment/conditions.

Running Inspections (Page 3-1)

- Switch the product to Run mode and start the actual inspection operations.
- If the expected measurement result cannot be obtained, you can solve the problem using the various utilities.

1.Creating a Program

What is a Program?

All the settings required for an inspection including camera settings, inspection regions, judgment conditions, etc. are grouped together in one entity in the controller called a program. This helps by making the organization of everything very easy so that switching workpiece types or performing product changeovers is supported by a simple process of just switching programs.

Types of Settings Files for the XG-X2000 Series

The settings data of the XG-X2000 Series are managed in separate files based on their purpose. Uploading or copying these settings data to the controller will enable you to perform an actual image processing inspection. The XG-X2000 Series uses the following files as settings data.

- The image processing programs at the core of the settings data are managed based on "programs"; and processes are performed for different purposes by switching the active program No. (Change Programs).
- Some settings files are managed based on "programs", while others are managed in common in the controller regardless of the programs.

Point

- Do not change the file/folder names of the settings data files. Since most file and folder names are assigned automatically by the system, the data may become unavailable if you modify the file names directly using Explorer on a PC.
- If only some of the workflow settings are different for each product type, you can operate by switching recipes with a single program. For more details, see "Retaining and Using Different Settings for Each Type (Recipe Function)" (Page 8-194).

Program Unit

- Program (inspect.dat): Stores all settings data related to processing not included in other files, such as the flowchart and local variable data that are parts of an image processing program.
- Registered Image (ref*_***.bmp/jpg, ref*_***/***_***.bmp/jpg): Image data that can be referenced as pattern data (image reference information) for a Pattern Search unit (Page 2-44), ShapeTrax3 unit (Page 2-52), ShapeTrax2 unit (Page 2-66) or PatternTrax unit (Page 2-78), a teaching image for a calibration unit (Page 2-407), or a working image for various measurement units.

- Master Image (***.bmp/jpg): Image data used for a comparison check when running a batch test during a retest (Not directly used in image processing).
- bin/dll file (***.bin, ***.dll): Compiled data required for the execution of C Plugin units. The bin files are for the controller, and the dll files are used for various simulations in XG-X VisionEditor.

Point

- For details on retests and batch tests, see "Re-checking the Image Processing Using Archived Images (Retest)" (Page 5-9).
- Although the data is not used directly in image processing, screen files (***.srn) containing the settings for each display template in the program are also supported. See the XG-X VisionEditor Reference Manual for more details.

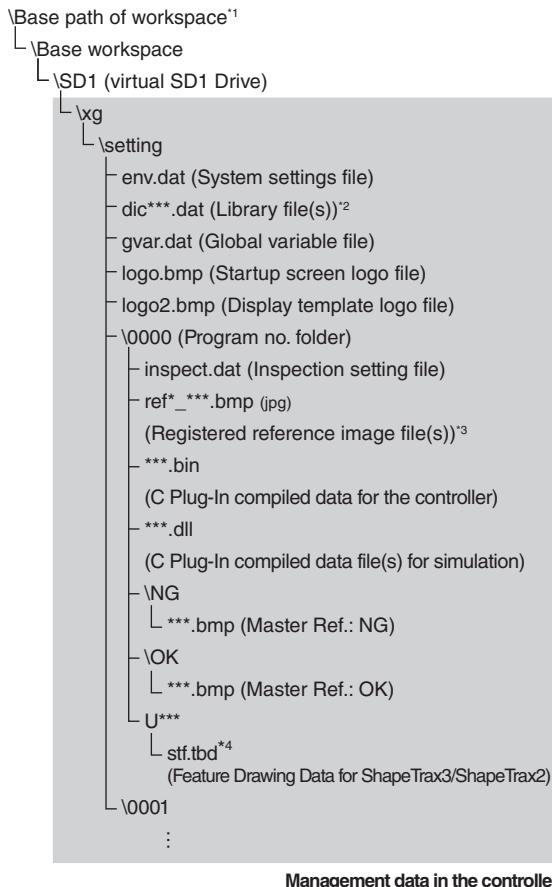
Program Common Settings

- System Settings (env.dat): Stores the common controller system settings data that are set for all programs.
- Library (dic***.dat): The library data used for character recognition by the OCR unit (Page 2-255) or OCR2 unit (Page 2-235) that is common for all programs. The library data can also be held separately per program. For more details, see "Sharing an OCR Library Among Programs (Library Specification)" (Page 6-39).
- Global variable setting (gvar.dat): Stores the variable data that can be referenced by all programs.
- Logo files (logo.bmp and logo2.bmp): One type is for the startup screen (logo.bmp), and another type is for the display template (logo2.bmp).

1.Creating a Program

Management Structure of Settings Files

Each program in the controller is managed and saved in a folder as a group of files. This includes the individual settings data used for image processing, registered image data, library data, variables and other files.



*1 The base path of the workspace can be set to any location on the PC. See the XG-X VisionEditor Reference Manual for more details.

*2 When [Common for All Programs] is selected for [Library Specification] (Page 6-39) in the system settings (The file is saved to the program No. if [By Program] is selected)

*3 Or ref*_*_*_*_.bmp (.jpg)

*4 It is only created when the feature drawing function is used in the ShapeTrax3 or ShapeTrax2 unit.

- Point**
- SD Card 1 and 2 can individually manage up to 1000 programs from 0000 to 0999, where as the actual number of programs that can be stored depends on the setting content of the programs.
 - Removing SD Card 1 will remove the system settings file and prevent the controller from operating properly.
 - Make sure SD Card 1 is inserted when using the controller.
 - The system settings are referenced by all programs in the controller.
 - The bin/dll files are used for C Plugin units.

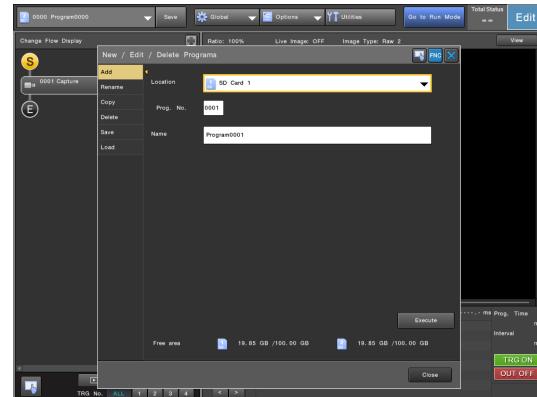
Adding a New Program (Add New)

Add as many new programs for registering various measurement settings as required. The program name can be specified at the same time, so it is useful to register a descriptive program name.

- 1 Select [New/Edit/Del Programs] from the [Program No.] menu on the top left of the screen.**

The [New/Edit/Delete Programs] screen appears.

- 2 Select [Add].**



- 3 To add a program to SD Card 2, change the default selection in the [Location] field from [SD Card 1] to [SD Card 2].**

Point [Location] cannot be set to SD Card 2 if no SD card exists. When adding a Program No. to SD Card 2, be sure to first insert the SD card into the SD2 slot.

- 4 Select [Prog. No.] and specify the program number for the program.**

The name of the newly created program defaults to "Program****", where **** represents the program number.

Point A Program No. that is already being used cannot be specified.

- 5 Select [Name].**

The [Rename Program] screen appears.

- 6 Input the program name and select [OK].**

Refer to "Entering Characters" (Page 1-12) for more details on inputting characters.

- 7 Select [Execute].**

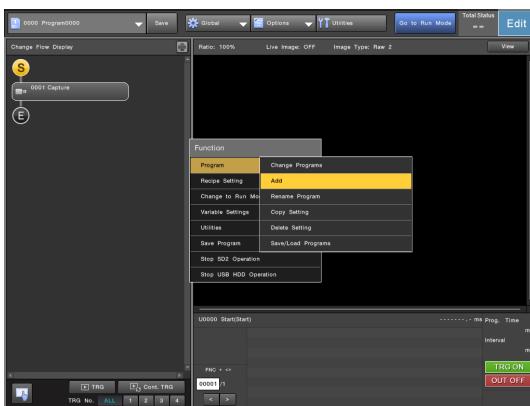
The Program is added and the system is switched to that program.

Point

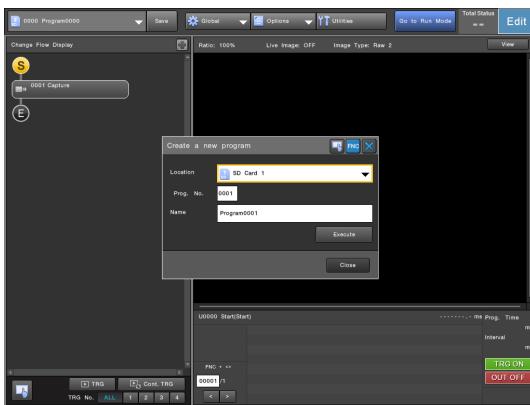
- Selecting [Close] will cancel the creation of a new program.
- The available free area on each SD card is displayed at the bottom of the [New/Edit/Delete Programs] screen as "Free area/total area in SD Card 1" and "Free area/total area in SD Card 2".

Adding a New Program from the Function Menu

- 1 Select [Program] - [Add] from the Function menu (Page 2-10).**



The [Create a new program] screen appears.



- 2 Specify the save location, inspection program No., and inspection program name.**

For more details, see "Adding a New Program (Add New)" (Page 2-4).

- 3 Select [Execute].**

A new program is created and the system changes to the new program.

Changing Programs

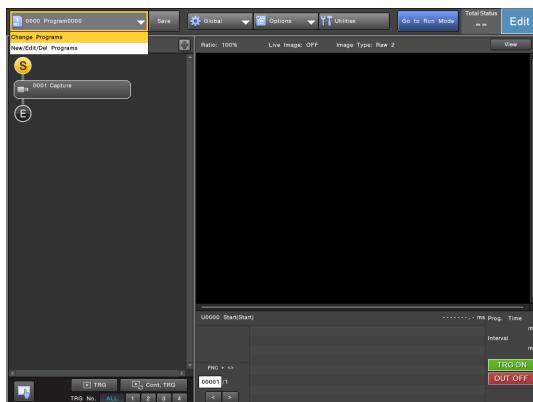
NOTICE

During the program change, the controller will read from and write to the SD card where the program data is stored. The flash memory is used as the storage element in the SD card and it has a read/write life. Corruption and or loss of data may result if programs are frequently changed. It is strongly recommended that data stored on the SD card is backed up regularly to other storage media.

Point

- Changing the program will stop the inspection in progress and clear all archive and statistics data in the controller's memory. Any unsaved variables being used in the current program will also be cleared and returned to their initial values.
- If terminal outputs, measurement value outputs, or image outputs were being executed during switching operations, then the program switching cannot be performed until the data outputs can be interrupted. If the size of the data being output is large, such as image data, it may take several tens of seconds or more before the program can be switched. During this time, the controller will be inoperable. For more details, refer to "Output Units" in the XG-X VisionEditor Reference Manual.

- 1 Select the [Program No.] menu on the top left of the screen.**



Point

- The icon to the left of the program indicates the program is stored on either SD Card 1 or SD Card 2.
- Both SD Card 1 and SD Card 2 can individually manage up to 1000 programs each (0000 to 0999). The actual number of programs that can be set will depend on the available space on the SD card.

- 2 Select [Change Programs].**

The [Change Programs] screen appears.

- 3 Select the desired program No. from the menu and then select [OK].**

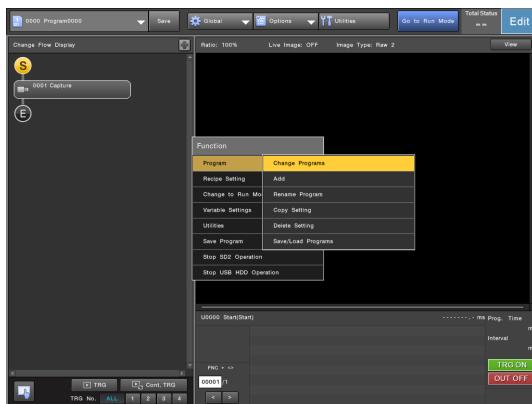
The controller changes to the selected program.

Reference

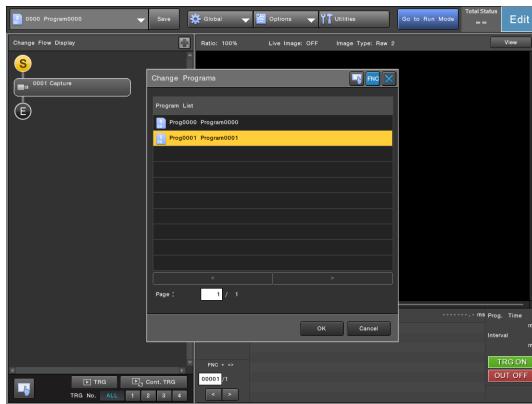
Program switching can also be done via an external command.

Switching from the Function Menu

- Select [Program] - [Change Programs] from the Function menu (Page 2-10) .



The [Change Programs] screen appears.



- Select the program you wish to edit the flowchart for and select [OK].

The controller changes to the selected program.

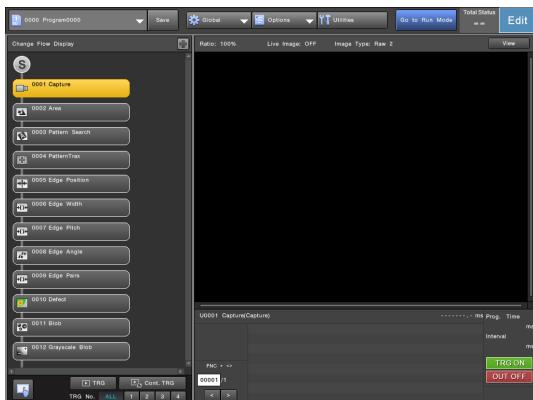
2.Placing Units in a Flowchart

What is a "Flowchart"?

This controller manages the series of operations from capturing an image, processing its information through to generating data and results as a "flowchart."

- A flowchart is created by freely combining and arranging the required "units", which are used to represent inspection, calculation, control, and other processes.
- An inspection will be performed according to the created flowchart.

Example of a Flowchart



- Each process executed in the flowchart is shown as a unit.
- Units are connected automatically with lines, indicating they will be processed one by one from the top to the bottom of the flowchart (The lines through which the process passed are shown in yellow, and those the process did not pass through are shown in gray).
- The unit execution result is displayed for each unit.
 - Green●: Execution result is OK
 - Red●: Execution result is NG
 - Yellow▲: Calculation error (Error occurred with the calculation execution content).
 - None: Judgment value is not set or the unit is not executed
- Units whose execution is set to [Never Execute] in the unit's properties are shown in gray.



When the [Execute] for each unit is set to [Variable Reference], the unit is not shown in gray.

Editable Units

The following units can be placed in the flowchart:



- Some restrictions are imposed on changing the settings on the controller side. See the explanation of each unit for more details.
- The settings for a C Plugin unit, Start unit, End unit, Break unit, Loop End unit, and Join unit cannot be changed from the controller side. See the XG-X VisionEditor Reference Manual for more details.

Image Acquisition

- Capture (Page 2-25)

Vision Tools

- Area (Page 2-37)
- Pattern Search (Page 2-44)
- ShapeTrax3 (Page 2-52)
- ShapeTrax2 (Page 2-66)
- PatternTrax (Page 2-78)
- Edge Position (Page 2-88)
- Edge Width (Page 2-97)
- Edge Pitch (Page 2-106)
- Edge Angle (Page 2-114)
- Edge Pairs (Page 2-121)
- Defect (Page 2-130)
- Blob (Page 2-143)
- Grayscale Blob (Page 2-153)
- Profile Position (Page 2-166)
- Profile Width (Page 2-178)
- Profile Defect (Page 2-189)
- Multi-Profile Defect (Page 2-202)
- Intensity (Page 2-220)
- Color (Page 2-225)
- Color Grouping (Page 2-230)
- OCR2 (Page 2-235)
- OCR (Page 2-255)
- 2D Code Reader (Page 2-274)
- 1D Code Reader (Page 2-291)
- Height Measurement (Page 8-36)
- Profile Measurement (Page 8-49)
- Continuous Profile Measurement (Page 8-80)
- 3D Geometry (Page 8-111)

Position Adjustment

- Position Adjustment (Page 2-306)

2.Placing Units in a Flowchart

Flowchart Functions

- Program Branch (Page 2-310)
- Loop Function / Loop End (Page 2-313)
- Break (Page 2-314)
- End (Page 2-315)

Operations

- Calculation (Page 2-317)
- Image Operation (Page 2-373)
- Defect Extraction Operation (Page 2-394)
- Contour Region Generator (Page 2-399)
- Calibration (Page 2-407)
- Image Stitching (Page 2-418)
- Robot Coordinate Conversion
- Robot Coordinate Operation

Timing

- Pause (Page 2-423)
- Timer Start (Page 2-424)
- Timer End (Page 2-425)
- Terminal I/O Delay (Page 2-426)
- Variable Delay (Page 2-428)
- User Menu (Page 2-430)

Display

- On-Screen Graphics (Page 2-431)

Output

- Parallel Terminal Output (Page 2-447)
- Data Output (Page 2-449)
- Image Output (Page 2-458)

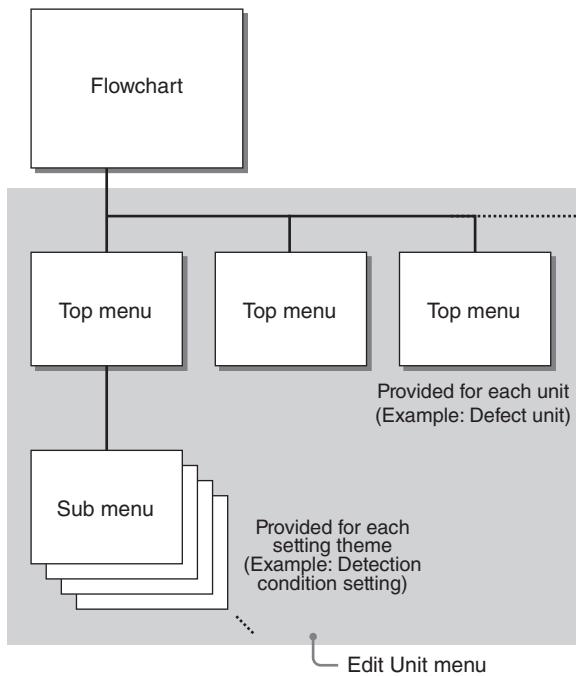
Commands

- Command Execution (Page 2-465)

Reference For more details on the Robot Coordinate Conversion and the Robot Coordinate Operation unit, refer to the User's Manual (Robot Vision Edition).

Flowchart Editor Configuration

The flowchart is configured using related Edit Unit menus selectable from the flowchart editor menu.



Top Menu

This menu is used to access the edit menu (sub menus) for each unit. When you select the setting you want to change in the top menu, the corresponding sub menu opens.

Sub Menu

This menu is used to change the individual setting parameters of a unit such as [Inspection Region] or [Condition].



Depending on the unit, top menus may not exist.

Cautions on Flowchart Editing

Timing when %Trg1 - 4Ready Status Changes

The state of the triggers (%Trg1Ready, %Trg2Ready, etc.) can change between ON/OFF when changes are applied to certain functions such as the image capture buffer. If the prohibition of trigger input is enabled, %Trg*Ready will always be OFF when editing the flowchart.

Available setting items and contents are affected by the user account settings

Available setting items and contents on the controller are affected by the user account settings configured in XG-X VisionEditor.

See the XG-X VisionEditor Reference Manual for more details.

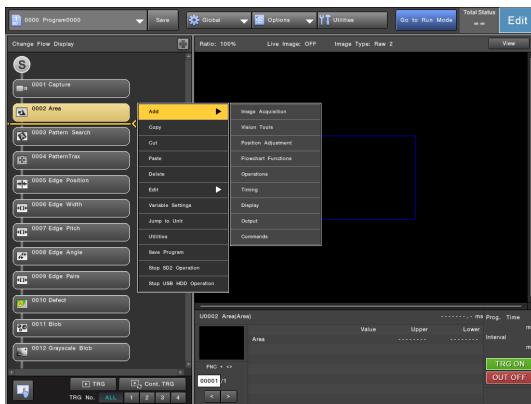
Adding Units to the Flowchart

When a new program is created, the flowchart contains a start unit (Unit ID: U0000), capture unit (U0001) and end unit (U0999). Add necessary units to create a flowchart.



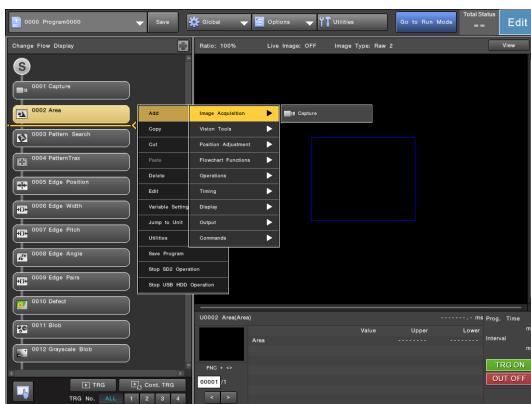
- Up to 1000 units can be added to a flowchart, including the start and end units. When there are already 1000 units in a flowchart, no more units are able to be added.
- Even with 999 units in a flowchart, a branch unit and loop unit cannot be added because they are made up of 2 units.
- If the various memories are insufficient, then units cannot be added even if the unit count is below 999.

- 1 Switch to the program you wish to edit the flowchart for or add a new program (Page 2-3).**
- 2 Place the cursor on the unit below which you want to add a unit, and then display the flowchart edit menu (Page 2-10).**



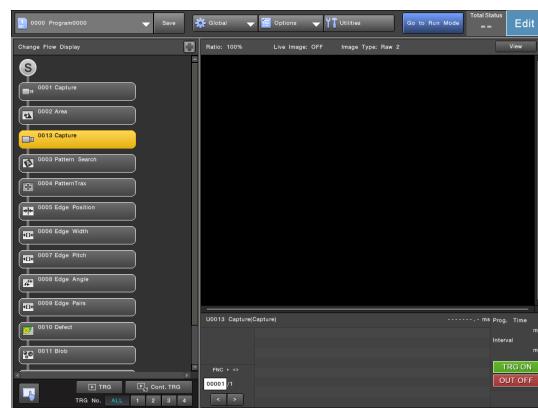
- 3 Select [Add].**

The position where a unit will be added is highlighted.



- 4 Select the type of unit to be added.**

The selected unit is added to the flowchart.



- 5 Configure the necessary settings for the unit.**

See the explanation of each unit for more details.



The added unit is automatically assigned with the smallest available unit ID.

2. Placing Units in a Flowchart

Handheld Controller Operation on the Flowchart Editor

- No. 7 button: Switches between the normal display and an enlarged display of the flowchart.
- No. 1 button or No. 7 button + up/down keys: Scrolls the flowchart by screen when the flowchart is in normal display. This is useful when editing a flowchart that contains many units.
- No. 1 or No. 7 button + No. 0 button (when a setting parameter is selected): Displays the [Reference Variable] screen.
- Hold down the No. 3 button (only when trigger inputs are enabled): Issues a continuous trigger to the system. The trigger input stops when the No. 3 button is pressed again.

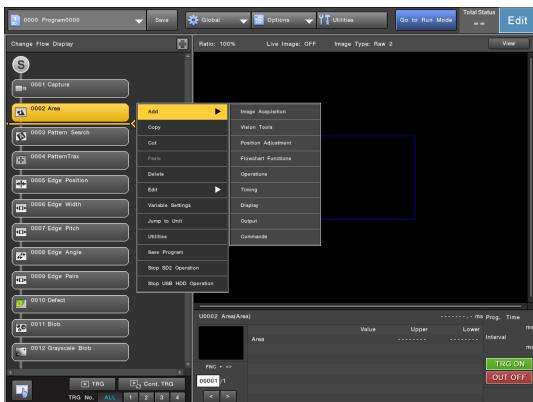
Function Menu Items Displayed During Flowchart Editing

The Function menu, which appears when the No. 1 (FUNCTION) button of the handheld controller is pressed during flowchart editing, displays different menu items in different situations.



- The selectable menu items may vary depending on the account settings.
- The user account cannot be switched during flowchart editing.

The flowchart edit menu is displayed while a unit is selected on the flowchart.



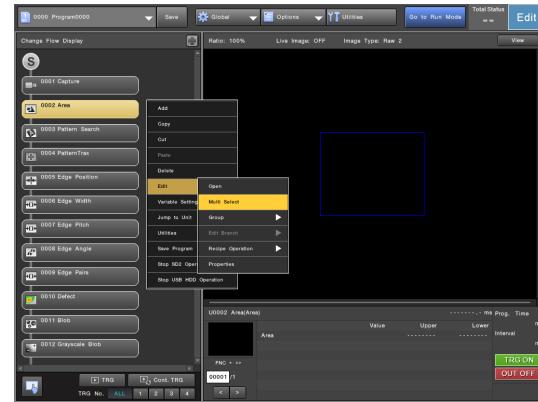
You can add units to the flowchart, copy units, etc.

Editing/Managing a Flowchart

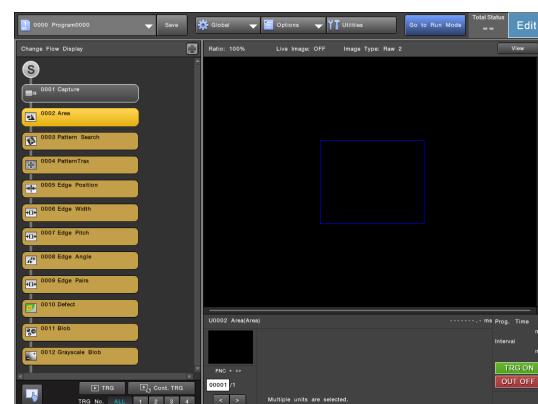
Selecting Two or More Units on a Flowchart Simultaneously

This function is useful when you want to copy/cut/delete two or more units in one operation.

- Select [Edit] - [Multi Select] in the flowchart edit menu (Page 2-10).**



- On the flowchart, select the first unit of the selection range.**
- On the flowchart, select the last unit of the selection range.**



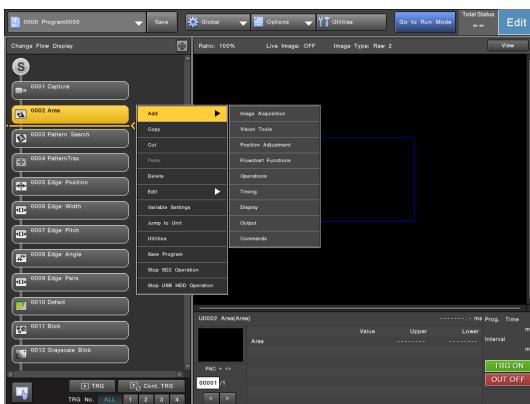
The units between the first and last unit selected in steps 2 and 3 respectively are selected.

Deleting a Unit from a Flowchart

! Point

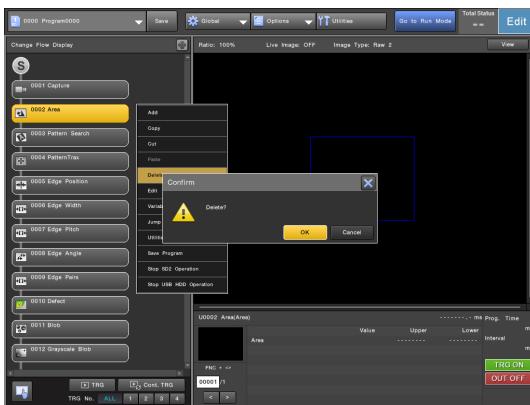
- When you select a group and delete it, all units in the group are deleted.
- When a locked group is included in the selection, the deletion is disabled.
- When a branch of a branch unit is deleted, all units of the deleted branch No. are deleted.
- The start unit and the end unit at the end of a flowchart cannot be deleted.
- When the Branch / Join units or Loop Function / Loop End units are selected, all units between the branch / join units or between the loop Function / loop end units respectively are selected. Take care to note that if you choose to delete the units in this state, all selected units will be deleted.

1 Place the cursor on the unit you wish to delete or select multiple units, and then display the flowchart edit menu (Page 2-10).



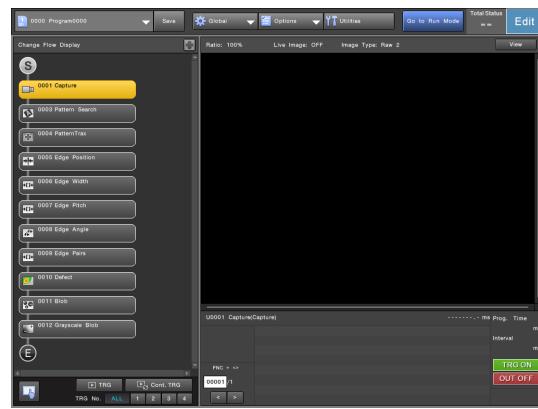
2 Select [Delete].

A confirmation screen will appear.



3 Select [OK].

The specified unit(s) are deleted from the flowchart.



! Point

Even when a unit(s) is deleted, the unit IDs assigned to the other units will not change.

Copying/Cutting a Unit

You can cut, copy and paste single / multiple units already set in a flowchart.

1 Place the cursor on the unit you want to copy or select multiple units, and then display the flowchart edit menu (Page 2-10).

2 Select [Copy].

To cut the unit, select [Cut].

The selected unit(s) are copied.

If [Cut] was selected, the unit is cut.

! Point

Copying/cutting is disabled when a locked group is included in the selection range.

Pasting a Cut/Copied Unit

1 Place the cursor on the unit directly below which you wish to paste, and then display the flowchart edit menu (Page 2-10).

2 Select [Paste].

The position where the unit(s) will be added is highlighted.

The cut / copied unit(s) are pasted into the flowchart.

! Point

It is also possible to paste a unit which was copied from a different program No. However, this may not be possible in some cases depending on the data size of the copied unit.

2. Placing Units in a Flowchart

Grouping Multiple Units

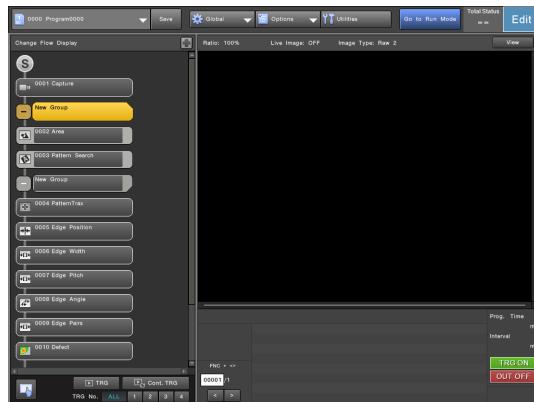
A series of related units in a flowchart can be shown as a group. Such grouped units can be collapsed in the view. Grouping logically related units allows for easy understanding of the overall structure of the flowchart.

Point

- The start unit, end unit at the bottom of a flowchart, and discrete units (units which are not directly connected with lines) cannot be grouped.
- Up to 128 groups can be created in a flowchart. When there are already 128 groups in a flowchart, no more grouping is possible.

- 1 Place the cursor on a unit you wish to include in a group or select multiple units, and then display the flowchart edit menu (Page 2-10).**
- 2 Select [Edit] - [Group] - [Group].**

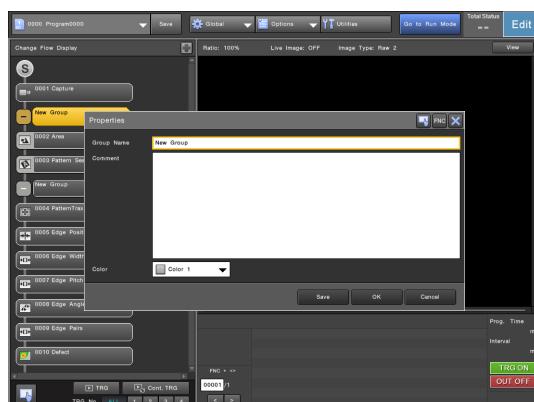
The unit(s) selected in step 1 are grouped as [New Group] and shown in the flowchart as a group icon.



Selecting next to the group icon collapses the units in the group, and selecting expands the units.

- 3 Select the created group.**

The [Properties] screen appears.



- 4 In the [Group Name] field, enter the name of the group.**

Comments (creation purpose, background) for reference purposes can be allocated to the group in the [Comment] field as necessary.

Reference

In the [Color] field, it is possible to select from 10 colors for displaying the group in the flowchart. This allows easy differentiation of the groups in the flowchart.

- 5 Select [OK].**

- 6 Add or move units into the group as necessary.**

To move other units into a group, cut the unit first and then paste it in the group. For more details, see "Copying/Cutting a Unit" (Page 2-11).

Reference

You can also group units which have already been grouped (nested grouping). However, nested grouping is only possible when one group completely contains the other group.

Resetting Groups

Point

When a group is locked (Page 4-24), the group cannot be ungrouped.

- 1 Place the cursor on the group you wish to ungroup, and then display the flowchart edit menu (Page 2-10).**
- 2 Select [Edit] - [Group] - [Ungroup].**
- 3 Select [OK].**

The grouping is removed.

Editing (Adding/Deleting) Branches

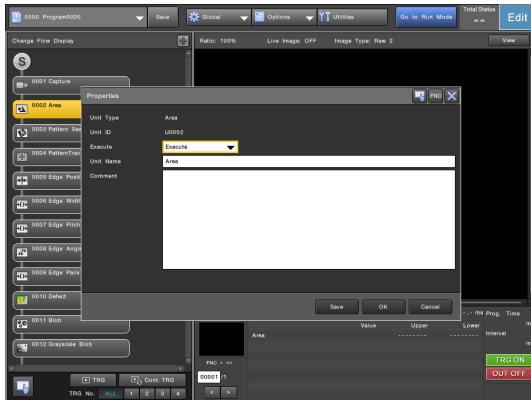
Branches which have been set in the flow chart can also be edited. For more details, see "Adding additional branches" (Page 2-312) and "Removing part of a branch" (Page 2-312) of the Branch/Join units.

Viewing/Editing Information of a Unit in a Flowchart

You can view or edit the setting content of a specific unit or grouped units.

- 1 Place the cursor on the unit you wish to view information for, and then display the flowchart edit menu (Page 2-10).**
- 2 Select [Edit] - [Properties].**

The [Properties] screen appears.



- 3 Change the settings as required.**

Unit Type

The type of the selected unit is displayed.

Unit ID

The ID of the selected unit is displayed.

Execute

Select whether to execute the selected unit or not.

- **Execute** (default): Process the unit.
- **Never Execute**: Does not execute the measurement.

Unit Name

The name of the selected unit is displayed.

Any name (up to 50 characters, 100 single-byte characters) can be entered for easy, intuitive referencing.

Comment

Any associated comments for the selected unit are displayed. Up to 256 characters (512 single-byte characters) can be entered freely. It is useful to enter information that you want to see later, such as circumstances or remarks concerning the measurement unit settings.

Color (Branch, Loop and Group Units Only)

Select the color to use for displaying the unit/group in the flowchart from the 10 available colors.

- 4 Select [OK].**



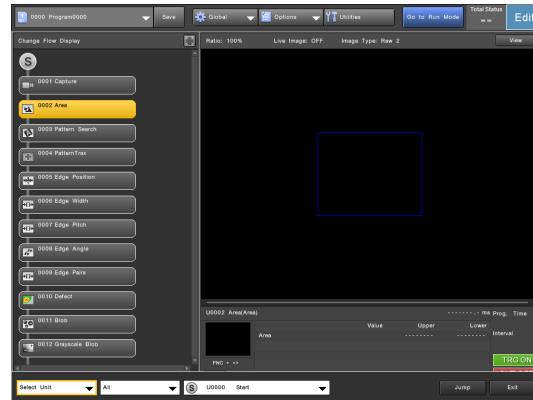
Point You cannot display the properties screen for two or more units simultaneously.

Finding and Displaying Units Based on Their ID (Jump)

To find and go directly to a unit you want to edit, you can specify its ID or name to jump directly to it.

- 1 Display the flowchart edit menu (Page 2-10).**
- 2 Select [Jump to Unit].**

Fields that specify the unit to jump to are displayed at the bottom of the screen.



- 3 Select the unit you want to jump to.**

First, select the method for finding a unit and then select the unit to jump to.

- **Unit ID**: Specify the ID of the unit to jump to.
- **Select Group**: Specify the name of the group to jump to.
- **Select Unit**: Select the unit to jump to from a list.

- 4 Select [Jump].**

The flowchart scrolls to the position of the specified unit and the unit is highlighted.

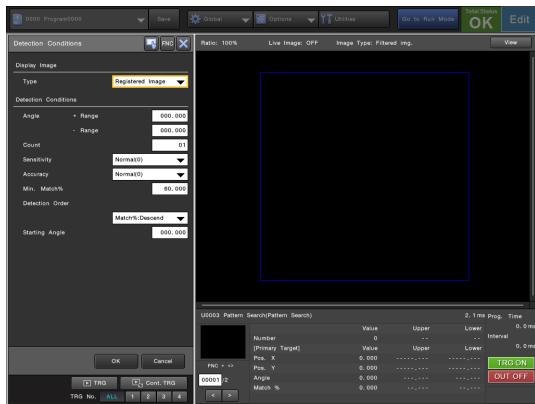


Point If the specified unit is in a collapsed group, between branch /join units, or in a loop, the view is automatically expanded to show that unit. If the specified unit is in a locked group, the group is not expanded.

3. Changing the Settings of a Unit (Edit Unit Menu)

What is the Edit Unit menu?

A dedicated built-in menu for each unit used for changing the setting parameters of units that have been added to the flowchart on the controller. In this menu, you can edit various settings of a unit, such as changing the setting value or assigning a variable to the setting value (Page 4-9).



Point

- As the controller allows for the restriction of operations and functions available via the menus, some or all of the functions described here may not be available or their operation and behavior may differ from these descriptions.
- Depending on the program, this Edit Unit menu can be launched from [Edit Unit] in the function menu, or from the retesting results Statistics menu. The following sections describe the overview and operational procedures of the Edit Unit menu.

Notes on Editing a Unit

Behavior when [Cancel] is Selected in the Menu

- When [Cancel] is selected after a setting is changed in the sub menu, the value returns to the previous value shown immediately after when the sub menu is opened (When the variable reference is canceled, the reference will return to its previous state).
- When [Cancel] is selected in the top menu, all settings changed in the sub menu return to the previous values immediately after the top menu opens.
- When program data is changed in the Edit Unit menu on the controller, the archived result data recorded before the change may not conform to the changed inspection result, preventing proper replay of the archived result.

Point

The [Image Area], [Camera Selection], [Processing], and [Trigger Parameters] settings of a capture unit, and the [Target] setting of a position adjustment unit, do not return to their original settings even after [Cancel] is selected.

Changing Settings Based on Variable References

- A setting value with a variable reference is shown with a light blue or gray background. Since the setting value with a gray background references a system variable, setting data, or the result data of a unit, that value cannot be changed.
- The setting value shown in red letters has a link error due to the absence of the referenced variable or for another reason. Consequently, that value cannot be changed.
- A setting value with variable reference will lose its reference if the setting value is cleared or if a setting change causes a reference to be cleared.
- If the [Change Variable Settings] option is disabled in the user account settings, only a direct value input will be allowed for setting values with variable reference. Clearing of values (initializing), a setting change involving clearing of values, and setting of new variable references are not allowed.

Difference Between Sub Menus of the Edit Unit Menu and Other Built-in Menus

Although the following menus have basically the same functionality, take care to note that some operations and behaviors are different.

- The inspection region menu (Page 2-473) and the [Inspection Region] (sub menu) of the Edit Unit menu
- Image registration menu (Page 2-468) and the [Register Image] (sub menu) of the Edit Unit menu.
- Color extraction menu (Page 2-483) and the [Color] (sub menu) of the Edit Unit menu.
- Library Setting menu (Page 2-270) and the [Library] (sub menu, OCR, OCR2 only) of the Edit Unit menu.

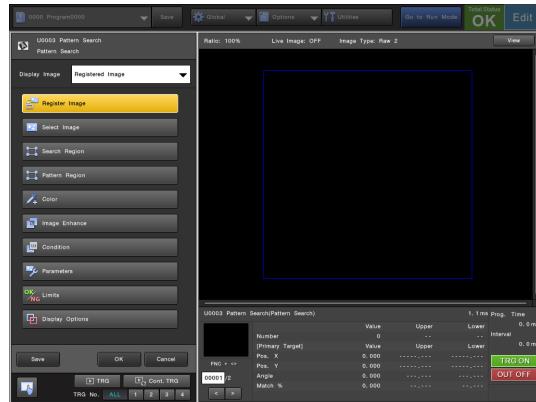
How to Differentiate Sub Menus from the Other Built-in Menus

In the case of the sub menu, the unit ID is displayed in the unit information display at the lower part of the screen.

Configuring the Unit Settings

1 Select a unit whose setting you want to change.

The top menu for the selected unit appears.



Reference

- A confirmation screen may appear depending on the type of selected unit. Be sure to read the message before selecting [OK].
- When there are many units in a flowchart, it is useful to use the jump function (Page 2-13) which allows easy selection of the unit to be edited.

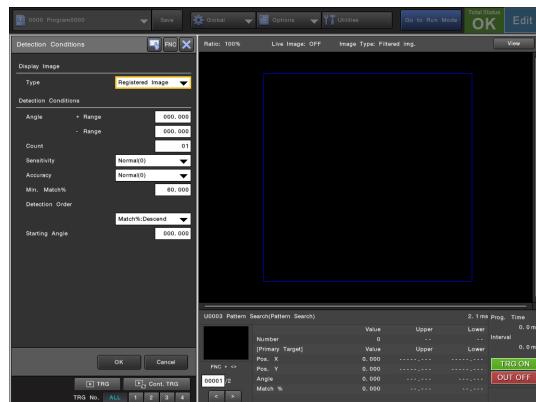
When Using the Mouse or Touch Panel

- When you click (tap) the icon part of a unit, the top menu for the selected unit will appear. If you are using a mouse, double-clicking other than on the icon part will also open the top menu for the selected unit.
- Clicking (tapping) other than on the icon part will display the edit icon ; and clicking (tapping) on the edit icon will display the flowchart edit menu. When you select [Edit] - [Open] in the flowchart edit menu, the top menu for the selected unit appears.

Point

The editing icon is grayed out if you do not have flowchart editing privileges.

2 Open the sub menu that contains the setting that you want to change and change the appropriate settings of the unit.



See the explanation of each unit for more details.

Reference

If a unit has parameters which support variable referencing, a variable can be assigned to control or change the parameters externally, or to tie multiple settings to one central point. For more details, see "Assigning variables to Parameters" (Page 4-9).

3. Changing the Settings of a Unit (Edit Unit Menu)

3 Select [OK].

4 Select [Save].

The changes to settings made so far are saved in the program file.

- Point** Any changes in the settings that were not saved prior to turning off the controller will be lost.

Key Operations on the Edit Unit Menu

On the Edit Unit menu, the following key combination operations are available with the handheld controller.

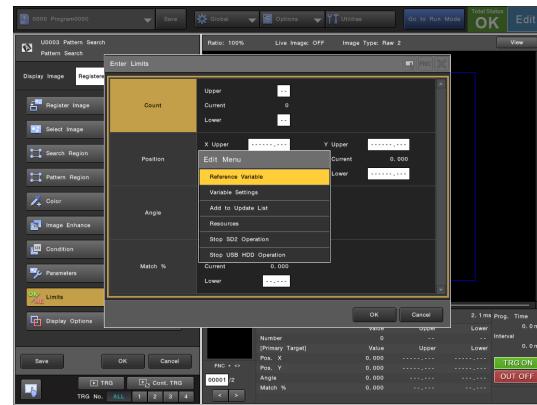
Menus	Combination keys	Operation
Top menu, [Limits] screen	Combination assigned with [Change screen] for [Handheld Controller Function] in the system settings of the XG-X VisionEditor (Default: No.4 + No.7 buttons)	Switch display image
Various screens (when a parameter that allows variable reference is selected)	No.1 button or No.7 button +No.0 button	Display the variable reference screen
[Image Enhance] screen	No. 1 or No. 7 button + Up/down key	Change the order of image enhancement filters
[Inspection Region] screen (when composition regions are set)	No. 1 or No. 7 button + Up/down key	Change the order of composite regions
[Inspection Region] screen (when a polygon is set)	No. 1 or No. 7 button + Up/down key	Change the order of the nodes of a polygon
Conversion screen (image operation unit)	No. 1 or No. 7 button + Up/down key	Change the order of conversions
Block setup screen (OCR unit, OCR2 unit)	No. 1 or No. 7 button + Up/down key	Change the order of block regions
Data output screen (data output unit)	No. 1 or No. 7 button + Up/down key	Change the order of output data No.
Setup Graphics Screen (On-Screen Graphics Unit)	No. 1 or No. 7 button + Up/down key	Change the drawing order of graphics settings
Branch screen (Branch unit)	No. 1 or No. 7 button + Up/down key	Change the branch No.
Multi Reference Table Settings screen (2D Code Reader Unit, 1D Code Reader Unit)	No. 1 button or No. 7 button + Up/down key	Change the order of reference patterns

Function Menu Items Displayed During Unit Editing

The Function menu, which appears when the No.1 (FUNCTION) button of the handheld controller is pressed during flowchart editing, displays different menu items in different situations.

- Point**
 - The selectable menu items may vary depending on the account settings.
 - The user account cannot be switched during flowchart editing.

The [Edit Menu] is displayed while the Edit Unit dialog (top menu, sub menu) is being displayed.



Variable settings and variable references for parameters can be edited.

- Reference Variable:** Setting values can be made to reference variables and unit result data.
- Variable Settings:** Edit and or create variables. Refer to "Changing the Variable Settings (Variable Settings)" (Page 4-4) for more details.
- Add to Update List:** If the parameter is referencing a variable, the variable reference destination is added to the Variable Update Settings (Page 5-31).
- Resources:** Allows the user to check the amount of memory currently being used.
- Stop SD2 Operation:** Stop SD card 2 operation so that the SD card can be removed.
- Stop USB HDD Operation:** Stop the USB HDD operation so that it can be removed.
- Linescan Calibration:** Displays the Graph Viewer utility (Page 8-184) (only while a capture unit is being edited).

- Point** For those parameters which cannot reference variables or result data, the [Reference Variable] is grayed out.

4.Saving the Settings (Save Program)

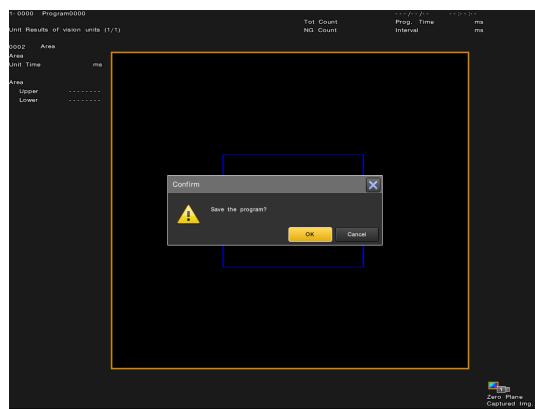
The present state is saved to the program file.



- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.

1 Select [Save Program] from the Function menu.

A confirmation screen will appear.



2 Select [OK].

The settings are saved to the current program file in SD Card 1 or SD Card 2.



- Items specified not to be saved are excluded from the saving operation.

As examples of items that can be made so they are not saved, there are the variables and the screen, such as a display pattern screen, display state changed in the current program setting.

Managing Programs

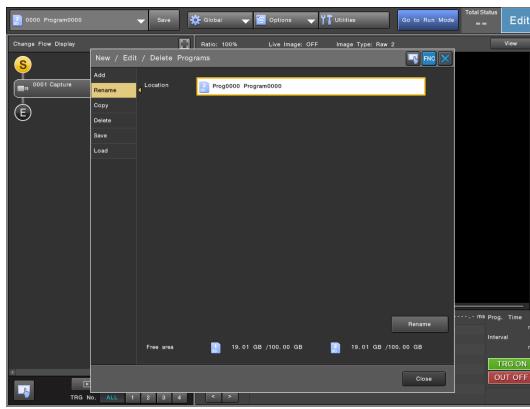
Renaming a Program

Programs can be renamed for easy identification.

- 1 Select [New/Edit/Del Programs] from the [Program No.] menu.

The [New/Edit/Delete Programs] screen appears.

- 2 Select [Rename].



- 3 Select the program to change its name and select [Rename].

The [Rename] screen appears.

- 4 Input a new name for the program and then select [OK].

Refer to "Entering Characters" (Page 1-12) for more details on inputting characters.

- 5 Select [Close].

The program name is changed.

Copying a Program

All the settings contained under one program can be copied across to another program.

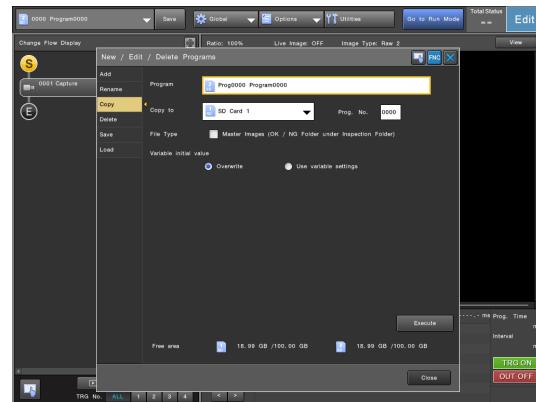


- When a program is copied, the previous settings in the destination program will be overwritten with the settings of the source program.
- When using a program stored in SD Card 2 as the source or destination for copying, make sure an SD card is in slot 2 beforehand.
- Copies cannot be made if the copy destination has insufficient space to store the program.

- 1 Select [New/Edit/Del Programs] from the [Program No.] menu.

The [New/Edit/Delete Programs] screen appears.

- 2 Select [Copy].



- 3 Select [Program] and choose the source program.

- 4 Select [Copy to] and choose the location and program No.

- 5 To include the master images, check the [Master Image (OK / NG Folder under Inspection Folder)] box.

6 Change the setting of [Variable initial value] from [Overwrite] (default) to [Use variable settings] as required.

- **Overwrite** (default): Overwrite the initial value of the variables with the values in the source program.
- **Use variable settings**: Do not overwrite the initial value of the variables that have [Keep initial value when loading program] selected. The variable settings are also copied across to the destination program.

 For more details on keeping initial values of the variables, refer to the XG-X VisionEditor Reference Manual

7 Select [Execute].

The settings are copied and [File(s) copied.] is displayed.

 If the selected program number already exists in the destination location, conformation is required to overwrite the program.

8 Select [Close].

To stop copying, select [Close] instead of [Execute] in Step 7.

Deleting a Program

Existing programs can be deleted.

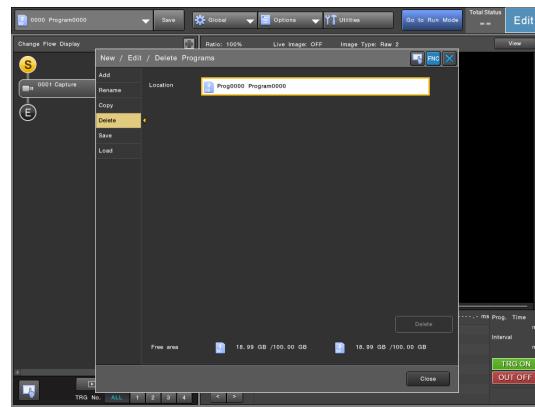


- If a program is deleted, all related settings (such as units, local variables etc.) are also deleted.
- A program that is currently selected cannot be deleted.

1 Select [New/Edit/Del Programs] from the [Program No.] menu.

The [New/Edit/Delete Programs] screen appears.

2 Select [Delete].



3 Select [Location], and then select a program to delete.

4 Select [Delete].

A confirmation screen will appear.

5 Select [OK].

The program selected in Step 3 is deleted.

6 Select [Close].

Saving/Loading Programs (Export/Import)

Saving Individual Program Settings

Choose what settings and image data for a specified program to be saved.

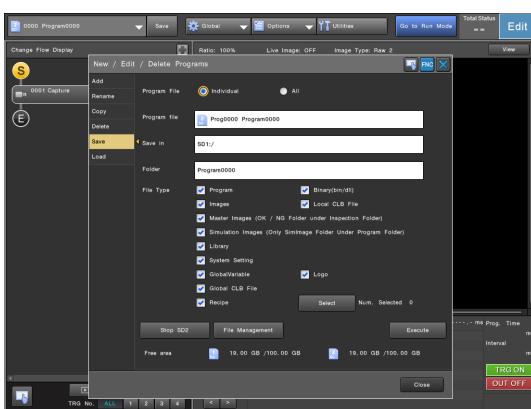
- Point** The following operations cannot be performed if an appropriate SD card is not inserted.

- 1 Select [New/Edit/Del Programs] from the [Program No.] menu.

The [New/Edit/Delete Programs] screen appears.

- 2 Select [Save].

- 3 Choose [Individual] for [Program File].



- 4 Select [Program file] and choose the program to save.

- 5 Under [File Type], check the files / settings to be saved.

For more details on the data contents, refer to "Types of Settings Files for the XG-X2000 Series" (Page 2-3).

- 6 Select [Save in] and specify where to save the data.

Specify a folder as necessary because the controller manages all program files by folder name.

- Point** Folders under "SD1:/xg/setting" and "SD2:/xg/setting" cannot be specified as the export destination.

- 7 Select [Folder] and specify the name of the folder to which the data will be saved.

- 8 Select [Execute].

The controller starts saving the selected program files / settings.

When the settings have been saved, a confirmation screen appears.

- 9 Select [Close].

Reference

The available free area on each SD card is displayed at the bottom of the [New/Edit/Delete Program] screen as "Free area/total area in SD Card 1" and "Free area/total area in SD Card 2".

Exporting All Setting Values

Choose what setting values, image data, and system settings data to be saved for all programs.

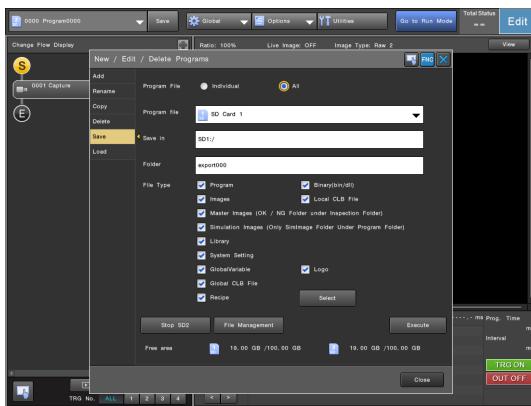
Point The following operations cannot be performed if an appropriate SD card is not inserted.

1 Select [New/Edit/Del Programs] from the [Program No.] menu.

The [New/Edit/Delete Programs] screen appears.

2 Select [Save].

3 Choose [All] for [Program File].



4 Select [Program file] and choose the location for all the programs.

- **SD Card 1:** Save all program settings stored on SD Card 1.
- **SD Card 2:** Save all program settings stored on SD Card 2.

5 Under [File Type], check the files / settings to be saved.

For more details on the data contents, refer to "Types of Settings Files for the XG-X2000 Series" (Page 2-3).

6 Select [Save in] and specify where to save the data.

Specify a folder as necessary because the controller manages all program files by folder name.

Point Folders under "SD1:/xg/setting" and "SD2:/xg/setting" cannot be specified as the export destination.

7 Select [Folder] and specify the name of the folder to which the data will be saved.

8 Select [Execute].

When the settings have been saved, a confirmation screen appears.

9 Select [Close].



The available free area on each SD card is displayed at the bottom of the [New/Edit/Delete Program] screen as "Free area/total area in SD Card 1" and "Free area/total area in SD Card 2".

Loading Individual Programs

Load the setting values and image data saved in a folder on an SD card into a program on the SD card.

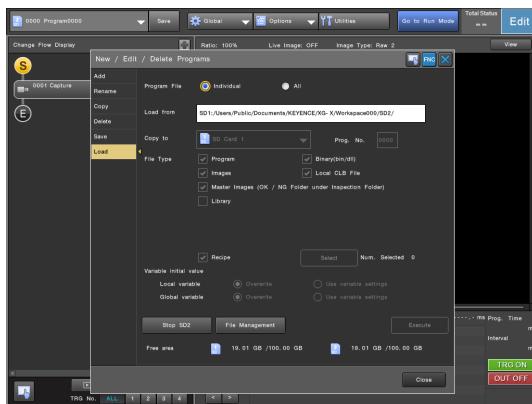
- Point** The following operations cannot be performed if an appropriate SD card is not inserted.

- Select [New/Edit/Del Programs] from the [Program No.] menu.

The [New/Edit/Delete Programs] screen appears.

- Select [Load].

- Choose [Individual] for [Program File].



- Select [Load from] and specify the location of the desired files.

Select the program to load after designating the folder specified during export as the import source.

- Point**
 - Folders under "SD1:/xg/setting" and "SD2:/xg/setting" cannot be specified as the import source.
 - The subsequent operations cannot be performed if the folder containing the setting values is not specified correctly.

Reference Importable folders containing the setting values are shown by the following icons: (when the folder is not selected) and (when the folder is selected).

- Under [File Type], check the setting values to be loaded.

For more details on the data contents, refer to "Types of Settings Files for the XG-X2000 Series" (Page 2-3).

- Select [Copy to] and choose where to load the data.

- SD Card 1:** Load the data to SD Card 1.
- SD Card 2:** Load the data to SD Card 2.

- Select [Prog. No.] and then choose the program number to load the data to.

- As necessary, select [Variable initial value] and then select the overwriting method for the variable initial value when the program is loaded (only when [Program No.] is checked in the [File Type] field).

If a variable with the same name exists in the local or global variables at the import destination and import source, you can select the overwriting method for the variable initial value at the import destination.

- Overwrite** (default): Overwrite the initial value of the variables with the values in the source program.
- Use variable settings:** Do not overwrite the initial value of the variables that have [Keep initial value when loading program] selected.

Reference For more details on initial values and settings of the variables, refer to the XG-X VisionEditor Reference Manual.

- Select [Execute].

The controller loads the selected files / settings. When loading operation is completed, a confirmation screen appears.

- Point** If [System Setting] is checked for [File Type], the system setting data are not applied until the controller is restarted. The controller can be restarted by selecting [Restart now] from the confirmation screen.

- Select [Close].

Reference The available free area on each SD card is displayed at the bottom of the [New/Edit/Delete Program] screen as "Free area/total area in SD Card 1" and "Free area/total area in SD Card 2".

Loading All Program and System Settings

Load program settings, image data, and system settings for all programs from an SD card.



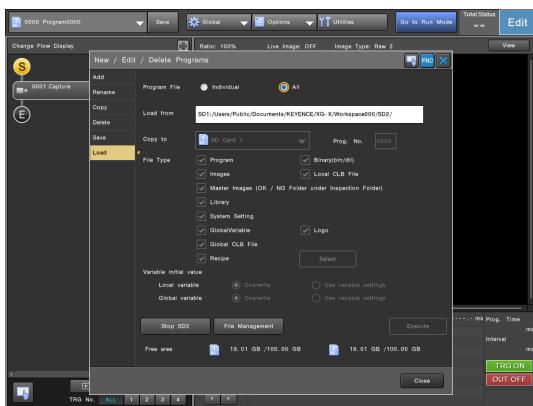
- The following operations cannot be performed if an appropriate SD card is not inserted.
- This operation overwrites all the existing program settings and system settings. Save the current program settings and system settings to an SD card or other media before performing this operation.

1 Select [New/Edit/Del Programs] from the [Program No.] menu.

The [New/Edit/Delete Programs] screen appears.

2 Select [Load].

3 Choose [All] for [Program File].



4 Select [Load from] and specify the location of the desired files.

Specify the folder specified during export as the import source, and then select the SD card to load all the settings from (SD Card 1 or SD Card 2).



- Folders under "SD1:/xg/setting" and "SD2:/xg/setting" "SD1:/xg/setting" and "SD2:/xg/setting" cannot be specified as the import source.
- The subsequent operations cannot be performed if the folder above the folder containing the setting values is not specified correctly.



Importable folders containing the setting values are shown by the following icons: (when the folder is not selected) and (when the folder is selected).

5 Under [File Type], check the setting values to be loaded.

For more details on the data contents, refer to "Types of Settings Files for the XG-X2000 Series" (Page 2-3).

6 Select [Copy to] and choose where to load the data.

- SD Card 1:** Load the data to SD Card 1.
- SD Card 2:** Load the data to SD Card 2.

7 As necessary, select [Variable initial value] and then select the overwriting method for the variable initial value when the program is loaded (only when [Program] or [GlobalVariable] is checked in the [FileType] field).

Choose how the copying and overwriting of global variables with same name in both the [Copy to] and [Load from] locations are handled.

- Overwrite** (default): Overwrite the initial value of the variables with the values in the source program.
- Use Variable Settings:** Do not overwrite the initial value of the variables that have [Keep initial value when loading program] selected.



For more details on initial values and settings of the variables, refer to the XG-X VisionEditor Reference Manual.

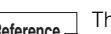
8 Select [Execute].

The controller loads the selected files / settings. When loading operation is completed, a confirmation screen appears.



If [System Settings] or [GlobalVariable] is checked for [File Type], the system setting data and global variable settings are not applied until the controller is restarted. The controller can be restarted by selecting [Restart now] from the confirmation screen.

9 Select [Close].



The available free area on each SD card is displayed at the bottom of the [New/Edit/Delete Program] screen as "Free area/total area in SD Card 1" and "Free area/total area in SD Card 2".

Image Acquisition

Measurement Condition Setting

► Image Acquisition

Vision Tools

Position Adjustment

Flowchart Functions

Operations

Timing

Display

Output

Commands

Common Setting Items

Capture

A capture unit is used for capturing images of the inspection/measurement target workpiece using a camera. When the CA-DC40E/DC50E/DC60E illumination expansion unit is connected, the settings (flashing/light intensity) can also be controlled without wiring to the controller.

- This section describes the settings to use an area camera. When using other cameras, refer to the descriptions below:
 - 3D Camera: Page 8-14
 - LJ-V Series Head: Page 8-22
 - Line Scan Camera: Page 8-175
- When using Capture Mode, refer to the descriptions below:
 - LumiTrax Mode (area camera only): Page 7-11
 - LumiTrax Specular Reflection Mode (area camera): Page 7-32
 - LumiTrax Specular Reflection Mode (line scan camera): Page 7-44
 - MultiSpectrum Mode (area camera only): Page 7-62
 - Standard Lighting Mode Using MultiSpectrum Light: Page 7-86

Image Capture Setup

In the capture unit, an image is captured by using the camera, maximum of 4, connected to the controller. The image data is sent from the camera to the controller and stored in the specified image variable.

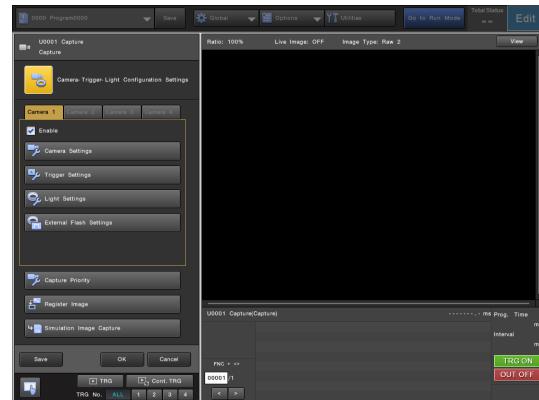
- Point**
- If the cameras used in a capture unit are different from the cameras actually connected to the controller, a camera setting error will occur. No image capturing and subsequent image processing units will be processed. In such cases, set the camera model correctly or turn off the controller and connect the correct camera.
 - The model and other information for the camera set in a capture unit can be viewed in the [Camera Selection] screen (Page 4-11).
 - When using a Capture Mode, such as LumiTrax Mode, LumiTrax Specular Reflection Mode, and MultiSpectrum Mode, on CA-HX*C/HX*M cameras, refer to "Capture Mode" (Page 7-1).

Top Menu Structure

The capture unit menu has the following options. Change the settings as required.



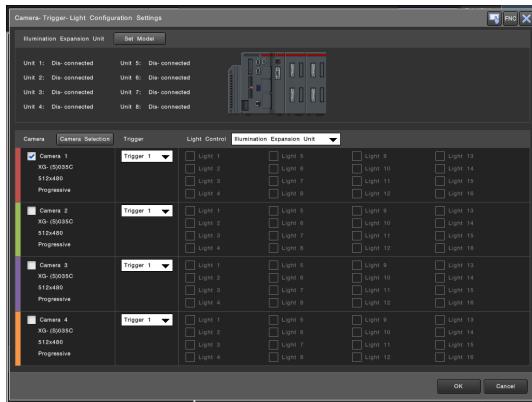
The details displayed on the screen differ depending on the selected camera and light settings.



Camera-Trigger-Light Configuration Settings (Page 2-26)	The connected cameras and illumination expansion units, trigger input for each camera, and illumination control targets can be configured together.
Camera Settings (Page 2-27)	You can specify the conditions for image capture.
Trigger Settings (Page 2-30)	Specify the settings for triggering the controller to take an image.
Light Settings (Page 2-32)	When an illumination expansion unit CA-DC40E/DC50E/DC60E (sold separately) is connected to the controller, the settings related to the light brightness and illumination are configured per light.
External Flash Settings (Page 2-33)	Set the illumination timing for controlling external light equipment using the external FLASH terminal.
Capture Priority (Page 2-34)	This option controls the conditions of the trigger input status for capture unit completion (transition to the next unit) with priority.
Register Image (Page 2-34)	Registers an image to be used as a reference for measurement and setting.
Simulation Image Capture (Page 2-35)	Save the captured image to the SD card. The saved images can be referenced as simulation images in XG-X VisionEditor.

Camera-Trigger-Light Configuration Settings

The connected cameras and illumination expansion units, trigger input for each camera, and illumination control targets can be configured together.



Illumination Expansion Unit

Displays the information of the illumination expansion unit connected to the controller. Select [Set Model] to specify the model of the connected illumination expansion unit for each light unit No.

Camera

Check the camera No. box of the camera to be used. Select [Camera Selection] to specify the model of the connected camera for each camera No. For more details, see "Specifying the Model of the Connected Camera (Camera Selection)" (Page 4-11).

Trigger

Select the trigger to be assigned to each camera.

Light Control

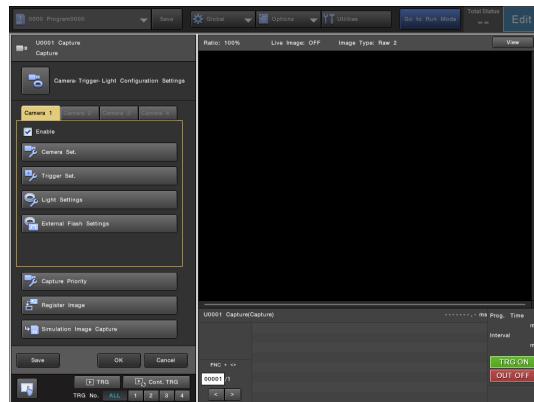
Specify the control method for the light assigned to each camera.

- Illumination Expansion Unit:** Check the light number of the illumination expansion unit to which you wish to assign an illumination control.
- External Flash:** Check the FLASH terminal to assign an illumination control to.

Point The illumination expansion unit and external FLASH terminal can be selected simultaneously.

Camera 1 to Camera 4

Select the tab of the camera for setting the capture options for.

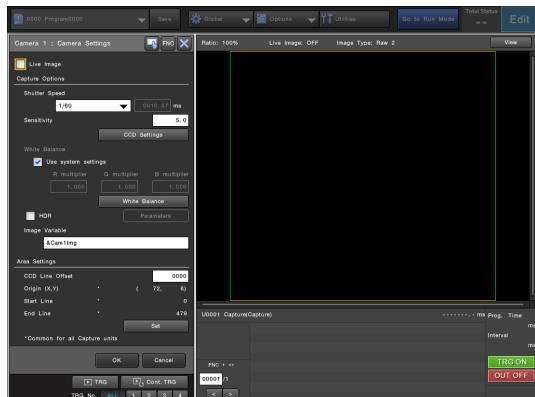


Enable

Check the box to enable the current setting target camera. Remove the check mark if a camera is connected to the controller but is not used.

Camera Settings

You can specify the conditions for image capture.



The image quality can also be adjusted by camera sensitivity adjustment and gain correction of the captured image. This functionality is useful when needing to optimize an images, brightness and adjust for black / white saturation.

Point If you change the capture options after the color extraction settings have been set, the color extraction result for the captured image may be different. Make sure to readjust the color extraction settings if the capture options are changed.

Reference The gain adjustment can not only be set for each camera but also be set for each measurement unit as [Contrast Conversion] filter (Page 2-492).

Live Image

Check this box to display the latest images through a continuous feed.

- Point**
- [Live Image] is only available in Setup Mode.
 - If the capture on trigger input is disabled in the trigger settings (Page 2-30), this check box is always unchecked and the setting cannot be changed.
 - When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
 - In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
 - Live Image is not available in the case of LumiTrax Mode (Page 7-8), LumiTrax Specular Reflection Mode (Page 7-29), MultiSpectrum Mode (Page 7-59), or when HDR capture (Page 2-29) is enabled.

Capture Options

Shutter Speed

Select or enter the shutter speed for the camera specified with the camera tab. Select the shutter speed according to the target movement speed and lighting conditions. When setting the shutter speed to match a fast line, prepare a light where the required lighting can be secured for producing the desired images.



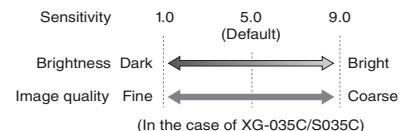
When using a high shutter speed and a high intensity light enters the camera, a smear effect (vertical light streaks on the image) may occur on some camera models. If this affects measurement, adjust the aperture and the light.

Sensitivity

The sensitivity of the camera can be adjusted. Typically, to adjust the brightness of an image, the lens aperture, lighting and shutter speed are the ones adjusted accordingly. However, if none of these improve image brightness, such as in lines where the movement speed is fast, then change the camera sensitivity.



- If the camera sensitivity is increased, so will the overall brightness of the image. However, noise in the image will become more visible (and the image will appear coarser). When the camera sensitivity is decreased, the overall image darkens but the noise will be reduced (the image appears smoother).



- If using a high-speed camera (XG-H035C/H035M/H200C/H200M/H500C/H500M, CA-H2100C/H2100M) and the camera sensitivity is set higher than default, a vertical line may appear on the screen depending on the capture condition. This phenomenon is a feature of the controller and not an error. If this occurs, set the camera sensitivity lower and secure illuminance via an external auxiliary lighting etc.
- The range of sensitivity adjustment for each camera type is different.
 - XG-H035C/H035M/S200C/S200M: 1.0 to 7.0 (Default 3)
 - XG-H200C/H200M/H500C/H500M, CA-H2100C/H2100M: 1.0 to 7.0 (Default: 4)
 - CA-HX048C/HX048M: 1.0 to 7.0 (Default: 4)
 - CA-HX200C/HX200M/HX500C/HX500M: 1.0 to 7.0 (Default: 3)
 - Cameras other than the above: 1.0 to 9.0 (default: 5)

Capture

CCD Settings

To adjust the image display balance in the high and low tone regions (gain adjustment) for the displayed image of the selected camera, select [CCD Settings]. This option allows adjustment of the shift (offset) and span (range) for the CCD. For color cameras, these parameters can be set for RGB components individually.

Reference The gain adjustment can also be set for each measurement unit through the [Contrast Conversion] filter (Image Enhance) (The offset and span for RGB are adjusted together and cannot be adjusted individually). To adjust the gain for each vision unit, select the [Contrast Conversion] filter in [Image Enhance], and then select [Detail].

1 Select [CCD Settings].

The [(Camera No.): CCD Settings] screen appears.

2 When setting RGB individually, select [SEL], and then select the color (R, G, or B).

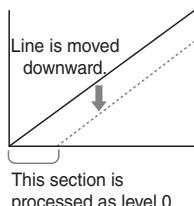
The graph on the screen will be displayed in the selected color.

Reference To return to being able to adjust all RGB elements at once again, select [ALL]. When the selection state is set to [ALL], any previous individual settings are set to the same as the setting values for the R component.

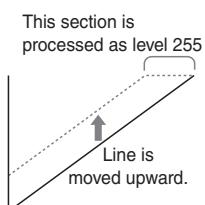
3 Select [Shift], and then specify the shift (offset) level for the entire digital signal.

The range of values that can be specified are -255 to +255 (default: 0).

- To darken the image:** Specify a negative value to move the entire line downward. The section below the minimum value on the Y-axis is processed as level 0 (black).



- To lighten the image:** Specify a positive value to move the entire line upward. The section above the maximum value on the Y-axis is processed as level 255 (white).

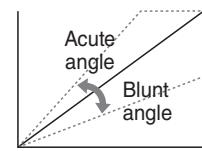


Reference According to one's purposes, shift can also be used to set all bright parts or dark parts above/below certain values to either 255 or 0.

4 Specify a value for [Span] to adjust how correction is to be applied to gradation changes.

The setting range is from 0.0 to 7.9 (default 1.0).

- To increase the contrast in images:** Use a high value so there is a greater rate of change.
- To decrease the contrast in images:** Use a low value so there is a lesser rate of change.



Point In the same way as [Shift] in Step 3, the range below the minimum value on the Y-axis is processed as 0 (black), and the range above the maximum value is processed as 255 (white).

5 To apply the settings, select [OK].

Reference If [Divide Graph] is checked, it is possible to set an individual contrast span for each of the 16 shades of the graph. Select a level of shading for which to set the span via [Division] and specify the span value.

White Balance

Adjustment of the white balance of the selected camera.

When a color camera is used, you can adjust the color balance to reproduce the white color of the captured image correctly by correlating the illumination of the environment to a reference.

- R Multiplier:** Specify the correction multiplier for the R component.
- G Multiplier:** Specify the correction multiplier for the G component.
- B Multiplier:** Specify the correction multiplier for the B component.

Point

- This setting cannot be changed when the [Use system settings] option is checked.
- The color extraction result and other measurement results may change due to changes in the white balance setting. Be sure to verify the operation after changing the white balance setting.

HDR (High Dynamic Range)

HDR capture allows an image with a broad dynamic range to be created by capturing multiple images at different exposures. Check this option when using HDR capture. The use of HDR capture can provide an image which is suitable for processing even when there is uneven glare, mixed bright and dark spots, or other issues with the inspection target. When [Parameters] is selected, the HDR settings screen appears, and the HDR capture settings can be changed.

- **Temporary normal capture:** HDR capture is temporarily disabled to display normal capture images.
- **Highlight levels:** Set the number of highlight levels to prevent bright saturation for an HDR image. A higher level increases the number of captures.
- **Lowlight levels:** Set the number of lowlight levels to prevent dark saturation for an HDR image. A higher level increases the number of captures.
- **No. Captures:** Select how to determine the number of captures (whether to prioritize quality or speed).
 - **Speed (Auto):** The number of captures is set to maximize speed.
 - **Quality (Auto):** The number of captures is set to maximize image quality.
- **Brightness:** Adjust the brightness within the range of 0 (dark) to 100 (bright) (default 50).
- **Contrast:** Adjust the contrast within the range of 0 (low) to 100 (high) (default 50).

Point

- As HDR performs multiple captures, it is not possible to capture images correctly if the target is moving.
- HDR cannot be used at the same time as the image capture buffer (Page 4-12), Calibration (Page 2-407), LumiTrax Mode (Page 7-8), LumiTrax Specular Reflection Mode (Page 7-29), MultiSpectrum Mode (Page 7-59).
- HDR cannot be enabled at the same time for multiple cameras.
- In HDR capture, images are captured multiple times at different shutter speeds. Since the shutter speed setting ranges of CA-HX200C/HX200M/HX500C/HX500M and CA-HX048M/HX048C are 0.010 to 100 ms and 0.022 to 1000 ms, respectively, the effect of HDR capture may be insufficient on these cameras if the shutter speed is set extremely short (or extremely long).

Image Variable

Specify an image variable which will contain the image captured with the camera selected.

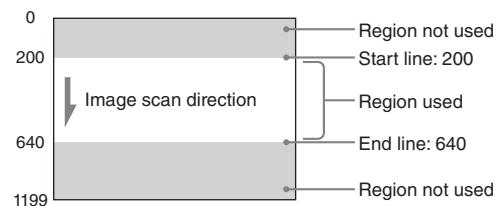
Point

- The variable to be specified needs to be added in advance.
The image variable can also be added/edited via the "Variable Settings".
- Changing the setting clears all image variables, archived data, and target classification results.

Area Settings

The current CCD imaging region for the camera is displayed.

Example: When the CCD imaging region is set to "Start Line: 200, End Line: 640" when an area camera is used



CCD Line Offset

Set the offset for the start line in the CCD imaging region settings. The range of values available are from 0 (default) to (Maximum capture lines of the camera used - Specified end line).

Point

- When the CCD line offset is set, the line positions following the offset are shown in blue next to the [Start Line] and [End Line].
- When the offset value is changed, the processing time for the capture unit that will recently be executed is extended due to the changes being applied.

Set

Set the CCD imaging region.

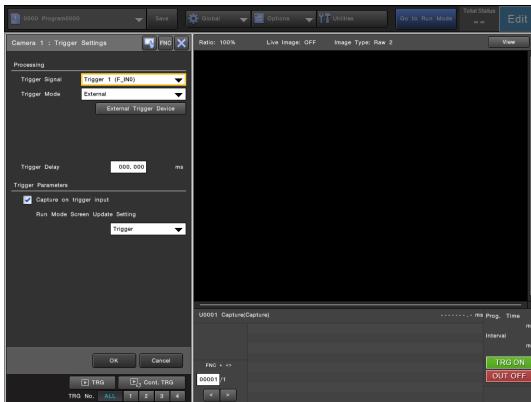
- **Origin X:** Specify the X coordinate of the origin (upper left) of the imaging region.
- **Origin Y:** Specify the Y coordinate of the origin (upper left) of the imaging region.
- **Start Line:** Specify the start line of the capture range.
- **End Line:** Specify the end line of the capture range.
- **Mirror/Rotate Image:** Select whether to perform mirror inversion or rotation of the capture image.
 - **OFF** (default): Does not mirror the image horizontally.
 - **Horizontal**: Captures the image horizontally inverted.
 - **Vertical**: Captures the image vertically inverted.
 - **180° Rotate**: Rotates the image by 180° during image capture.

Point

- While a CCD imaging region is being set, ordinary capture is performed even if HDR is enabled.
- Workpieces will not be processed if they do not lie between the start and end lines, even if they are in the process area.
- The area around the edge of the captured image may appear dark when a lens with a small maximum image size is used and the process area is at the edge part of the capture element.
- The CCD setting is common for all capture units.
- When setting the CCD imaging region, all image variables, archived data, and the output buffer are cleared.

Trigger Settings

Specify the settings for triggering the controller to take an image.



Processing

Trigger Signal

Select the trigger signal to be used. The assignment of trigger signals and terminals are specified on the [Terminal Block & Parallel Port] screen (Page 6-11) in the global settings.

Trigger Mode

Select the type of trigger to be used.

- External** (default): Capture images in response to trigger inputs from the handheld controller or trigger signals sent from an external device. The process is performed only once for each trigger input.
- Internal**: Capture images in response to internally generated periodic trigger signals by specifying the interval time or encoder pulse count.



If [Trigger Mode] is set to [Internal] and [Trigger Cycle] is set to [Time Delay], respectively, the trigger will constantly be generated while in Run mode (No triggers are generated in Setup mode). To temporarily stop the generation of internal trigger signals from an external device, use either of the following methods to prohibit trigger input. When internal trigger is disabled, the output of the result data up to that point continues.

- Terminal block input (EXT terminal)
- Communications command (TE,0 command).

For more details, see the XG-X2000 Series Communications Control Manual.

Trigger Cycle (Only when [Internal] is selected)

- Time Delay** (default): Select to specify the trigger cycle or line scan interval using the time.
- Specify Encoder**: Select to specify the trigger cycle or line scan interval using the encoder's pulse count.



[Specify Encoder] can only be selected when a camera input unit that accepts the encoder count as trigger signals has been specified.

Details (When [Specify Encoder] is set)

- Trigger Cycle**: Specify the encoder count for the trigger cycle (1 - 99999999 pulses).

Sampling Mode:

- **x1** (default): Pulse count increases by 1 on the rising edge of phase A of the encoder.
- **x2**: Pulse count increases by 1 on both the rising and falling edge of phase A of the encoder.
- **x4**: Pulse count increases by 1 on both the rising and falling edge of both phase A and B of the encoder.

Encoder Direction:

- **OFF** (default): The pulse count goes up for rotation in both the clockwise and counterclockwise directions.
- **CW**: The pulse count always goes up only for rotation in the clockwise direction.
- **CW and CCW**: The pulse count goes up for rotation in the clockwise direction. If there is a pulse count for the counter-clockwise direction, that amount goes down before counting again.

Reverse Detection:

- **OFF** (default): The pulse count goes up for rotation in the clockwise direction.
- **ON**: The pulse count goes up for rotation in the counter-clockwise direction.

Z-Phase Function:

- **None** (default): Encoder Z phase input is not used.
- **Trigger**: Encoder Z phase is used as trigger input.
- **Reset Pulse Count**: Encoder Z phase is used to reset the encoder pulse count.
- **Reset Pulse Count and Trigger**: Encoder Z phase is used to reset the encoder pulse count and as trigger input.

- Detect Timeout**: Specify the duration before a timeout error occurs when an encoder pulse stops (units: ms).

Check Encoder Connection (When [Specify Encoder] is set)

The [Check Encoder Connection] screen is displayed.

External Trigger Device (Only when [External] is selected)

To use an external trigger, select and check the type of trigger to be used for image capture.

- **Terminal Block:** Trigger input through the external terminal assigned with %Trg1 through to 4
- **Handheld Controller/Mouse:** Trigger input provided by the No. 3 (TRIGGER) button on the handheld controller or the TRG button on the screen
- **RS-232C:** Trigger input through the RS-232C commands
- **Ethernet(TCP/IP):** Trigger input through the Ethernet commands
- **PLC-Link:** Trigger input through the RS-232C or Ethernet PLC-Link commands
- **CC-Link:** Trigger input through the CC-Link bit devices or commands
- **EtherNet/IP:** Trigger input through the EtherNet/IP™ cyclic communication, message communication, or commands
- **PROFINET:** Trigger input through the PROFINET cyclic communication, message communication, or commands
- **EtherCAT:** Trigger input through the EtherCAT cyclic communication, mailbox communication, or commands
- **PC Program:** Trigger input through the ActiveX control method



External triggers using the handheld controller/mouse are always available in Setup mode.

Trigger Delay

To set a fixed time delay between the selected trigger input and capturing of an image, specify a trigger delay time (Trigger Delay).

- The trigger delay can be set in the range between 0 and 999.999 ms for each camera.
- When [Trigger Cycle] is set to [Specify Encoder], specify the encoder count (0 to 65535, default: 0).

Trigger Parameters

Capture on trigger input

Choose whether or not the capture unit will wait for a trigger signal to capture an image. When the check is removed, all cameras that are set will capture images according to the capture processing, regardless of their independent trigger signals.

This is the case when the image capture buffer (Page 4-12) is enabled and empty when the capture unit is processed. If there are any images in the buffer which satisfy the capture priority, the capture will be completed and the next unit will be executed regardless of this setting.

Run Mode Screen Update Setting

Select whether to update the camera images continuously in Run mode.

- **Trigger:** Update the image only when a trigger input is received.
- **Live image:** Always displays the latest image while waiting for a trigger signal.

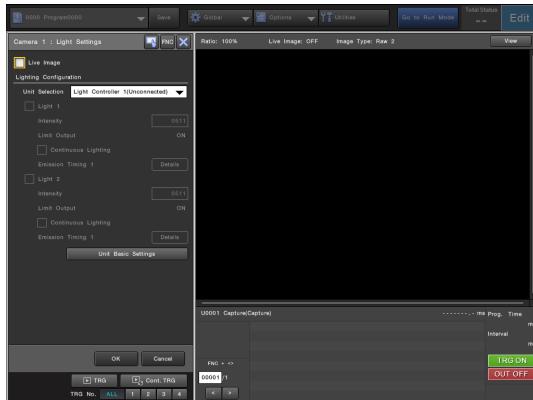


• [Live Image] is only applied in Run mode.

- If the capture on trigger input is disabled in the trigger settings (Page 2-30), this setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- Live Image is not available in the case of LumiTrax Mode (Page 7-8), LumiTrax Specular Reflection Mode (Page 7-29), MultiSpectrum Mode (Page 7-59), or when HDR capture (Page 2-29) is enabled.
- Even if [Live Image] is selected, a Live image will not be displayed if [Live Image Feed] (Page 4-43) is not enabled in the Image Display screen part settings of Screen Editor (Page 4-25).

Light Settings

When an illumination expansion unit CA-DC40E/DC50E/DC60E (sold separately) is connected to the controller, the settings related to the light brightness and illumination are configured per light.



Live Image

Check this box to display the latest images through a continuous feed.



- To change the light settings when using MultiSpectrum, refer to "Switching to MultiSpectrum Mode" (Page 7-60).
- [Live Image] is only applied in Setup Mode.
- If the capture on trigger input is disabled in the trigger settings (Page 2-30), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- Live Image is not available in the case of LumiTrax Mode (Page 7-8), LumiTrax Specular Reflection Mode (Page 7-29), MultiSpectrum Mode (Page 7-59), or when HDR capture (Page 2-29) is enabled.

Lighting Configuration

Unit Selection

Choose the illumination expansion unit (Light Controller) to which the light you wish to enable emission is connected to.



- When multiple illumination expansion units are connected, they will be numbered 1 through 8, with 1 being the unit closest to the controller.
- If the connected illumination expansion unit and the model specified in [Illumination Expansion Unit] under [Camera - Trigger - Light Configuration Settings] are different, the currently selected light controller will be displayed in red.

Light*

Check the box of the light number you wish to enable emission.



The emission timing cannot be changed when continuous lighting is enabled.

Intensity

The brightness of each light can be set in the range of 0 to 1023 (default 511). Use this in conjunction with the shutter speed setting to correctly illuminate images.



- The intensity can only be changed for lights that have been enabled in the [Light Configuration] screen (Page 6-9).
- The intensity of continuous lighting can be changed regardless of the camera selection. If a FLASH terminal output has been assigned to the light, the intensity can only be changed when the selected camera is the camera that is used with the FLASH terminal output.
- When the [Limit Output] is [ON], the upper limit is set to 511. (Even when 512 or a higher value is entered, the intensity remains at 511.)
- When the [Limit Output] is [OFF] and the intensity is set to 512 or higher, be careful not to damage the light through excessive heat generation.
- If two lights, including a CA-DRW20X, are connected to one light controller (CA-DC50E), the CA-DRW20X light intensity is limited to 320.
- If you are using CA-DRM10X or CA-DRM20X in MultiSpectrum Mode or Standard Lighting Mode, the light intensity when one light is connected to one light controller (CA-DC60E) is limited to 700 and 511 when two lights are connected. There are no limits on the light intensity of the CA-DRM5X itself, but the limits above apply.
- If the CA-DWX10X or CA-DZW30X/DZW50X is connected to CA-DC60E and you use LumiTrax Specular Reflection Mode or Standard Lighting Mode, the light intensity is limited to 700. However, with regard to the CA-DZW50X, if the ambient temperature exceeds 35 °C, the actual light intensity that can be used is up to 511 and the intensity is set to a value higher than that, a warning message may be displayed.

Limit Output

The status of the light output limit to prevent degradation of the LED light through overheating is displayed (default: ON). To disable the light output limit, change the setting in [Unit Basic Settings] or [Light Configuration] (Page 6-9) in the global settings.

Continuous Lighting

Check this box to keep the light illuminated regardless of the FLASH terminal output.

Emission Timing

The light emission timing controlled in linkage with the camera can be specified.

Select [Details] and select the illumination control timing from either emission timing 1 to 12 or external flash 1 to 4, and then specify the output on-delay and time. The light will illuminate in coordination with the assigned emission timing.

- Emission timing 1 to 12:** Allows you to set the emission timing of each light controller for each capture unit.
- External Flash 1 to 4:** Can be used in the same manner as the emission timing. However, the output on-delay and time settings are shared with the external flash terminals for controlling the external light.

Point

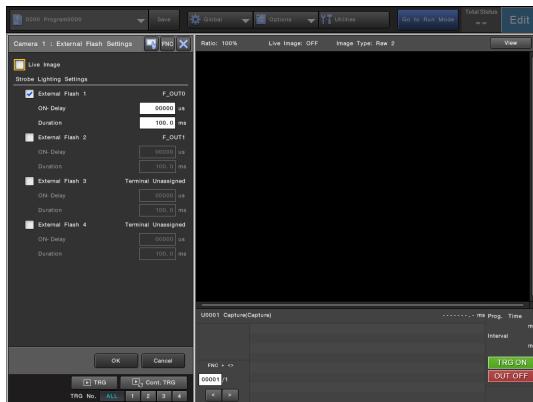
- The emission timing being used on the same camera and the same light controller is assigned preferentially (a free number is otherwise assigned).
- For CA-DC50E/DC60E, the output on-delay and time are fixed values and cannot be changed.

Unit Basic Settings

The basic common settings of the illumination expansion unit can be changed. The settings configured here are also reflected to [Lighting Configuration] in the global settings (Page 6-9).

External Flash Settings

Specify the conditions for when using flash for image capture.



When an illumination expansion unit CA-DC40E/DC50E/DC60E (sold separately) is connected, the contents specified via the FLASH signal are also reflected to the illumination expansion unit.

Live Image

Check this box to display the latest images through a continuous feed.

Point

- [Live Image] is only applied in Setup Mode.
- If the capture on trigger input is disabled in the trigger settings (Page 2-30), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- Live Image is not available in the case of LumiTrax Mode (Page 7-8), LumiTrax Specular Reflection Mode (Page 7-29), MultiSpectrum Mode (Page 7-59), or when HDR capture (Page 2-29) is enabled.

Strobe Lighting Settings

External FLASH*

Check the box to associate the camera with the FLASH* signal, and then specify the ON-delay and duration.

- ON-Delay:** Set the Flash* signal output start point in the range from -50000 to 50000 (μs) (If [Specify Encoder] is set for [Trigger Cycle], the range is -32767 to 32767 pulses.), with the image capture start time as 0 (default value: 0μs = Same time as image capture start). If a negative value is specified, output starts before the capture starts. If a positive value is specified, output starts after the capture starts.
- Duration:** Sets the Flash* signal output time in the range between 0.1 and 999.9 (ms).

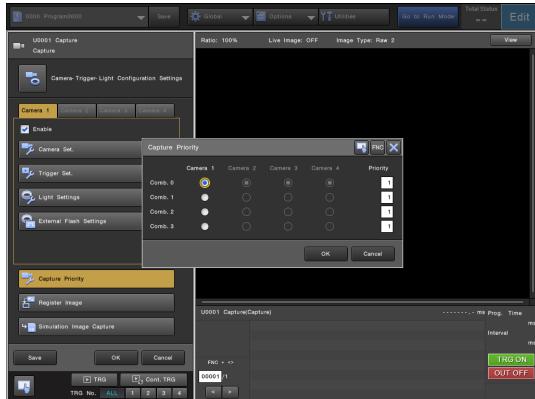
Point

Setting the [ON-Delay] to a negative value when using HDR capture increases the capture time.

Capture

Capture Priority

The [Capture Priority] screen will appear on which you can specify the trigger input conditions for capture unit completion (transition to the next unit) with priority. Normally, the capture unit is complete when the trigger inputs for all enabled cameras are received. It is possible to move to the next unit when the trigger input(s) of the specified camera(s) combination is received.



Comb. 0 to 3

Set up to 4 condition combinations to complete the capture unit. When all trigger inputs for the specified cameras are received, the process moves to the next unit.

Point

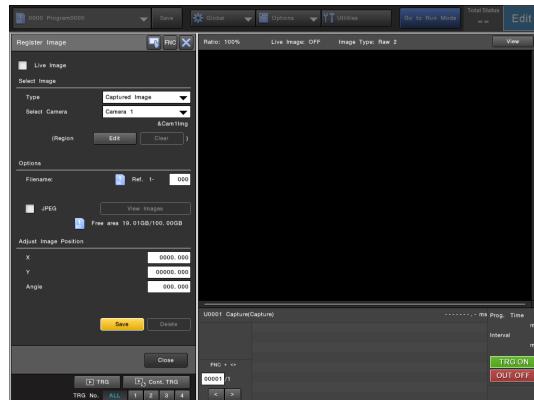
- Trigger input can only be specified for enabled cameras.
- The combination with which the unit was completed is stored as 0 to 3 in unit result data [Passing Status] (RSLT.STAT).

Priority

Specify the priority (from 1 to 4) for when more than one condition is met simultaneously. When the same priority is assigned, the condition met earliest is processed.

Register Image

Registers an image to be used as a reference for measurement and setting.



Live Image

Check this box to display live images through a continuous feed.

Point

- [Live Image] is only applied in Setup Mode.
- If the capture on trigger input is disabled in the trigger settings (Page 2-30), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- Live Image is not available in the case of LumiTrax Mode (Page 7-8), LumiTrax Specular Reflection Mode (Page 7-29), MultiSpectrum Mode (Page 7-59), or when HDR capture (Page 2-29) is enabled.

Select Image

Type

Select the image to be the registration source.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified in [Options].

Select Camera

Select the number of the camera used for registration. Choose from Camera1 to Camera4, and select only the camera number used for the capture unit being edited.

Region

To register only a part of an image, select [Edit] then specify the region to register. To cancel the selected region, select [Clear].

Options

Filename

Specify the registered image number used for image registration in the form "(Camera No.)-(Specified No.)".

Reference The name of the saved file is "ref (Camera No.)(Specified No.)" (for full screen image registration) or "ref (Camera No.)(Specified No.)_XXX_YYY" (for partial image registration).

JPEG

Check this box to save the image in JPEG format. When this box is not checked, the image will be saved in BMP format as either a 24-bit color bitmap image (color camera) or an 8-bit grayscale bitmap image (monochrome camera).

Point Using image compression may result in some image deterioration, thus measurement results from a compressed image may be different from those when an uncompressed image is used.

View Images

You can check a list of registered images.

Adjust Image Position

Adjust the position of the image being captured.

X

Adjust the movement in the X (horizontal) direction between -8191.000 and 8191.000 pixels.

Y

Adjust the movement in the Y (vertical) direction between -16383.000 and 16383.000 pixels.

Angle

Adjust the position angle (rotation) around the center of the image between -999.999° and 999.999°.

Point Position adjustment may cause missing peripheries (black regions) due to image movement or jagged edges (jaggies) due to rotation in the registered image.

Save

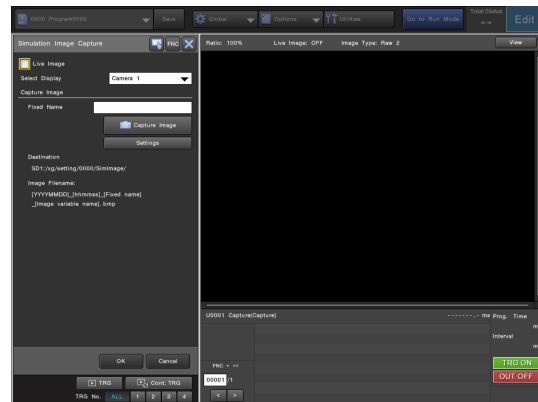
Save the displayed image as a registered image under the conditions specified in the [Register Image] screen.

Delete

When [Registered Image] is selected for [Type], you can delete the registered image specified in [Options].

Simulation Image Capture

The simulation image capture allows you to check of the actual images being captured by the camera based on the changed settings, or save the captured images to the SD card in the image format specified in the output settings. This is useful for quickly checking camera settings and saving images for simulation in XG-X VisionEditor.



Live Image

Check this box to display live images through a continuous feed.

Point

- [Live Image] is only applied in Setup Mode.
- If the capture on trigger input is disabled in the trigger settings (Page 2-30), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- Live Image is not available in the case of LumiTrax Mode (Page 7-8), LumiTrax Specular Reflection Mode (Page 7-29), MultiSpectrum Mode (Page 7-59), or when HDR capture (Page 2-29) is enabled.

Select Display

Switch from 4-screen display to 1-screen display of the desired camera.

- Camera 1:** Displays the image from Camera 1.
- Camera 2:** Displays the image from Camera 2.
- Camera 3:** Displays the image from Camera 3.
- Camera 4:** Displays the image from Camera 4.
- Camera 1 to 4:** Displays images from all the connected cameras.

Capture

Capture Image

Save the current camera image to the SD card in the save format specified in the output settings.

Fixed Name

Enter the fixed name if the file naming rule for the files saved here (includes a fixed name).

Capture Image

Save the image with the current settings.

Settings

The current save conditions can be checked in the list and changed as required.

 **Reference** This function saves images from all cameras, regardless of the selected preview.

Save

The present state is saved to the program file.

The settings for all units are saved to the currently used program setting file in SD Card 1 or SD Card 2.

Point

- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As examples of items that can be made so they are not saved, there are variables and the screen, such as display pattern screen display state changed in the current program setting.

Vision Tools

Measurement Condition Setting

Image Acquisition

► Vision Tools

Position Adjustment

Flowchart Functions

Operations

Timing

Display

Output

Commands

Common Setting Items

Vision Tools List

The following is a list of measurement units that can be used in the XG-X2000 Series. Various inspections can be performed by combining tools together.

Reference For more information on the Height Measurement unit, Profile Measurement unit, Continuous Profile Measurement unit, and 3D Geometry unit, refer to the 3D related functions and "Measurement Using 3D-compatible Cameras" (Page 8-2).

Vision Tool	Overview	Size		Position		Shape		Counting	Defect/Dirt	Intensity	Character processing	1D/2D code reading
		Pixel count	Gap measurement	Pitch	Coordinate data	Angle data	Characteristics					
Area (Page 2-40)	Counts number of pixels in an area.	O	-	-	-	-	-	-	-	-	-	-
Pattern Search (Page 2-44)	Detects a pattern.	-	-	-	O	O	-	O	O	-	-	-
ShapeTrax3 (Page 2-52)	Detects a pattern.	-	-	-	O	O	-	O	O	-	-	-
ShapeTrax2 (Page 2-66)	Detects a pattern.	-	-	-	O	O	-	O	O	-	-	-
PatternTrax (Page 2-78)	Detects a pattern.	-	-	-	O	O	-	O	O	-	-	-
Edge Position (Page 2-88)	Measures the position of an edge.	-	-	-	O	O	-	-	O	-	-	-
Edge Width (Page 2-97)	Measures the width of a gap.	-	O	-	O	O	-	-	O	-	-	-
Edge Pitch (Page 2-106)	Measures the maximum, minimum and average distance between pairs of edges.	-	-	O	O	O	-	-	O	-	-	-
Edge Angle (Page 2-114)	Measures the angle of an edge.	-	-	-	O	O	-	-	O	-	-	-
Edge Pairs (Page 2-121)	Measures the maximum, minimum and average distance between pairs of edges.	-	-	O	O	O	-	-	O	-	-	-
Defect (Page 2-130)	Detects defects based on change.	-	-	-	O	-	-	-	O	O	-	-
Blob (Page 2-143)	Measures features and characteristics of blobs (binarized image).	O	-	-	O	O	O	-	O	-	-	-
Grayscale Blob (Page 2-153)	Measures features and characteristics of blobs (grayscale image).	O	-	-	O	O	O	-	O	O	-	-
Profile Position (Page 2-166)	Scans the measurement region unidirectionally and measures the edge position.	-	-	-	O	-	-	-	O	-	-	-
Profile Width (Page 2-178)	Scans the measurement region unidirectionally and measures the edge width.	-	O	-	O	-	-	-	O	-	-	-
Profile Defect (Page 2-189)	Scans the measurement region unidirectionally and measures flaws based on an edge profile.	-	O	-	O	-	-	-	O	O	-	-
Multi-Profile Defect (Page 2-202)	Implements Profile Defect inspections on the contours of complex shapes, and measures burrs, chips, etc.	-	O	-	O	-	-	-	O	O	-	-
Intensity (Page 2-220)	Measures the maximum, minimum average and standard deviation of intensity in a region.	-	-	-	-	-	-	-	-	O	-	-
Color (Page 2-225)	Measures the maximum, minimum and average and standard deviation of color in a region.	-	-	-	-	-	-	-	-	O	-	-
Color Grouping (Page 2-230)	Measures the area and distribution of color of the image captured in MultiSpectrum mode.	O	-	-	-	-	-	-	-	O	-	-

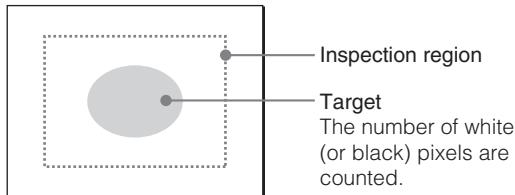
Vision Tool	Overview	Size		Position	Shape	Match %	Counting	Defect/Dirt	Intensity	Character processing	1D/2D code reading
		Pixel count	Gap measurement								
OCR2 (Page 2-235)	Reads and checks text information.	-	-	-	-	-	-	-	-	<input type="radio"/>	-
OCR (Page 2-255)	Reads and checks text information.	-	-	-	-	-	-	-	-	<input type="radio"/>	-
2D Code Reader (Page 2-274)	Reads and checks 2D codes.	-	-	-	-	-	-	-	-	<input type="radio"/>	<input type="radio"/>
1D Code Reader (Page 2-291)	Reads and checks 1D codes.	-	-	-	-	-	-	-	-	<input type="radio"/>	-

Area

Area Tool

Converts the captured image into binary data (black-and-white pixels) and measures (counts the number of pixels) of either the white or black area.

Measurement Overview



Main measurement results

The standard results and data returned by the area tool are as follows:

Area	Outputs the number of pixels. <small>[Tolerance inspection target]</small>
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

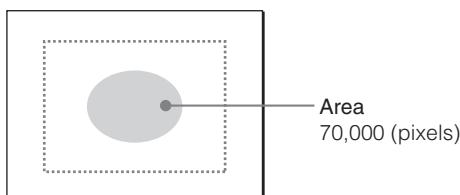
Reference

For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

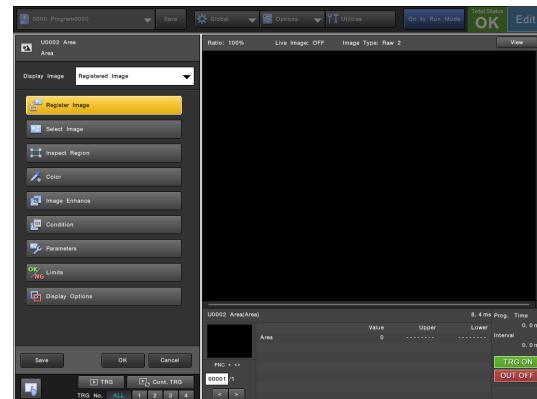
Example showing the results of an area inspection performed under the following conditions:

- Detect color: Black



Top Menu

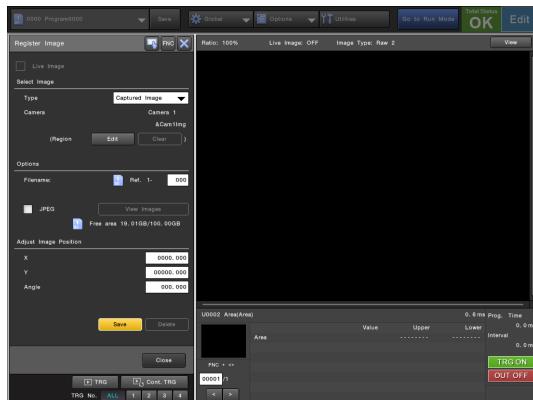
The top menu of the area tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-41)	Register an image to be used as a template for settings.
Select Image (Page 2-41)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-41)	Define the region to be used for unit processing.
Color (Page 2-41)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-41)	Specify the filter processing to apply to the image.
Condition (Page 2-42)	Specify the conditions to detect area during measurement.
Parameters (Page 2-42)	Specify other conditions for the Area tool as required.
Limits (Page 2-43)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-43)	Specify the display methods for things such as the inspection region and mask region.
Save (Page 2-43)	Save the current state to the program file.

Register Image

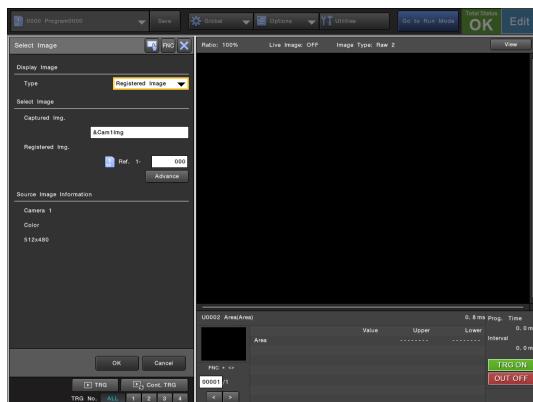
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

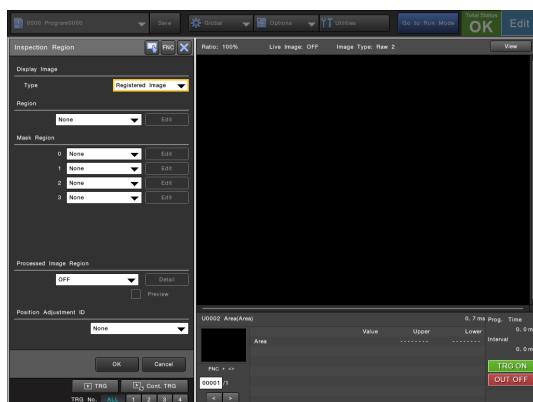
Specify the captured image and registered image to use for measurement.



For more details, see "Select Image" (Page 2-471).

Inspect Region

Define the region to be used for unit processing.



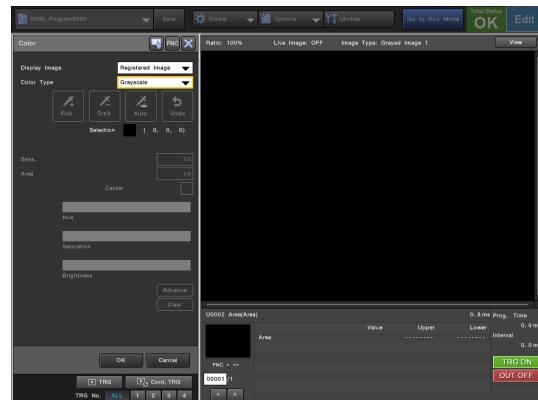
For more details, see "Region Settings" (Page 2-473).

Color

When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.



This setting is disabled when a monochrome image variable is used or when a resultant image variable ("Defining and editing image variables" (Page 4-8)) is referenced as the captured image.



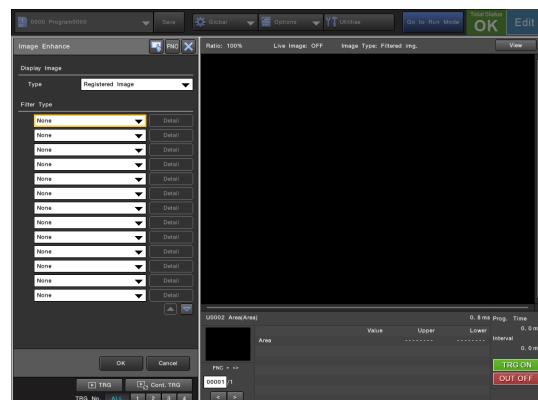
For more details, see "Color Extraction" (Page 2-483).

Image Enhance

Specify the filter processing to apply to the image.



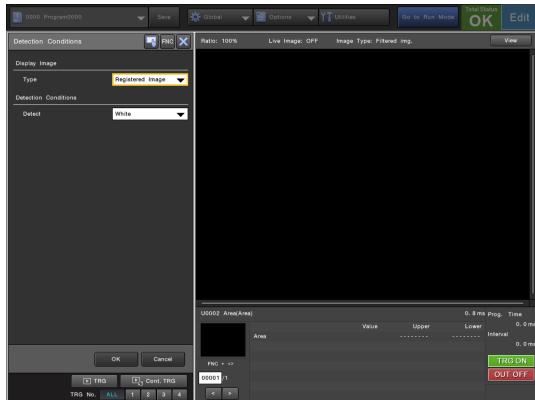
- For the area tool, [Binary] must be selected unless color to binary is used in the color extraction settings.
- If the binary filter is not selected or another filter is applied after the binary filter, the measurement result may not be correct.



For more details, see "Image Enhance" (Page 2-489).

Condition

Specify the conditions to detect area during measurement.



Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Detection Conditions

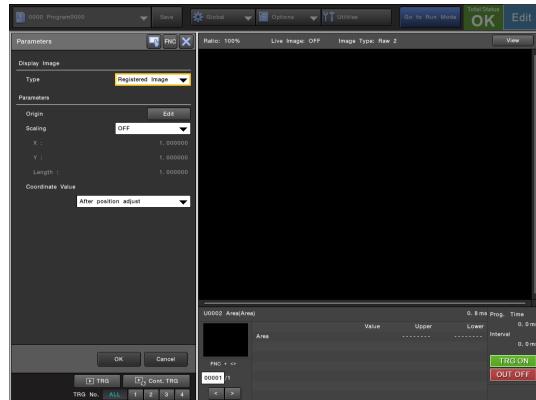
Detect

Specify the color of pixels (black/white) to be detected in the binary (monochrome) image.

- **White:** The number of white pixels are counted.
- **Black:** The number of black pixels are counted.

Parameters

Specify other conditions for the Area tool as required.



Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels. The result data and setting parameters used for display, judgment and calculations can be converted and scaled to real life values and dimensions by using the pre-set scaling factor option.

- **OFF:** Do not use scaling.
- **ON:** Use scaling.

• The scaling factor can be changed from the [Options] menu (Page 4-18).
• For a summary list of the result data for which scaling can be used, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate value

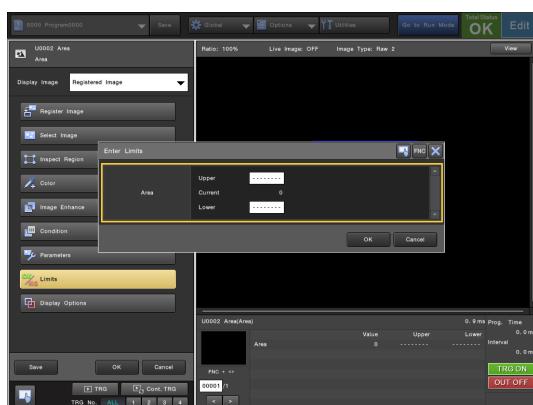
Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- **After position adjust:** The inspection uses the adjusted coordinate axes determined after position adjustment.
- **Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.

Reference

- [----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Area

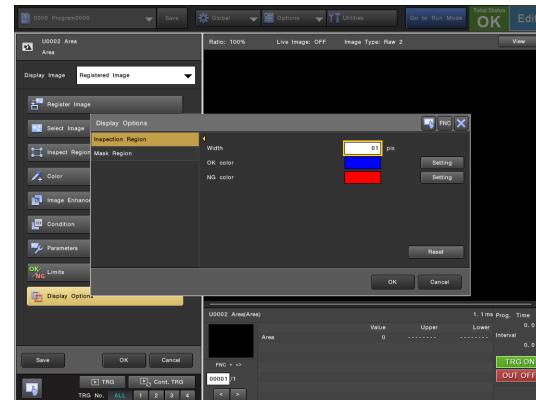
Specify the tolerance for the inspected area.

The unit of measurement is the [Number of Pixels] of the measured area (0 to 99999999).

Display Options

Specify the display methods for things such as the inspection region and mask region.

The display color of the units visual indicators can be changed based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select Color] - [None].



Inspection region

Specify the line width and display color of the inspection region.

Mask region

Specify the line width and display color of the mask region.

Reset

Returns the display options to their defaults.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

Point

- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

Pattern Search

Pattern Search Tool

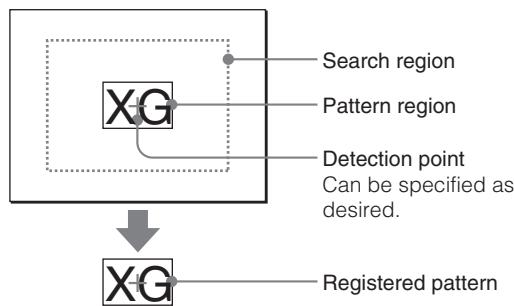
A particular shape or pattern from a registered image can be stored and compared to the current image. From this comparison, the position, angle, and correlation value can be calculated and output.



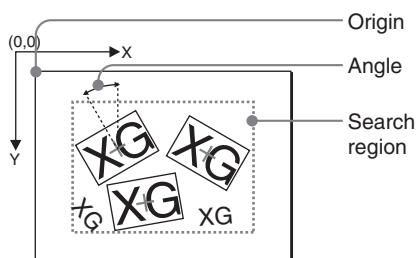
The size of the pattern region may be limited by the remaining processing and image memory. The program memory is shared by all units in one program. Consequently, when processing multiple units which use the target memory, you need to limit the total memory usage to less than that of the target memory. In the Pattern Search, the pattern region consumes the majority of program memory. Once [Processing capacity] (displayed during region setting) has reached 100%, no more pattern regions can be set.

Measurement Overview

When a pattern is registered



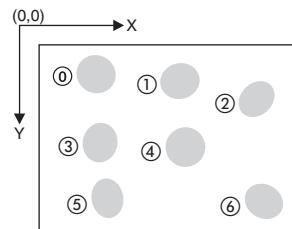
When the system is in operation



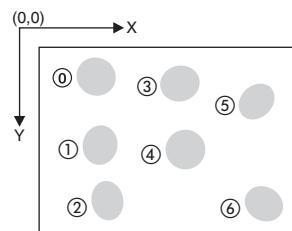
Ordering detected patterns with pattern numbers

There are 10 ways the patterns can be ordered.

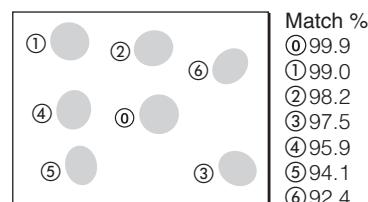
- Y>X: Ascend (ordered in rows)



- X>Y: Ascend (ordered in columns)



- X: Ascend
- X: Descend
- Y: Ascend
- Y: Descend
- Match%: Ascend
- Match%: Descend



- Clockwise
- Counter Clockwise

To select a different order, see "Detection Order" (Page 2-48).

Main measurement results

The standard results and data returned by the Pattern Search tool are as follows:

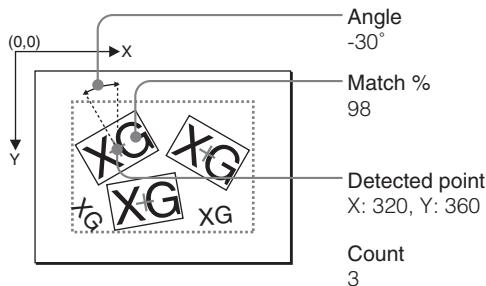
Count	Outputs the number of detected patterns. Tolerance inspection target
Detected point (X, Y) []	Outputs the coordinates of all detected patterns in pixels. Tolerance inspection target Label specification target
Detected angle []	Outputs the difference in angles between the registered pattern and each detected pattern. The angle difference in a clockwise direction is calculated with a positive (+) sign. The angle difference in a counter-clockwise direction is calculated with a negative (-) sign. Tolerance inspection target Label specification target
Correlation Value % []	Outputs the similarity level between the pattern detected within the search region and the registered pattern using a numerical value in the range of 0 to 99.999. Tolerance inspection target Label specification target
Unit judgment value	When the measurement result is outside the specified tolerance range (between the upper and lower limits), it is judged as [NG]. When the result is within the tolerance range, it is judged as [OK].

Reference For the lists of available measurement output values and setting parameters, see "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

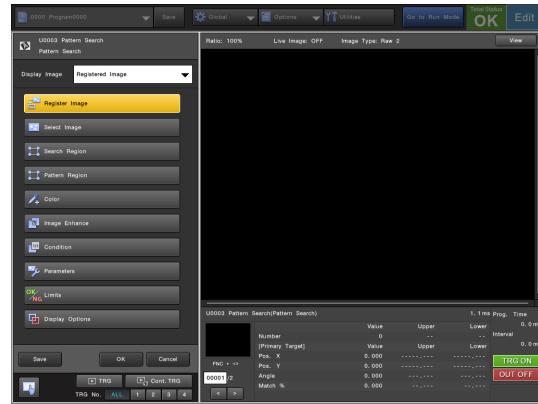
Example showing the results of a measurement performed under the following conditions:

- Detection Order: X>Y: Ascend
- Primary Target: 0



Top Menu

The top menu of the Pattern Search tool consists of the following options. Configure settings under each option as required for the inspection.

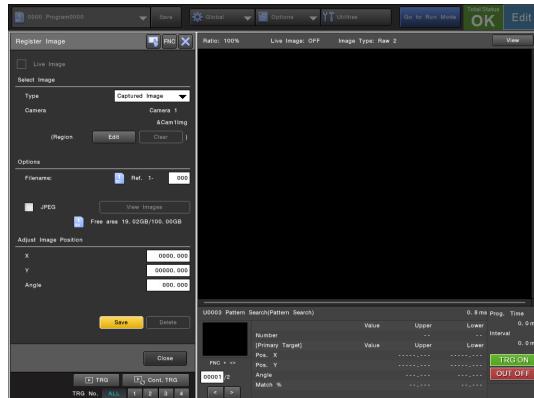


Register Image (Page 2-46)	Register an image to be used as a template for settings.
Select Image (Page 2-46)	Specify the captured image and registered image to use for measurement.
Search Region (Page 2-46)	Outline the region on the captured image to be used for searching.
Pattern Region (Page 2-46)	Outline the region on the captured image to record the pattern.
Color (Page 2-47)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-47)	Specify the filter processing to apply to the image.
Condition (Page 2-47)	Specify the conditions to detect patterns during measurement.
Parameters (Page 2-49)	Specify other conditions for the Pattern Search tool as required.
Limits (Page 2-50)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-51)	Specify the display methods for things such as the search and mask regions.
Save (Page 2-51)	Save the current state to the program file.

Pattern Search

Register Image

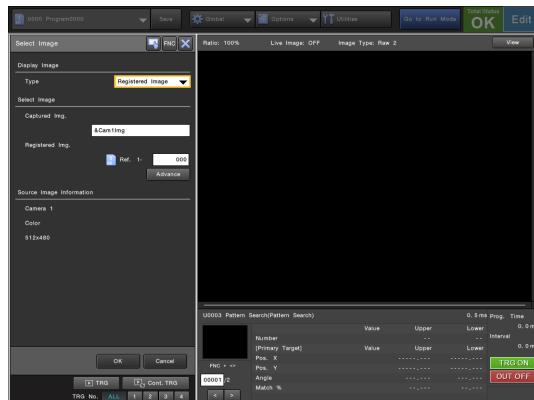
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

Specify the captured image and registered image to use for measurement.

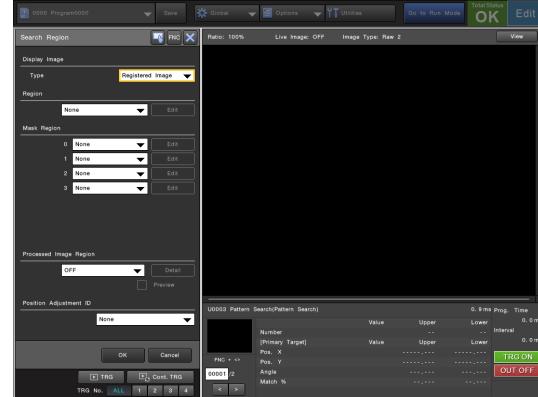


For more details, see "Select Image" (Page 2-471).

Search Region

Sets a detection range (search region) in the image to search for the model registered in the pattern region (Page 2-46).

Reference The smaller the search region, the shorter the processing time.



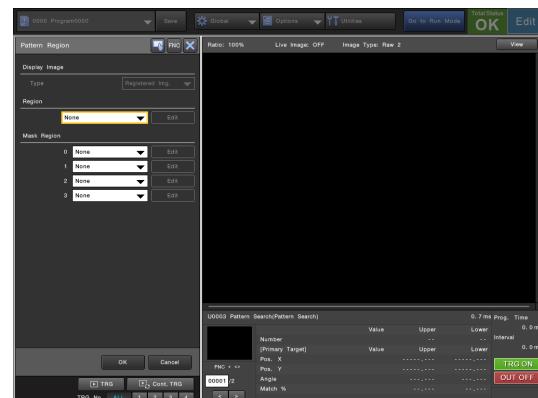
For more details, see "Region Settings" (Page 2-473).

Pattern Region

Register the image of the model that you want to detect as a [Pattern Region].

Reference If the pattern region has a complicated shape, you can set a mask region later to hide the unwanted parts.

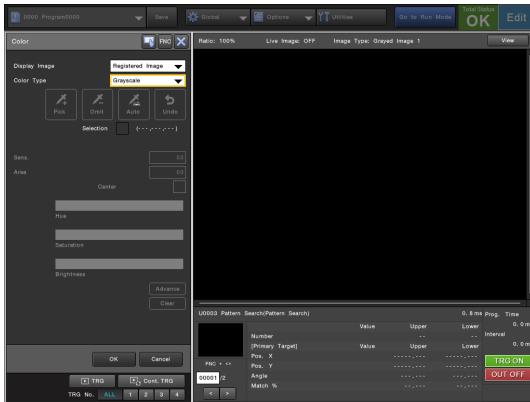
Point If the width or height of the region size is 2,432 pixels or 2,050 pixels or more respectively, [Large Area Search] (Page 2-50) needs to be enabled. However, it is not possible to set a large pattern region which exceeds 8192 pixels in height.



For more details, see "Region Settings" (Page 2-473).

Color

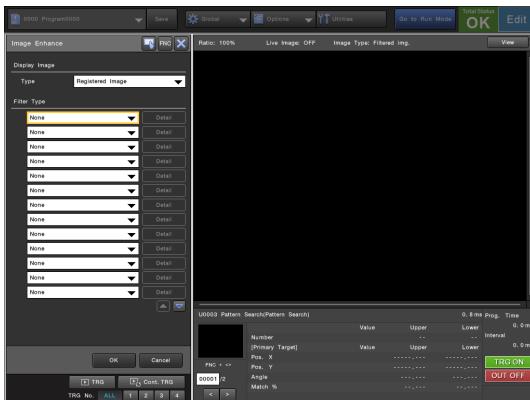
When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.



For more details, see "Color Extraction" (Page 2-483).

Image Enhance

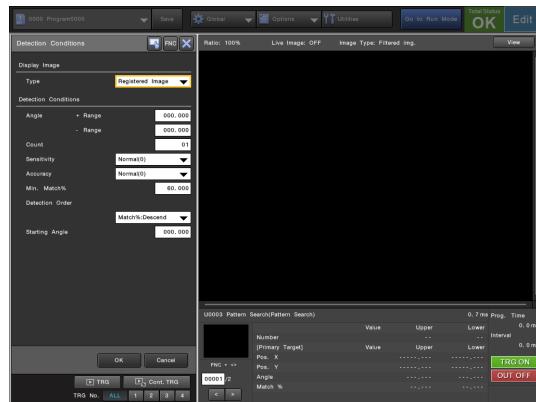
Specify the filter processing to apply to the image.



For more details, see "Image Enhance" (Page 2-489).

Condition

Specify the conditions to detect patterns during measurement.



Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Detection Conditions

Angle

When a pattern is rotated, specify the angle to be measured in the range between -179.999° and 180.000°.

- Select [+ Range] (clockwise rotation) and set the maximum allowable angle range for detection.
- Select [- Range] (counter-clockwise rotation) and set the maximum allowable angle range.

Count

Specify the maximum number of patterns between 1 and 99 to be detected in the Pattern Search. For example, if [3] is specified, the process searches for up to three pattern positions.

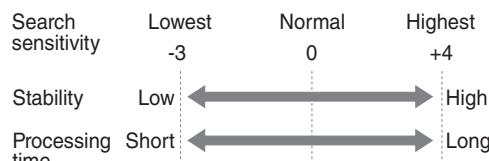


Even if there is only one detection target, by setting the [Count] to a higher count, internal search processing increases and as a result, detections may be stable.

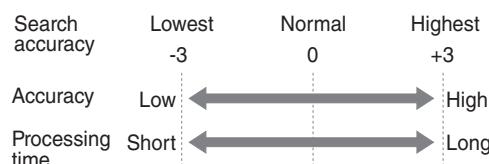
Pattern Search

Sensitivity

Configure the search sensitivity. When detection is unstable, increase the level of sensitivity.



Increasing the level of search sensitivity may improve the stability of detection, but the processing time may become longer.



Increasing the level of search accuracy may improve the stability of detection, but the processing time may become longer.

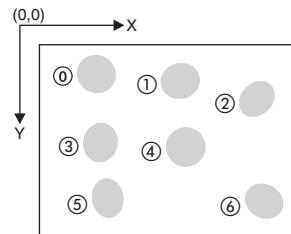
Minimum Match %

Specify the minimum match value for measurement detection candidates (default setting: 60). This option is useful when you want to prevent erroneous detections. For example, if [Min. Match%] is set to 80%, only those patterns having a correlation value of 80% or more are actually processed.

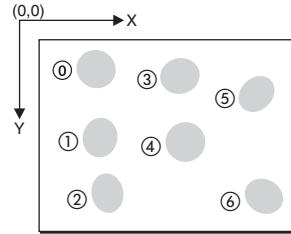
Detection Order

Specify how to apply a number in order to manage multiple detected patterns.

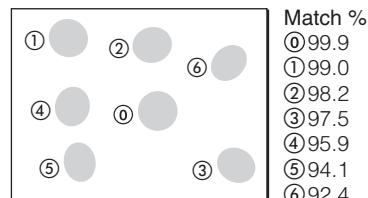
- Y>X: Ascend



- X>Y: Ascend



- X: Ascend (1)
- X: Descend (2)
- Y: Ascend (3)
- Y: Descend (4)
- Match%: Ascend (12)
- Match%: Descend (default setting) (11): Order from highest to lowest match result.



- Clockwise (9)
- Counterclockwise (10)

Starting Angle

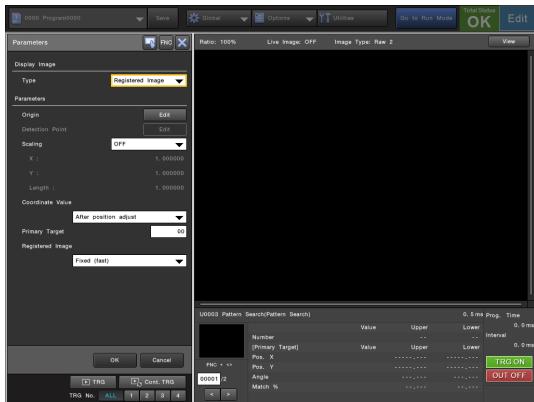
Specify the angle to start numbering when the [Detection Order] setting is [Clockwise] or [Counterclockwise].



This setting is not used if the [Detection Order] is not [Clockwise] or [Counterclockwise].

Parameters

Specify other conditions for the Pattern Search tool as required.



Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

Reference The origin can be set outside the process region. The configurable range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Detection Point

To offset (shift) the detection point, select [Edit] and then specify the offset value.

Point

- The origin of the offset is the center of the pattern region.
- If pattern region is not set, you cannot set offset.

Scaling

The controller processes image data in pixels internally. However, you can convert the result data and setting parameters used for on-screen display, judgment, and calculation to the desired units, such as actual dimension values. (This process is called "scaling".)

- OFF** (default setting): Do not use scaling.
- ON:** Use scaling.

Reference

- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, see "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate Value

Select the coordinate system to be used after position adjustment. If position adjustment (Page 2-306) is not used, this setting will have no effect on the measurement.

- After position adjust** (default setting): The inspection uses the adjusted coordinate axes determined after position adjustment.
- Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Primary Target

Specify pass/fail from the multiple patterns detected. While you can set the value from 0 to 98, normally set it to [0].

Point

Only one of the patterns set here is the target of a pass/fail check (excluding the measurement count).

Registered Image

Select whether to use high speed mode in order to execute fast pattern detection.

- Fixed (fast)** (default setting): Use the processing memory to speed up processing. In this mode, variables cannot be assigned for pattern region settings, color extraction, or image enhancement.
- Updated each process (slow):** While processing time increases as the image memory is used to recalculate image reference information for each measurement, variables can be used and referenced for the registered image and for pattern region settings, color extraction, and image enhancement.
- User updated (fast):** By using both processing memory and image memory, processing is faster than the [Updated each process (slow)] setting while supporting the use of variables. Parameter changes related to pattern registration due to use of variables are applied to image processing by issuing the recalculation command for the image reference information (RU) at the desired time. For more details, see the XG-X2000 Series Communications Control Manual.

Pattern Search

Point

- Parameters related to image reference information include pattern region, color extraction, image enhancement, and detection conditions (angle range, search sensitivity, and search accuracy).
- Even if [User updated (fast)] is selected, changes in settings made via the Region menu (Page 2-473), Color menu (Page 2-483) and Edit Unit menu are applied without the need of the recalculation (RU) command. (The recalculation of the registered image information and reflection to the target unit are done immediately in the case of the Edit Unit menu, and when [OK] is selected in the case of the other menus.)
- If there is not enough memory for each operation, a setting error occurs.
- [Registered Image] cannot be set to [Fixed (fast)] when a variable is assigned to the pattern region setting, color extraction or image enhancement. In such cases, cancel the assignment of the variable and then change the setting.
- If the captured image size from any camera exceeds 26214400 pixels, it is not possible to set [Updated each process (slow)] for high speed mode.

Large Area Search

Specify which mode to use for processing large pattern regions.

- OFF** (default setting): Large Area Search is not used.
- Mode 1:** Use this mode when the region size is 2432 pixels or more in width or 2050 pixels or more in height.
- Mode 2:** Use this mode when the region size is 4096 pixels or more in width or 4096 pixels or more in height.

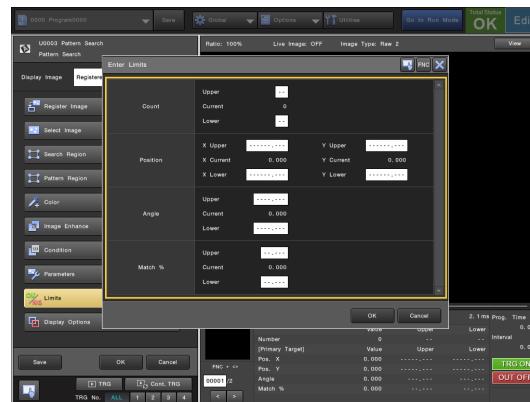
Point

- Only displayed when the 21 megapixel camera (21 megapixel mode), line scan camera, or LJ-V Series sensor head are being used.
- It is not possible to set a large pattern region which exceeds 8192 pixels in height regardless of the mode.
- If Large Area Search mode is enabled, inspection accuracy may decrease, even if the pattern region is small.

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.

Reference

- [----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Count

Specify the tolerance for the pattern detection count.

The measurement value is the number of detected patterns.

Position

Specify the tolerance for the coordinates of the detected pattern.

The measurement value is the number of pixels indicating position.

Angle

Specify the tolerance for the angle of the pattern.

The measurement value is an angle in degrees.

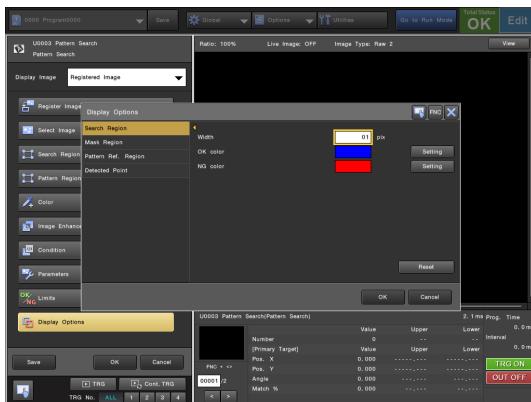
Match %

Specify the tolerance for the correlation value of the pattern. The measurement value is a numerical value in the range of 0 to 99.999.

Display Options

Specify the display methods for things such as the search and mask regions.

You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Search region

Specify the line width and display color of the inspection region.

Mask region

Specify the line width and display color of the mask region.

Pattern reference region

Specify the line width and display color of the pattern region.

Detected Point Primary target

Primary Target

Specify the width and display color of the detected pattern region and reference point (center of the pattern region).

Point When the detection point offset has been set, the detected point shifts according to the offset value.

Other targets

Specify the width and display color of the detected pattern region and detection point (center of the pattern region) for detected patterns not specified in [Primary Target].

Point When the detection point offset has been set, the detected point shifts according to the offset value.

Reset

Restores the display options to their default settings.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

Point

- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

ShapeTrax3

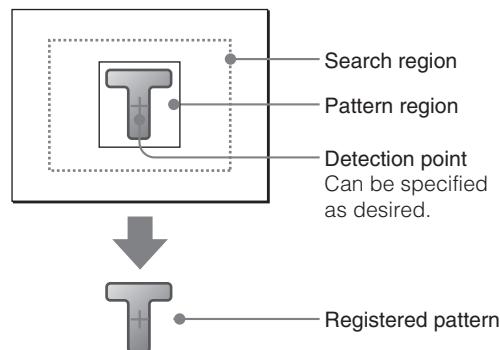
ShapeTrax3 Tool

Precise measurements of position, angle and correlation can be made of a target by comparing the edge data from the captured image with the registered image pattern. Differing from Pattern Search (Page 2-44), ShapeTrax3 mainly uses edge information from the target's profile, making it ideal for position detection in the case where the target's surface condition varies or is damaged and stability and accuracy are required. Not only is ShapeTrax3 faster than ShapeTrax2 (Page 2-66), but some settings are also automated enabling easy and stable measurement.

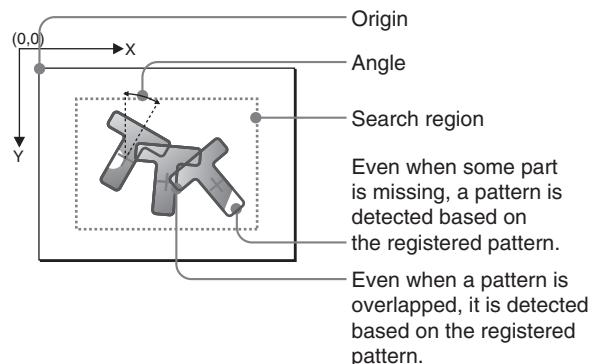
- Point
 - The ShapeTrax3 unit cannot be used on the XG-X2800LJ.
 - While ShapeTrax2 measurement is available for compatibility with existing models, it is recommended that ShapeTrax3 measurement is used for new programs due to its superior functionality.
 - There are restrictions due to processing memory capacity. In ShapeTrax3 measurement, processing memory is consumed in order to register image patterns. As processing memory is shared among units within 1 program, resources for all units including ShapeTrax3 must fit into this device's processing memory. The amount of processing memory used is displayed as [Processing capacity] while configuring region and image enhancement settings, and configuration may not be possible if the value nears 100%.
 - Processing time may change depending on the state of the captured image. Because edge information is detected from the current image, changes in the amount of edge detection may cause changes in the processing time. If changes in the processing time are a problem, it is recommended that you first set the timeout (Page 2-62) setting and then check on the actual line.

Measurement Overview

When a pattern is registered



When the system is in operation



The detected patterns are managed with label numbers

There are 24 types of ways to put label numbers that are available to suit your purposes. To select a different order, see "Detection Order" (Page 2-58).

Main measurement results

The standard results and data returned by ShapeTrax3 measurement are as follows:

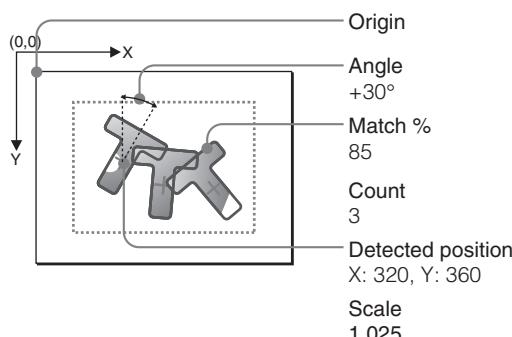
Count	Outputs the number of detected patterns. [Tolerance inspection target] [Label specification target]
Detected Position (X, Y) []	All the detected pattern position coordinates are output by pixel count. [Tolerance inspection target] [Label specification target]
Angle []	All angle deviations between the registered pattern and detected pattern are output. Deviations in the clockwise direction are represented by a plus (+) sign and counter clockwise deviations with a minus (-) sign. [Tolerance inspection target] [Label specification target]
Correlation Value % []	Outputs the similarity level between the pattern detected within the search region and the registered pattern using a numerical value in the range of 0 to 99.999 for all the detected patterns. [Tolerance inspection target] [Label specification target]
Scale []	Outputs numerically the difference in size of all detected patterns, using the registered image size as a reference of 1.000. [Tolerance inspection target] [Label specification target]
Feature Pixel Count 1 [] Feature Pixel Count 2 []	Outputs the number of feature pixels in the detection target selection region that is specified in and out of the detected pattern. Pixels are only output if [Detection Target Selection Condition 1/2] are set respectively. [Tolerance inspection target] [Label specification target]
Unit judgment value	When the measurement result of the target of tolerance judgment is outside the specified tolerance range (between the upper and lower limits), it is judged as [NG]. When the result is within the tolerance range, it is judged as [OK].

Reference For the lists of available measured values that can be output and setting parameters, see "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

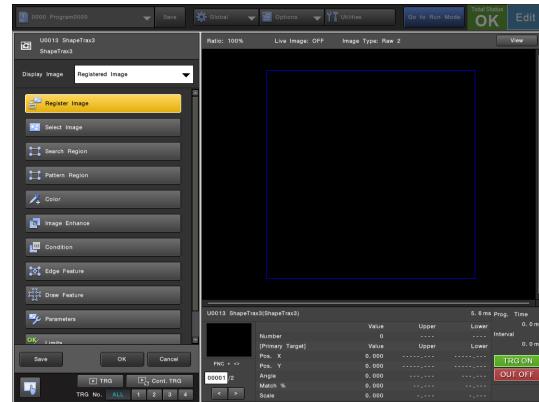
Example showing the results of a measurement performed under the following conditions:

- Detection order: From Upper Left (Downward)
- Primary Target: 0



Top Menu

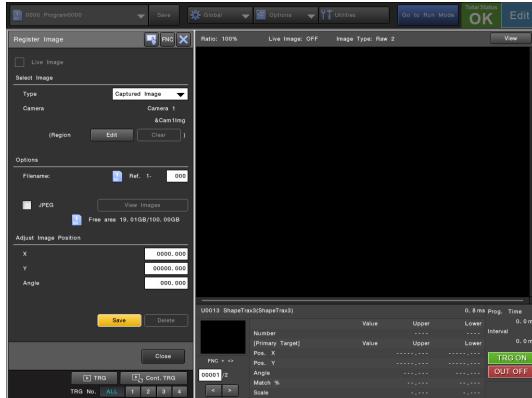
The top menu of the ShapeTrax3 tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-54)	Register an image to be used as a template for settings.
Select Image (Page 2-54)	Specify the captured image and registered image to use for measurement.
Search Region (Page 2-54)	Set a detection range (search region) in the image to search for the model registered in the pattern region.
Pattern Region (Page 2-54)	Register the image of the model that you want to detect as a [Pattern Region].
Color (Page 2-55)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-55)	Specify the filter processing to apply to the image.
Condition (Page 2-55)	Specify the conditions to detect patterns during measurement.
Edge Feature (Page 2-59)	Set detailed conditions for the edge detection of a registered image or current image.
Draw Feature (Page 2-61)	Features that are necessary for pattern detection can be directly drawn and edited (Feature Drawing Tool).
Parameters (Page 2-61)	Specify other conditions for the ShapeTrax3 measurement as required.
Limits (Page 2-63)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-64)	Specify the display methods for things such as the search and mask regions.
Save (Page 2-65)	Save the current state to the program file.

Register Image

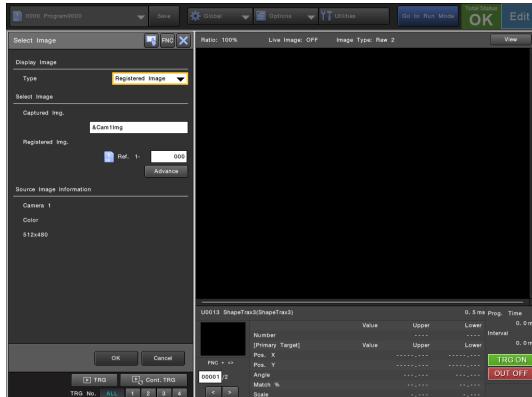
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

Specify the captured image and registered image to use for measurement.



For more details, see "Select Image" (Page 2-471).

Search Region

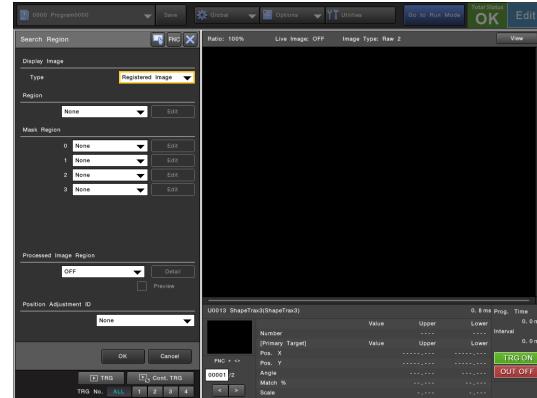
Set a detection range (search region) in the image to search for the model registered in the pattern region (Page 2-54).

Reference

The smaller the search region, the shorter the processing time.

Point

If the width or height of the region size is 2,432 pixels or 2,050 pixels or more respectively, [Large Area Search] (Page 2-60) needs to be enabled.



For more details, see "Region Settings" (Page 2-473).

Pattern Region

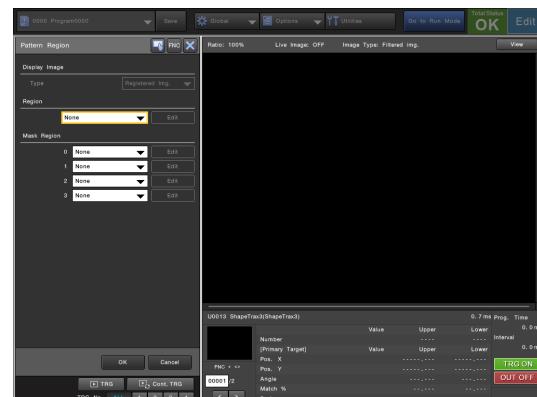
Register the image of the model that you want to detect as a [Pattern Region].

Reference

If the pattern region has a complicated shape, you can set a mask region later to hide the unwanted parts. You can also use [Multiple Area] as one of the mask regions for the pattern region (Page 2-481).

Point

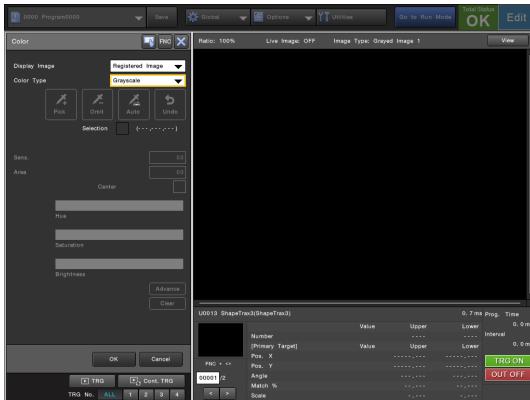
- If the width or height of the region size is 2,432 pixels or 2,050 pixels or more respectively, [Large Area Search] (Page 2-60) needs to be enabled.
- If you have set [Rotation Direction-Added Search] (Page 2-56), this search is based on the region size that includes the rotation feature region.



For more details, see "Region Settings" (Page 2-473).

Color

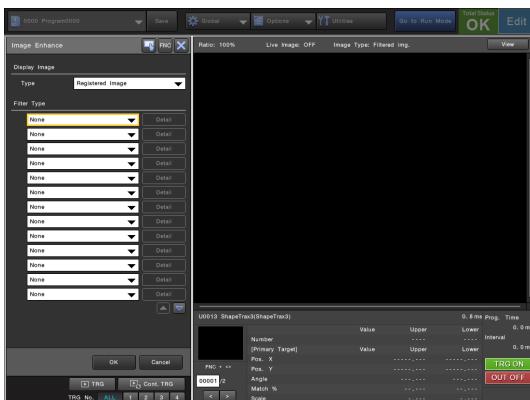
When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.



For more details, see "Color Extraction" (Page 2-483).

Image Enhance

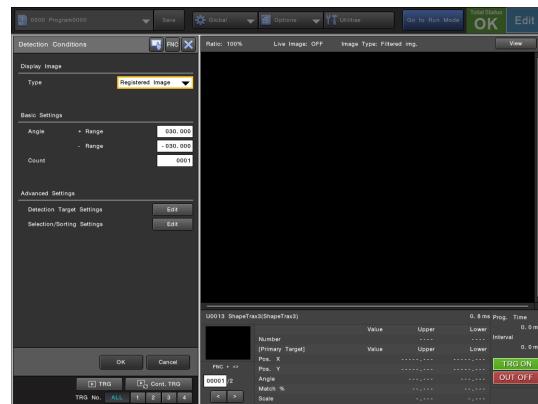
Specify the filter processing to apply to the image.



For more details, see "Image Enhance" (Page 2-489).

Condition

Specify the conditions to detect patterns during measurement.



Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Basic Settings

Angle Range

When a pattern is rotated, specify the angle to be measured in the range between -179.999 and 180.000 degrees.

- Select [+ Range] (clockwise rotation) and set the maximum allowable angle range for detection.
- Select [- Range] (counter-clockwise rotation) and set the maximum allowable angle range for detection.



- The smaller the angle range, the shorter the processing time.
- For workpieces that have a high rotation symmetry, enabling [Rotation Direction-Added Search] may stabilize the angle measurement result.
- The angle of the measurement result may exceed the angle range if [Rotation Direction-Added Search] (Page 2-56) is enabled.

Count

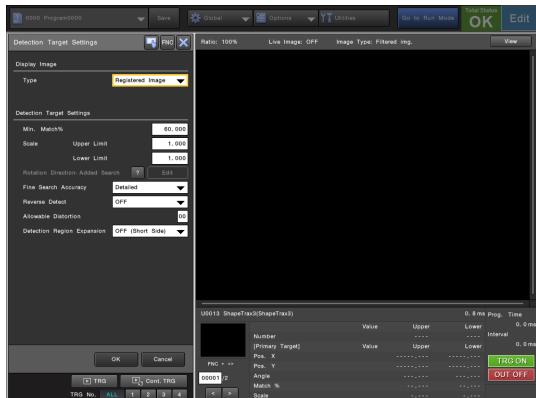
Specify the maximum number of patterns detected by ShapeTrax3 measurement. For example, if [3] is specified, the process searches for up to three pattern positions.



Even if there is only one detection target, by setting the [Count] to a higher count, internal search processing increases and as a result, detections may be stable.

Detection Target Settings

The detection stability can be improved by optimizing the settings according to the detection target.



Min. Match %

Specify the minimum match value for measurement detection candidates. This option is useful when you want to prevent erroneous detections.

For example, if [Min. Match%] is set to 80%, only those patterns having a correlation value of 80% or more are actually processed. The patterns that have a correlation value of less than 80% can be excluded from processing in advance.

Scale

The size change range of search targets in relation to the registered feature can be set in the range from 0.500 to 2.000 times, taking the size of the registered feature as 1.000.

Point Increasing the scale range will increase the processing time.

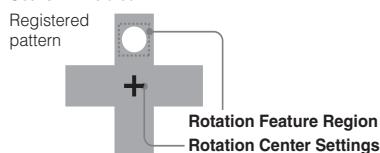
Rotation Direction-Added Search

Specify the conditions for the Rotation Direction-Added Search by selecting [Edit] for a point symmetric workpiece, such as a circle or regular n-sided polygon, if you want to calculate the rotation angle using a feature with a particular circumferential direction. This setting is effective if you want to perform a search that is different from the search for features on an entire workpiece and the features that determine the rotation angle are small. This search is executed after the overall position is determined using the overall features and right before a detailed search, and it detects the correct angle from a correction search that used features for determining the rotation angle.

Rotation Direction-Added Search: Disabled



Rotation Direction-Added Search: Enabled



Point The Rotation Direction-Added Search may detect an angle that exceeds the angle range set in [Condition].

- Enable Rotation Direction-Added Search:** To enable rotation direction-added search, select the check box.

- Rotation Feature Region Settings:** Register regions that have features for determining the rotation angle from the model that you want to detect with the rotation direction-added search. If you select the [Use as Mask] check box, you can specify regions that you want to exclude from the rotation feature region.

Point

- If the width or height of the region, with the pattern region included, is 2,432 pixels or 2,050 pixels or more respectively, [Large Area Search] (Page 2-60) needs to be enabled.
- As the rotation feature region is handled as part of the pattern region, if you place the rotation feature region outside of the pattern region, the pattern region will substantially widen, which may affect the search results.
- The scale of the region of the rotation feature region follows in accordance to the detection result of [Scale].

- Rotation Condition:** Select the correction range of the rotation direction.

- **Whole Circum.** (default setting): This setting is effective for workpieces for which the overall shape is round.
- **180° Rotation:** This setting is effective for workpieces for which the overall shape is rectangular or elliptical.
- **Polygon:** This setting is effective for workpieces, such as gears, for which the overall shape is a polygon (3 to 16 vertices).

Point

- When [Whole circum.] is set, the measurement time may increase greatly. If you want to reduce the measurement time, set [180° Rotation] or [Polygon]. Alternatively, review the settings and reduce the detection count or the like. Also review the timeout settings at the same time.
- The search position for the rotation feature region is displayed in accordance to the rotation condition. This is useful for when checking whether the center of the rotation and the rotation condition are correctly set. Note that when [Polygon] or [180° Rotation] is set, all search positions are displayed, and when [Whole circum.] is set, only a typical search position is displayed.

- Rotation Center Settings:** Set the center position of the rotation.

- **Specified Point:** Set any desired coordinates as the rotation center by specifying X offset and Y offset values to the center position of the pattern region that was set. If you wish to set the offset, select [Edit] and then enter an offset value.

- **Center Of Gravity:** Set the center of the rotation to be the center of gravity for the group of registered edges in relation to the registered image. Since the center of the rotation is set based on the group of registered edges in the registered image, the positional relationship between the center of the rotation and a search target is almost constant regardless of the settings for the rotation feature region. This option is useful because as long as the registered edges are extracted properly, the center of the rotation will be in almost the same position regardless of the registered location of the target in the rotation feature region.



- Setting the center of the rotation accurately stabilizes the Rotation Direction-Added Search.
- The origin of the offset is the center point of the pattern region.
- The offset cannot be set if the rotation feature region is not set.

- **Rot. Feat. Densification:** Select [ON] to capture and search for even finer feature in the rotation feature region.
- **Concentricity Margin Range:** Detects rotation features if their shift is of about the specified value (number of pixels) in cases that the center of the rotation can easily shift due to the lens angle and workpiece gradient.

Fine Search Accuracy

Specify the search accuracy.

- **Detailed:** Performing the fine search in greater detail allows higher accuracy.
- **Fast:** Select this setting when processing time should be prioritized over accuracy.



Increasing the accuracy of fine search will improve the accuracy of detection, but the processing time will increase.

Reverse Detect

Select this option to continue detection even when the image was reversed due to an image capture condition.

- **OFF:** Do not detect if you reversed black and white.
- **ON:** Even if you reversed black and white, detects in the same manner as if you did not reverse the colors.

Allowable Distortion

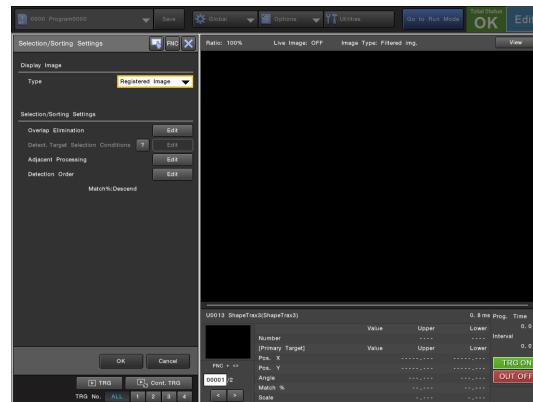
If each edge of the detection candidate is not aligned with the registered pattern due to the lens angle or work tilting, they are detected as edges during fine feature search as long as it is a distortion of about the same level as the specified value (number of pixels).

Detection Region Expansion

Select whether to detect the registered pattern outside the search region.

- **ON:** Search even for targets which are, when compared to the registered pattern, halfway outside of the search region as long as the detection point is within the search region.
- **OFF (Long Side)/OFF (Short Side):** Excludes the targets extending beyond the search region by searching the specified amount inside the long side or short side of the pattern region's bounding rectangle. However, targets outside the search region may be searched depending on the angle/region settings.

Selection/Sorting Settings



Overlap Elimination

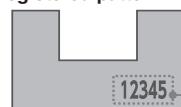
If multiple search results overlap on the detection target, candidates are omitted by the degree in which the area of the detection candidates overlap.

- **Overlap Elimination:** To use overlap elimination, select [Enable].
- **Elimination Target:** Specify the basis for omission from detection candidates if multiple search results overlap on the detection target.
 - **Other Than Best Match:** Of the multiple candidates that overlap, the candidate with the highest match percentage is left behind.
 - **All:** If multiple candidates overlap, all candidates are omitted.
- **Overlap Area:** Specify the extent of overlap of the areas of the detected candidates that is to serve as the criterion for elimination from the detected candidates when multiple search results overlap on the detection target.

Detect. Target Selection Conditions

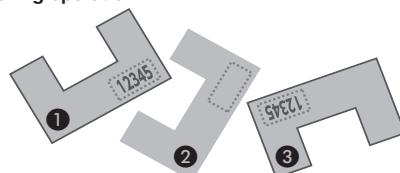
This function enables you to set a region that is different to the inspection region and select whether to include detection targets based on the feature amount in that region (executed during fine search). This is effective for when you want to set special areas (such as marks) that exist only on the front face of the workpiece and eliminate workpieces that are facing downwards from detection targets. It is also effective if you want to set around the workpiece and eliminate overlap detections.

Registered pattern



Detection Target Selection Condition 1
Feature Pixel Count 1 : Lower Limit100

During operation



- ① Primary Target 0, Feature Pixel Count 1 : 125
- ② Not subject to detecting, Feature Pixel Count 1 : 0
- ③ Primary Target 1, Feature Pixel Count 1 : 118



- Two detection target selection conditions ([Detection Target Selection Condition 1] and [Detection Target Selection Condition 2]) can be set at the same time. For example, by setting [Detection Target Selection Condition 1] so that only workpieces that have certain features remain and setting [Detection Target Selection Condition 2] so that workpiece overlap is eliminated, only detection targets that satisfy both conditions will remain.
- Processing of detection target selection conditions is performed after fine search, exclusion of adjacent candidates, and overlap elimination processing are performed.
- The Feature Pixel Count is calculated depending on the features in the detection target selection region.
- The scale of the search region for the detection target selection condition fluctuates depending on the [Scale] detection results. However, the threshold will not change automatically according to the scale. Therefore, if you increase the scale range, make sure that stable operation can be maintained.

- Enable Condition:** To enable [Detection Target Selection Condition1] or [Detection Target Selection Condition 2], select the corresponding check box.
- Region:** Register a region to calculate feature pixels. If you select the [Use as Mask] check box, you can specify regions where you do not want to calculate feature pixels.



Up to four regions can be set. The total of all the feature pixels in these regions is the Feature Pixel Count.

- Feature Extraction Settings:** Specify conditions to extract feature pixels.
 - Link w/ Current Feat.** (default setting): Use the feature threshold value used in a search as is.
 - Specify Value:** You can set any threshold value. You can adjust this value if the default setting detects too many feature pixels or the special areas that you want to use for [Detect. Target Selection Conditions] are not detected as feature pixels.
- Detection Target Retainment Condition:** You can specify conditions to leave detection targets in accordance with feature pixels.
 - Or More are Retained:** Output the detection target that has more feature pixels than the specified number as the result.
 - Or Less are Retained:** Output the detection target that has less feature pixels than the specified number as the result.
- Transient Display:**
 - Display All Candidates:** If you select [ON], candidates that were excluded by [Detect. Target Selection Conditions] and not displayed in the results are displayed with a red line (only when the [Detection Target Selection Condition Settings] screen is displayed).
 - Overlay Display:** If you select [ON], the match percentage and number of feature pixels are displayed on the screen.

Adjacent Processing

If search results overlap for a detection target, set the range of [Distance], [Angle], and [Scale] for omitting them from the candidates to specify the conditions for omitting the candidate close to the center of the registered feature's bounding rectangle. Candidates that meet the AND condition of those settings are omitted (executed during both coarse search and fine search).

Increasing the elimination amount may remedy the problems of duplicate detections of one object and erroneous detections of similar objects. However, if objects are close to each other when performing multiple detections, they may not be detected correctly.

- Minimum Distance:** Specify the range to exclude detection candidates using the distance (number of pixels) from the center of the circumscribed rectangle of the registered feature.
- Minimum Angle:**
 - Angle:** Specify the angle range to exclude detection candidates with the angle of the detection target (starting angle) as center.
 - Starting Angle:** Select the reference angle to exclude adjacent candidates by setting the angle of the detection target as 0 degrees. To exclude the case where reversed patterns are erroneously detected, select [0/180 degree]. This excludes candidates located at around 0 degrees or 180 degrees (this means reversed images) from the angle of the detection target, while patterns appearing at intersecting angles (such as 90 degrees) remain as candidates.
- Minimum Scale:** Specify the range to exclude detection candidates using a scale (%) based on the detection target.

Detection Order

Select [Edit] and set the detection order specification method.

- Detection Order:** Specify the identification order for managing of the multiple detected patterns.

- X: Ascend
- X: Descend
- Y: Ascend
- Y: Descend
- Match%: Ascend
- Match%: Descend (default setting)
- Feature Pixel Count 1: Ascend
- Feature Pixel Count 1: Descend
- Feature Pixel Count 2: Ascend
- Feature Pixel Count 2: Descend
- Clockwise
- Counterclockwise
- Scale: Ascend
- Scale: Descend
- Scale Disjunction: Ascend
- Scale Disjunction: Descend
- From Upper Left (Rightward)
- From Upper Left (Downward)
- From Upper Right (Leftward)
- From Upper Right (Downward)
- From Lower Left (Rightward)
- From Lower Left (Upward)
- From Lower Right (Leftward)
- From Lower Right (Upward)

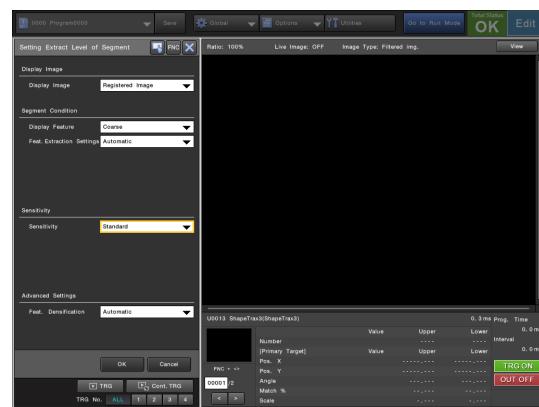
- **Starting Angle:** Specify the angle to start numbering when the [Detection Order] setting is [Clockwise] or [Counterclockwise].
- **Grouping Method:** Specifies the range for considering detected points as being on the same row or column when sorting using detection order if you selected [From Upper Left (Rightward)], [From Upper Left (Downward)], [From Upper Right (Leftward)], [From Upper Right (Downward)], [From Lower Left (Rightward)], [From Lower Left (Upward)], [From Lower Right (Leftward)], or [From Lower Right (Upward)] for [Detection Order].
- **Pattern Length (Long Side):** Uses in the XY direction the length of the long side of the pattern region's bounding rectangle as the range for considering detected points as being on the same row or column.
- **Pattern Length (XY Individual):** When the range for considering detected points as being on the same row is required, uses the vertical side length of the pattern region's bounding rectangle. In turn, when the range for considering detected points as being on the same column is required, uses the horizontal side length of the pattern region's bounding rectangle.
- **Specified Value:** Specifies the range for considering detected points as being on the same row or column in pixels.
- **Grouping Range (Pixel):** Specifies the range in pixels if you selected [Specified Value] for [Grouping Method] (1 to 9,999; default setting: 20).



Detection order [Feature Pixel Count* Ascend/Descend] assigns label numbers based on the number of feature pixels in the specified region in and out of the pattern. For more details about feature pixels, see "Detect. Target Selection Conditions" (Page 2-57).

Edge Feature

Set detailed conditions for the edge detection of the registered image and the current image. High-precision measurement is made possible by making sure that edge information can be properly extracted from the registered image and the current image. ShapeTrax3 runs a coarse search using a compressed image and pattern model to quickly detect the approximate position, and then uses a fine search to detect the precise position. Set the feature extraction conditions for coarse and fine searches independently here.



Display Image

Display Image

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Segment Condition

Display Feature

Select the features you want to display.

- **Coarse:** Displays the coarse features used for a coarse search.
- **Fine:** Displays the fine features used for a fine search.

Feat. Extraction Settings

Set conditions for the edge detection of the registered image and the current image. ShapeTrax3 automatically detects optimal edges based on registered images and pattern regions. After executing a coarse feature search that uses a scaled-down image and its pattern model to roughly and quickly detect the position, a fine feature search accurately detects the position.

- **Automatic** (default setting): Set conditions to detect optimal edges based on registered images and pattern regions.
- **Automatic (Low Contrast)**: This setting is effective for workpieces whose appearance can easily change, such as the profile blurring or contrast changing, during operation.
- **Custom**: If detection is not stable with the auto settings, adjust the edge detection sensitivity manually.
 - Registered feature: To allow only special features of the target to be extracted as edges, set the settings while confirming them on the displayed image of the screen. Set values for the coarse features and fine features of the registered image respectively.
 - Current feature: To allow only special features of the target to be extracted as edges, set the settings while confirming them on the displayed image of the screen. Set values for the coarse features and fine features of the current image respectively.

Sensitivity

Sensitivity

Priority can be given to search speed or stability by changing the reduction rate of the image and features. The image reduction rate is the compression degree of the current image being used or the registered image and the feature reduction rate is the compression degree of features extracted from the current image or the registered image.

- **Fast**: Select to prioritize the search speed.
- **Standard** (default setting): Select for most situations.
- **Detailed**: Select to prioritize stability.
- **Custom**: If the above settings are not stable, adjust the degree of reduction for each item.
 - **Coarse Image Reduction**:
0 (small degree of reduction) - 10 (large degree of reduction)
 - **Coarse Feature Reduction**:
0 (small degree of reduction) - 10 (large degree of reduction)
 - **Fine Image Reduction**:
0 (small degree of reduction) - 10 (large degree of reduction)



Point

- Setting all of the reduction rates to "0 (smallest)" will drastically increase processing time, and will not necessarily improve search accuracy.
- If the fine reduction rate is set high, the change in match % may also become large.
- If the reduction rate is set high, features in the mask region may be extracted.
- You cannot specify a value for [Fine Image Reduction] that is larger than [Coarse Image Reduction].
- If the size of the image that is the target of measurement is large, the features may deviate from the actual edge, even if [Large Area Search] is disabled or the degree of reduction is set to a low value, and may be coarsely displayed.

Advanced Settings

Feat. Densification

If you wish to capture and search even finer features, select [Strong] (processing speed decreases). The [Automatic] setting has a fast processing speed while maintaining stability.

Large area search

Select when setting a large area for the pattern region and search region.

- **OFF** (default setting): Large Area Search is not used.
- **ON**: Use Large Area Search mode. It is necessary to enable Large Area Search mode when the region size is 2432 pixels or more in width or 2050 pixels or more in height.



Point

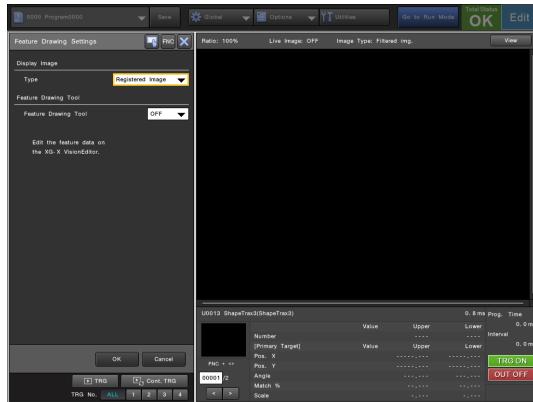
- Only displayed when the 21 megapixel camera (21 megapixel mode), line scan camera, or LJ-V Series sensor head are being used.
- When Large Area Search mode is enabled, the minimum setting for the rough search and fine search reduction rates (Page 2-60) is limited to four.

Draw Feature

Features that are necessary for pattern detection can be directly drawn and edited (Feature Drawing Tool). With this tool, even if you cannot extract the appropriate features from an image well, such as in the cases below, highly accurate ShapeTrax3 measurement is possible.

- The detection targets are close to each other and features cannot be extracted well
- Unnecessary features are extracted due to background shadows, or saturation and shadows due to lighting.
- Detection targets for which features cannot be extracted well due to shading are close to each other.

Point You can only edit feature data on XG-X VisionEditor.



Display Image

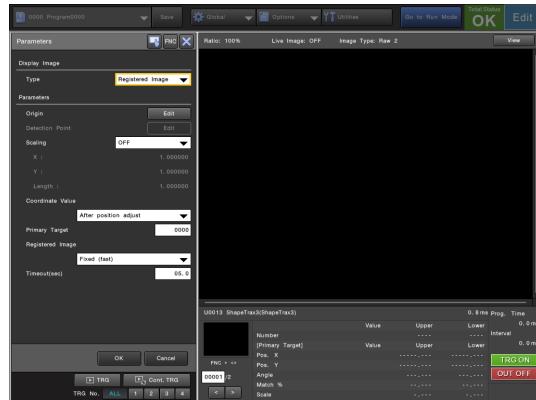
Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Specify other conditions for the ShapeTrax3 tool as required.



Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

Reference The origin can also be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Detection Point

Change the position of the detection point.

- Specified Point:** Set the detection point by using X and Y offset values to specify coordinates based on the center of the specified pattern region. To set the offset (shift) for the detection point, select [Edit] and then specify the offset value with a numerical value or variable.
- Center Of Gravity:** Set the detection point to be the center of gravity for the group of registered edges in relation to the registered image. Since the detection point is determined based on the group of registered edges in the registered image, the positional relationship between the detection point and a search target is almost constant regardless of the pattern region setting. This option is useful because as long as the registered edges are extracted properly, the detection point will be in almost the same position regardless of the registered location of the target in the pattern region.

Point

- The origin of the offset is the center of the pattern region.
- If pattern region is not set, you cannot set offset.

Scaling

The controller processes image data in pixels internally. However, you can convert the result data and setting parameters used for on-screen display, judgment, and calculation to the desired units, such as actual dimension values. (This process is called "scaling".)

- **OFF** (default setting): Do not use scaling.
- **ON**: Use scaling.

Reference

- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, see "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate Value

Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- **After position adjust**: The inspection uses the adjusted coordinate axes determined after position adjustment.
- **Before position adjust**: The distance from the position specified for the [Origin] of the inspection is used.

Primary Target

Specify the pass/fail judgment target from the multiple patterns detected. While you can set the value from 0 to 1999, normally set it to [0].

Point

Only the one pattern set here is the target of a check of pass/fail conditions (excluding the measurement of the count).

Registered Image

Select the operation for determining the speed of this unit.

- **Fixed (fast)** (default setting): Use the processing memory to speed up processing. In this mode, variables cannot be assigned for pattern region settings, color extraction, or image enhancement.
- **Updated each process (slow)**: While processing time increases as the image memory is used to recalculate image reference information for each measurement, variables can be used and referenced for the registered image and for pattern region settings, color extraction, and image enhancement.
- **User updated (fast)**: By using both processing memory and image memory, processing is faster than the [Updated each process (slow)] setting while supporting the use of variables. Parameter changes related to pattern registration due to use of variables are applied to image processing by issuing the recalculation command for the image reference information (RU) at the desired time. For more details, see the XG-X2000 Series Communications Control Manual.

Point

- Parameters related to image reference information include pattern region, color extraction, image enhancement, and detection conditions (angle range, search sensitivity, and search accuracy).
- Even if [User updated (fast)] is selected, changes in settings made via the Region menu (Page 2-473), Color menu (Page 2-483) and Edit Unit menu are applied without the need of the recalculation (RU) command. (The recalculation of the registered image information and reflection to the target unit are done immediately in the case of the Edit Unit menu, and when [OK] is selected in the case of the other menus.)
- If there is not enough memory for each operation, a setting error occurs.
- You cannot select [Fixed (fast)] in the following cases:
 - When variables are used in the settings below:
Pattern region, color extraction, height extraction, and image enhancement
Setting Extract Level of Segment menu:
Reduction rate, registered feature, feature densification
Condition menu: Angle range, scale range, reverse detection
Rotation Direction-Added Search: Rotation feature region, center of rotation offset, rotation feature densification
Detection Target Selection Condition: Region Parameters: Detection point offset
 - When one of the Shading Correction, Scratch Defect Extraction, or Noise Isolation filters is set and when one of the following cases is true:
 - Variables are used in the search region.
 - An image region is set.
 - When the registered image is referenced from an image variable
 - When [Real time extraction] is set for [Height extraction] and when one of the following cases is true:
 - Variables are used in the search region.
 - An image region is set.
- In such cases, cancel the assignment of the variable and then change the setting.
- If the captured image size from any camera exceeds 26214400 pixels, it is not possible to set [Updated each process (slow)] for high speed mode.
- If you use the Feature Drawing Tool, it is not possible to set [Updated each process (slow)] or [User updated (fast)].

Timeout

Set a maximum processing time. When the processing time for a given single unit exceeds the limit set for it (0.5 to 60 seconds, default: 5 seconds) due to the state of the current image, the unit will return a timeout error and all outputs will be set to 0.

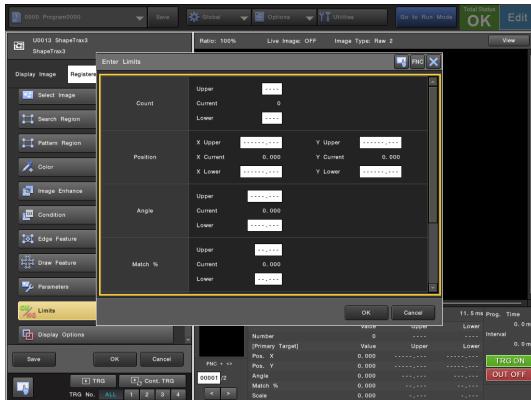
Point

The setting value is an aim. There may be some errors until the actual timeout occurs.

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the measurement result of the tolerance judgment target is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.

Reference

- [----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Count

Specify the tolerance for the pattern detection count.

The measurement value is the number of detected patterns.

Position

Specify the tolerance for the coordinates of the detected pattern.

The measurement value is the number of pixels indicating position.

Angle

Specify the tolerance for the tilt angle of the pattern.

The measurement value is an angle in degrees.

Match %

Specify the tolerance for the correlation value of the pattern.

The measurement value is a numerical value in the range of 0 to 99.999.

Scale

Specify the tolerance for the scale of the pattern.

The measurement value is a numerical value in the range of 0 to 9.999.

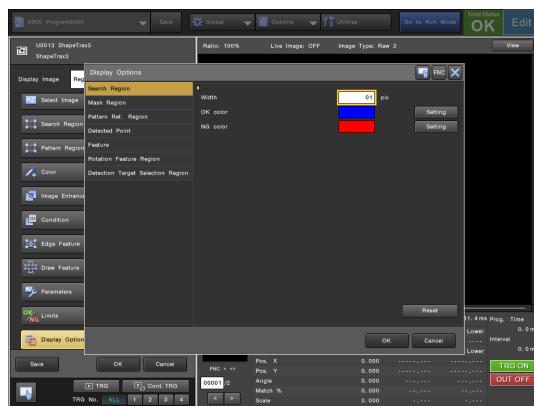
Feature Pixel Count

Set the tolerance for the number of feature pixels output inside and outside of the pattern by [Detect. Target Selection Conditions] (Page 2-57). The tolerance for the number of feature pixels can be set individually for both [Detection Target Selection Condition 1/2].

Display Options

Specify the display methods for things such as the search and mask regions.

You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Search region

Specify the line thickness and display color of the search region.

Mask region

Specify the line thickness and display color of the mask region.

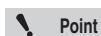
Pattern Ref. Region

Specify the line thickness and display color of the pattern region.

Detected Point

Primary target

Specify the thickness and display color of the detected pattern region and detection point (center of the pattern region) for the detected pattern.



When the detection point offset has been set, the detected point shifts according to the offset value.

Other target

Specify the thickness and display color of the detected pattern region and detection point (center of the pattern region) for detected patterns not specified in [Primary Target].



When the detection point offset has been set, the detected point shifts according to the offset value.

Target No. Display

Specify the size and whether to enable or disable the display of the target number, match percentage, and number of feature pixels.

Feature

Specify how to display the feature points displayed for [Filtered image] and [Contrast image].

Pattern region

To hide the display of the pattern region, select [OFF] (default: ON).

Trained Feature

Select what to display for registered features.

- **OFF:** Do not display the registered features.
- **Fine segment** (default setting): Display fine features.
- **Coarse segment:** Display coarse features.

Run Feature

Select features to be displayed in the search region of the current image. This can only be set when [Detect. Target Selection Condition Feature] is set to [OFF].

- **OFF** (default setting): Do not display detected edge points.
- **Fine segment:** Display the fine features.
- **Coarse segment:** Display the coarse features.

Detect. Target Selection Condition Feature

Select the features that were determined to be feature pixels by the [Detect. Target Selection Conditions] settings. When both [Detect. Target Selection Conditions] are set, they will be displayed at the same time. This setting can be set only when [Run Feature] is set to [OFF].

- **OFF** (default setting): Do not display feature pixels for detection target selection conditions.
- **ON:** Display feature pixels.



Setting [Trained Feature] or [Run Feature] [Detect. Target Selection Condition Feature] to a value other than [OFF] consumes the program memory. Check the amount of remaining program memory before enabling this setting.

Rotation feature region display

To hide the rotation feature region specified in [Rotation Direction-Added Search], select [OFF] (default setting: ON).

Detection target selection region 1/2 display

To hide the region specified in [Detect. Target Selection Conditions], select [OFF] (default setting: ON).

Detailed display

Select whether to display feature points in high-definition for high pixel images captured with the 21 megapixel camera (21 megapixel mode), line scan camera, or LJ-V Series sensor head that exceed five megapixels.

- **OFF:** Display feature points in low-resolution.
- **ON:** Display feature points in high-definition.

Point

- The default setting is [ON] when the detection point offset is set and the connected camera is a 21 megapixel camera (21 megapixel mode) or line scan camera; in all other cases, the default setting is [OFF].
- The [Detailed display] setting is enabled only for images that exceed five megapixels.
- Setting [Run Feature] to a value other than [OFF] and setting [Detailed display] to [ON] consumes even more program memory.

Rotation Feature Region

Specify the thickness and display color of the rotation feature region and rotation center position that is displayed for [Feature] - [Rotation feature region display].

Detection Target Selection Region

Specify the thickness and display color of the region specified in [Detect. Target Selection Conditions].

Reset

Restores the display options to their default settings.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

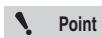
Point

- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

ShapeTrax2

ShapeTrax2 Tool

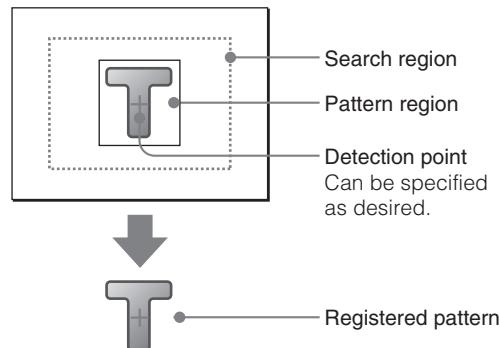
Precise measurements of position, angle and correlation can be made of a target by comparing the edge data from the captured image with the registered image pattern. Differing from Pattern Search (Page 2-44), ShapeTrax2 mainly uses edge information from the target's profile, making it ideal for position detection in the case where the target's surface condition varies or is damaged and stability and accuracy are required.



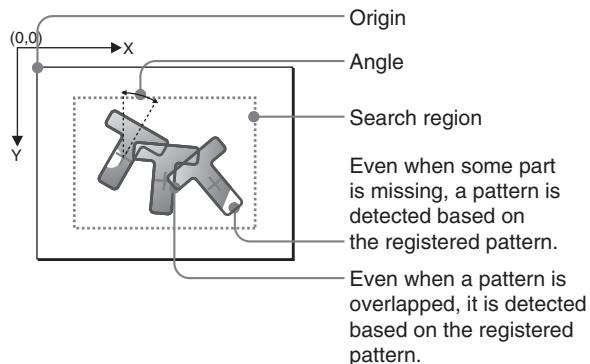
- The ShapeTrax2 unit cannot be used on the XG-X2800LJ.
- While ShapeTrax2 measurement is available for compatibility with existing models, it is recommended that ShapeTrax3 measurement is used for new programs due to its superior functionality.
- There are restrictions due to processing memory capacity. In ShapeTrax2 measurement, processing memory is consumed in order to register image patterns. As processing memory is shared among units within 1 program, resources for all units including ShapeTrax2 must fit into this device's processing memory. The amount of processing memory used is displayed as [Processing capacity] while configuring region and image enhancement settings, and configuration may not be possible if the value nears 100%.
- Processing time may change depending on the state of the captured image. Because edge information is detected from the current image, changes in the amount of edge detection may cause changes in the processing time. If changes in the processing time are a problem, it is recommended that you first set the timeout (Page 2-74) setting and then check on the actual line.

Measurement Overview

When a pattern is registered



When the system is in operation



The detected patterns are managed with label numbers

There are 20 types of ways to put label numbers that are available to suit your purposes. To select a different order, see "Detection Order" (Page 2-70).

Main measurement results

The standard results and data returned by ShapeTrax2 tool are as follows:

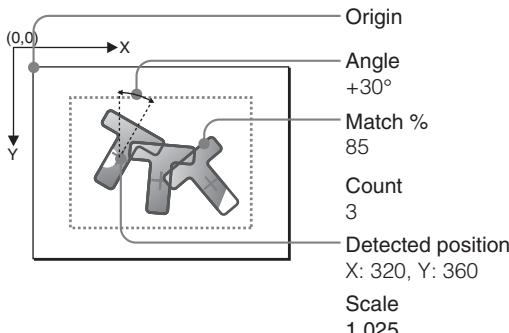
Count	Outputs the number of detected patterns. Tolerance inspection target
Detected point (X, Y) []	All the detected pattern position coordinates are output by pixel count. Tolerance inspection target Label specification target
Angle []	All angle deviations between the registered pattern and detected pattern are output. Deviations in the clockwise direction are represented by a plus (+) sign and counter clockwise deviations with a minus (-) sign. Tolerance inspection target Label specification target
Correlation Value % []	Outputs the similarity level between the pattern detected within the search region and the registered pattern using a numerical value in the range of 0 to 99.999. Tolerance inspection target Label specification target
Scale []	Outputs the difference in size of all detected patterns, using the registered image size as a reference of 1.000. Tolerance inspection target Label specification target
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper/lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

Reference For the lists of available measurement output values and setting parameters, see "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

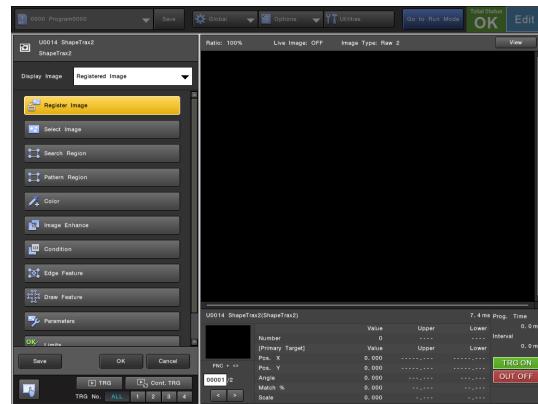
Example showing the results of a measurement performed under the following conditions:

- Detection Order: From Upper Left (Downward)
- Primary Target: 0



Top Menu

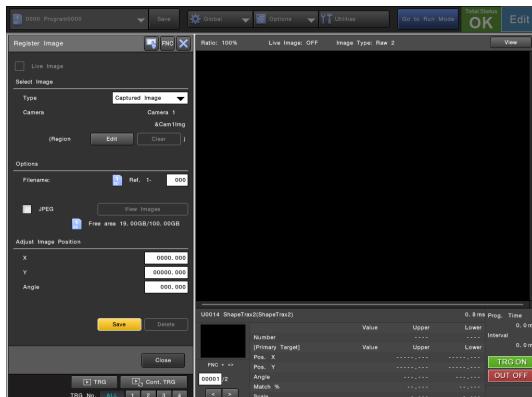
The top menu of the ShapeTrax2 tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-68)	Register an image to be used as a template for settings.
Select Image (Page 2-68)	Specify the captured image and registered image to use for measurement.
Search Region (Page 2-68)	Set a detection range (search region) in the image to search for the model registered in the pattern region.
Pattern Region (Page 2-68)	Register the image of the model that you want to detect as a [Pattern Region].
Color (Page 2-69)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-69)	Specify the filter processing to apply to the image.
Condition (Page 2-69)	Specify the conditions to detect patterns during measurement.
Edge Feature (Page 2-71)	Set detailed conditions for the edge detection of a registered image or current image.
Draw Feature (Page 2-71)	Features that are necessary for pattern detection can be directly drawn and edited (Feature Drawing Tool).
Parameters (Page 2-73)	Specify other conditions for the ShapeTrax2 tool as required.
Limits (Page 2-76)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-76)	Specify the display methods for things such as the search and mask regions.
Save (Page 2-77)	Save the current state to the program file.

Register Image

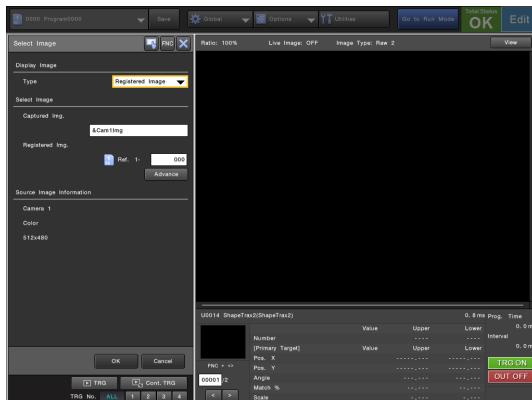
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

Specify the captured image and registered image to use for measurement.



For more details, see "Select Image" (Page 2-471).

Search Region

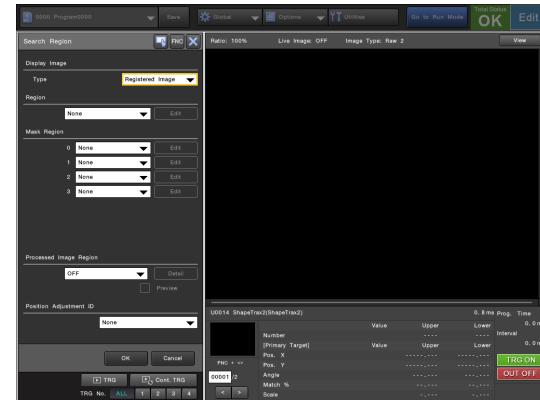
Set a detection range (search region) in the image to search for the model registered in the pattern region (Page 2-68).

Reference

The smaller the search region, the shorter the processing time.

Point

If the width or height of the region size is 2,432 pixels or 2,050 pixels or more respectively, [Large Area Search] (Page 2-72) needs to be enabled.



For more details, see "Region Settings" (Page 2-473).

Pattern Region

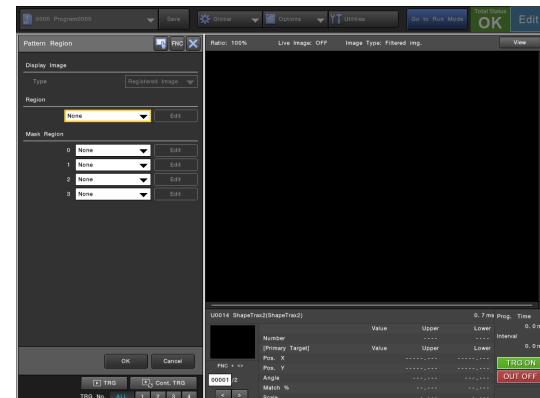
Register the image of the model that you want to detect as [Pattern Region].

Reference

If the pattern region has a complicated shape, you can set a mask region later to hide the unwanted parts. You can also use [Multiple Area] as one of the mask regions for the pattern region (Page 2-481).

Point

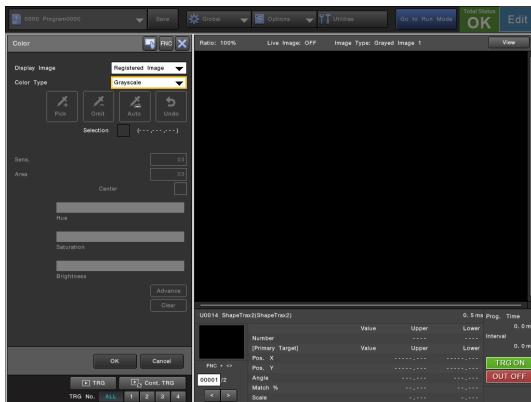
If the width or height of the region size is 2,432 pixels or 2,050 pixels or more respectively, [Large Area Search] (Page 2-72) needs to be enabled.



For more details, see "Region Settings" (Page 2-473).

Color

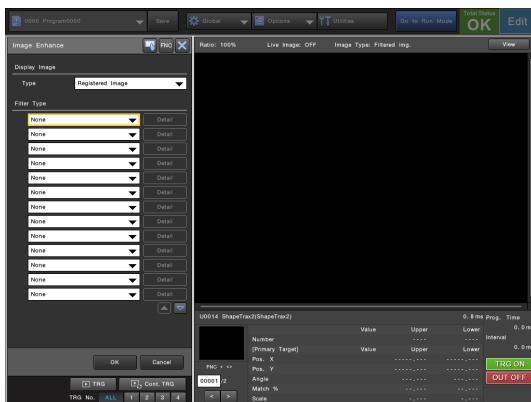
When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.



For more details, see "Color Extraction" (Page 2-483).

Image Enhance

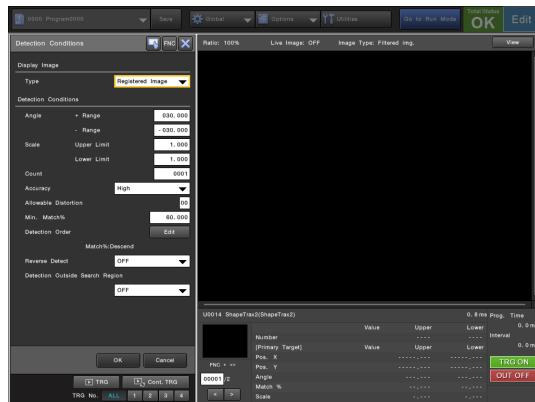
Specify the filter processing to apply to the image.



For more details, see "Image Enhance" (Page 2-489).

Condition

Specify the conditions to detect patterns during measurement.



Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Detection Conditions

Angle

When a pattern is rotated, specify the angle to be measured in the range between -179.999° and 180.000° .

- Select [+ Range] (clockwise rotation) and set the maximum allowable angle range for detection.
- Select [- Range] (counter-clockwise rotation) and set the maximum allowable angle range for detection.

Scale

The size change range of search targets in relation to the registered feature can be set in the range from 0.500 to 2.000 times, taking the size of the registered feature as 1.000.



Increasing the scale range will increase the processing time.

Count

The number of patterns detected by the ShapeTrax2 measurement can be set from 1 to 2000. For example, if [3] is specified, the process searches for up to three pattern positions.

 **Point**

Even if there is only one detection target, by setting the [Count] to a higher count, internal search processing increases and as a result, detections may be stable.

Accuracy

Specify the search accuracy.

- **High** (default) (0): A detailed fine search allows high accuracy.
- **Low** (1): Select this when processing time should be prioritized over accuracy.

 **Point**

Increasing the level of search accuracy may improve the accuracy of detection, but the processing time may become longer.

Allowable Distortion

If each edge of the detection candidate is not aligned with the registered pattern due to the lens angle or work tilting, they are detected as edges during fine feature search as long as it is a distortion of about the same level as the specified value (number of pixels).

Min. Match %

Specify the minimum match value for measurement detection candidates. This option is useful when you want to prevent erroneous detections.

For example, if [Min. Match%] is set to 80%, only those patterns having a correlation value of 80% or more are actually processed. The patterns that have a correlation value of less than 80% can be excluded from processing in advance.

Detection Order

Select [Edit] and set the detection order specification method.

- **Detection Order:** Specify the identification order of the multiple detected patterns.
 - X: Ascend
 - X: Descend
 - Y: Ascend
 - Y: Descend
 - Match%: Ascend
 - Match%: Descend (default setting): Order from highest to lowest match result.
 - Clockwise
 - Counterclockwise
 - Scale: Ascend
 - Scale: Descend
 - Scale Disjunction: Ascend
 - Scale Disjunction: Descend
 - From Upper Left (Rightward)
 - From Upper Left (Downward)
 - From Upper Right (Leftward)
 - From Upper Right (Downward)
 - From Lower Left (Rightward)
 - From Lower Left (Upward)
 - From Lower Right (Leftward)
 - From Lower Right (Upward)
- **Starting Angle:** Specify the angle to start numbering when the [Detection Order] setting is [Clockwise] or [Counterclockwise].
- **Grouping Method:** Specifies the range for considering detected points as being on the same row or column when sorting using detection order if you selected [From Upper Left (Rightward)], [From Upper Left (Downward)], [From Upper Right (Leftward)], [From Upper Right (Downward)], [From Lower Left (Rightward)], [From Lower Left (Upward)], [From Lower Right (Leftward)], or [From Lower Right (Upward)] for [Detection Order].
 - **Pattern Length (Long Side):** Uses in the XY direction the length of the long side of the pattern region's bounding rectangle as the range for considering detected points as being on the same row or column.
 - **Pattern Length (XY Individual):** When the range for considering detected points as being on the same row is required, uses the vertical side length of the pattern region's bounding rectangle. In turn, when the range for considering detected points as being on the same column is required, uses the horizontal side length of the pattern region's bounding rectangle.
 - **Specified Value:** Specifies the range for considering detected points as being on the same row or column in pixels.
- **Grouping Range (Pixel):** Specifies the range in pixels if you selected [Specified Value] for [Grouping Method] (1 to 9,999; default setting: 20).

Starting Angle

Specify the angle to start numbering when the [Detection Order] setting is [Clockwise] or [Counterclockwise].

- Point** This setting is not used if the [Detection Order] is not [Clockwise] or [Counterclockwise].

Reverse Detect

Select this option to continue detection even when the image was reversed due to an image capture condition.

- **OFF** (default setting) (0): Cancel detection when the image is reversed.
- **ON** (1): Continue detection even when the image is reversed.

Detection Outside Search Region

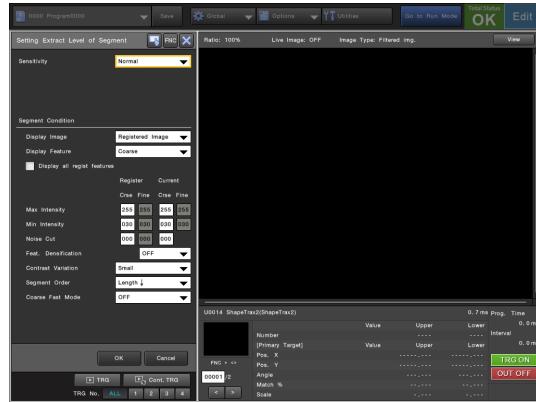
Set whether to issue a search error when the detection point strays outside the search region.

- **OFF** (default setting) (1): Continue processing even when the detection point strays outside the search region, as long as detection is possible.
- **ON** (0): Issue a search error when the detection point strays outside the search region and set all output values to 0.

- Point** The [Detection Outside Search Region] option is not effective when the pattern region strays outside the search region.

Edge Feature

Set detailed conditions for the edge detection of the registered image and the current image. High-precision measurement is made possible by making sure that edge information can be properly extracted from the registered image and the current image. ShapeTrax2 runs a coarse search using a compressed image and pattern model to quickly detect the approximate position, and then uses a fine search to detect the precise position. Set the specific feature detection conditions for the coarse and fine search independently here.



Sensitivity

Priority can be given to search speed or stability by changing the reduction rate of the image and features. The image reduction rate is the compression of the current image being used or the registered image and the feature reduction rate is the compression of features extracted from the current image or the registered image.

- **Low** (4): Select this to prioritize search speed.
- **Normal** (default setting) (5): Select this during normal operation.
- **High** (6): Select this to prioritize stability.
- **Custom** (1): if none of the above settings provide stability, use this setting to adjust the reduction rate of each item.
 - **Coarse Image Reduction**: 0 (small reduction rate) to 10 (large reduction rate) (default: 4)
 - **Coarse Feature Reduction**: 0 (small reduction rate) to 10 (large reduction rate) (default: 4)
 - **Fine Image Reduction**: 0 (small reduction rate) to 10 (large reduction rate) (default: 0)

- Point**
- Setting all of the reduction rates to [0 (smallest)] will drastically increase processing time, and will not necessarily improve search accuracy.
 - If the fine reduction rate is set high, the change in match % may also be large.
 - If the reduction rate is set high, features in the mask area may be extracted.
 - You cannot specify a value for [Fine Image Reduction] that is larger than [Coarse Image Reduction].
 - If the size of the image that is the target of measurement is large, the features may deviate from the actual edge, even if [Large Area Search] is disabled or the degree of reduction is set to a low value, and may be coarsely displayed.

Segment Condition

Display Image

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Display Feature

Select the features you want to display.

- **Fine:** Displays the features used for a fine search.
- **Coarse:** Displays the features used for a coarse search.

Display all registered features

Select [ON] to display all features that meet the registered feature detection conditions. Registered features are displayed as green lines. Features that meet the detection conditions are displayed as pink points.

Registered Features

To allow only special features of the target to be extracted as edges, apply settings while confirming them on the displayed image of the screen. Set values for the coarse features and fine features of the registered image respectively.

- **Max Intensity:** Set the upper limit (1 to 255) of the edge intensity (intensity change) of the edge to be detected (default: 255).
- **Min Intensity:** Set the lower limit (1 to 255) of the edge intensity (intensity change) of the edge to be detected (default: 30).
- **Noise Cut:** Set the strength of noise reduction during edge detection (0: Weak - 200: Strong) (default: 0).

Current Features

To allow only special features of the target to be extracted as edges, apply settings while confirming them on the displayed image of the screen. Set values for the coarse features and fine features of the current image respectively.

- **Max Intensity:** Set the upper limit (1 to 255) of the edge intensity (intensity change) of the edge to be detected (default: 255).
- **Min Intensity:** Set the lower limit (1 to 255) of the edge intensity (intensity change) of the edge to be detected (default: 30).
- **Noise Cut** (Coarse segment only): Set the strength of noise reduction during edge detection (0: Weak - 200: Strong) (default: 0).

Feat. Densification

If you wish to capture and search even finer features, select [High]. The higher the value, the slower the search speed.

Contrast Variation

Select the contrast variation of the search target.

- **Small** (default): Set this when the contrast variation between the search target and the registered image is small.
- **Large:** Set this when the contrast variation between the search target and the registered image is large. For example, searching can be expected to increase stability when working with an image of minimal contrast compared to that of the registered image. However, selecting [Small] will usually result in reduced processing time.

Segment Order

Select the priority in the selection of registered features.

- **Length ↑:** Set this to give priority to registered features with short edges. When searching a target composed of multiple short edge information such as letters, select [Length ↑].
- **Length ↓** (default): Set this to give priority to registered features with long edges.

Coarse Fast Mode

Use this option to make the processing even faster.

- **OFF** (default): Do not make the processing faster.
- **ON:** Increase the processing speed by reducing the resolution of features used in the coarse search. A reduction in stability is possible compared to that when [OFF] is selected.



Selecting [ON] may result in increased processing time, depending on other settings and the state of the current image.

Large Area Search

Select when setting a large area for the pattern region and search region.

- **OFF** (default setting): Large Area Search is not used.
- **ON:** Use Large Area Search mode. If the width or height of the region size is 2,432 pixels or 2,050 pixels or more respectively, Large Area Search needs to be enabled.



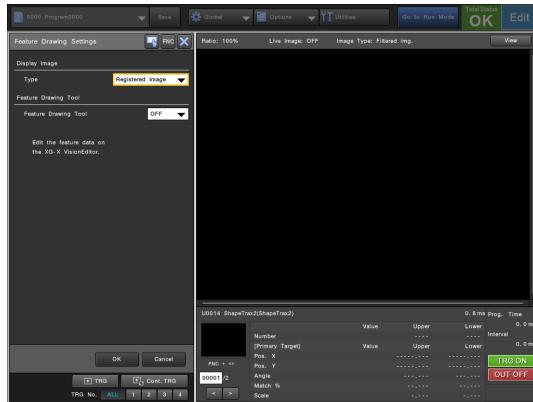
- Only displayed when the 21 megapixel camera (21 megapixel mode), line scan camera, or LJ-V Series sensor head are being used.
- When Large Area Search mode is enabled, the minimum setting for the rough search and detailed search reduction rates (Page 2-71) is limited to four.

Draw Feature

Features that are necessary for pattern detection can be directly drawn and edited (Feature Drawing Tool). With this tool, even if you cannot extract the appropriate features from an image well, such as in the cases below, highly accurate ShapeTrax2 measurement is possible.

- The detection targets are close to each other and features cannot be extracted well
- Unnecessary features are extracted due to background shadows, or saturation and shadows due to lighting.
- Detection targets for which features cannot be extracted well due to shading are close to each other.

 **Point** You can only edit feature data on XG-X VisionEditor.



Display Image

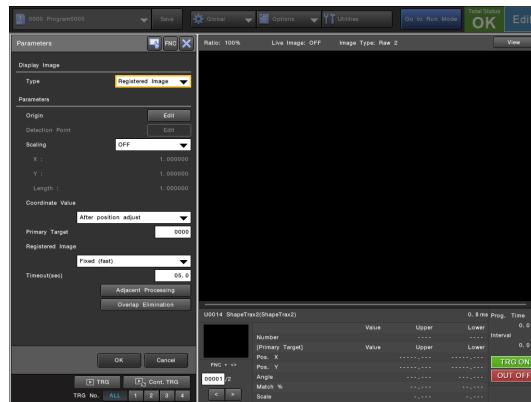
Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Specify other conditions for the ShapeTrax2 tool as required.



Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

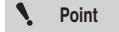
By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

 **Reference** The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Detection Point

Change the position of the detection point.

- Specified Point** (default setting): Set the detection point by using X and Y offset values to specify coordinates based on the center of the specified pattern region. To set the offset (shift) for the detection point, select [Edit] and then specify the offset value with a numerical value or variable.
- Center Of Gravity:** Set the detection point to be the center of gravity for the group of registered edges in relation to the registered image. Since the detection point is determined based on the group of registered edges in the registered image, the positional relationship between the detection point and a search target is almost constant regardless of the pattern region setting. This option is useful because as long as the registered edges are extracted properly, the detection point will be in almost the same position regardless of the registered location of the target in the pattern region.

 **Point**

- The origin of the offset is the center of the pattern region.
- If pattern region is not set, you cannot set offset.

Scaling

The controller processes image data in pixels internally. However, you can convert the result data and setting parameters used for on-screen display, judgment, and calculation to the desired units, such as actual dimension values. (This process is called "scaling".)

- **OFF:** Do not use scaling.
- **ON:** Use scaling.

Reference

- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, see "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate Value

Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- **After position adjust** (default setting): The inspection uses the adjusted coordinate axes determined after position adjustment.
- **Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Primary Target

Specify the pass/fail judgment target from the multiple patterns detected. While you can set the value from 0 to 1999, normally set it to [0].

Point

Only the one pattern set here is the target of a check of pass/fail conditions (excluding the measurement of the count).

Registered Image

Select the operation for determining the speed of this unit.

- **Fixed (fast)** (default setting): Use the processing memory to speed up processing. In this mode, variables cannot be assigned for pattern region settings, color extraction, or image enhancement.
- **Updated each process (slow):** While processing time increases as the image memory is used to recalculate image reference information for each measurement, variables can be used and referenced for the registered image and for pattern region settings, color extraction, and image enhancement.
- **User updated (fast):** By using both processing memory and image memory, processing is faster than the [Updated each process (slow)] setting while supporting the use of variables. Parameter changes related to pattern registration due to use of variables are applied to image processing by issuing the recalculation command for the image reference information (RU) at the desired time. For more details, see the XG-X2000 Series Communications Control Manual.

Point

- Parameters related to image reference information include pattern region, color extraction, image enhancement, and detection conditions (angle range, search sensitivity, and search accuracy).
- Even if [User updated (fast)] is selected, changes in settings made via the Region menu (Page 2-473), Color menu (Page 2-483) and Edit Unit menu are applied without the need of the recalculation (RU) command. (The recalculation of the registered image information and reflection to the target unit are done immediately in the case of the Edit Unit menu, and when [OK] is selected in the case of the other menus.)
- If there is not enough memory for each operation, a setting error occurs.
- You cannot select [Fixed (fast)] in the following cases:
 - When variables are used in the settings below:
Pattern region, color extraction, height extraction, and image enhancement
Setting Extract Level of Segment menu:
Reduction rate, registered feature, feature densification, segment order
Condition menu: Angle range, scale range, reverse detection
Parameters: Detection point offset
 - When one of the Shading Correction, Scratch Defect Extraction, or Noise Isolation filters is set and when one of the following cases is true:
 - Variables are used in the search region.
 - An image region is set.
 - When the registered image is referenced from an image variable
 - When [Real time extraction] is set for [Height extraction] and when one of the following cases is true:
 - Variables are used in the search region.
 - An image region is set.
- In such cases, cancel the assignment of the variable and then change the setting.
- If the captured image size from any camera exceeds 26214400 pixels, it is not possible to set [Updated each process (slow)] for high speed mode.
- If you use the Feature Drawing Tool, it is not possible to set [Updated each process (slow)] or [User updated (fast)].

Timeout

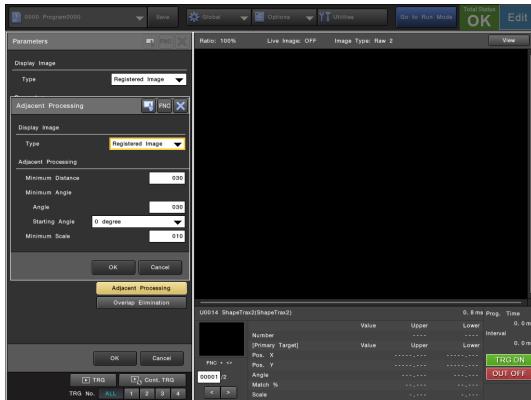
Set a maximum processing time. When the processing time for a given single unit exceeds the limit set for it (0.5 to 60 seconds, default setting: 5 seconds) due to the state of the current image, the unit will return a timeout error and all outputs will be set to 0.

Point

The setting value is an aim. There may be some errors until the actual timeout occurs.

Adjacent Processing

When there are several search results for the detection of a single pattern, specify conditions to exclude the candidates near the center of the circumscribed rectangle of the registered feature by setting the "distance", "angle", and "scale" ranges between detection points to exclude candidates. The candidates which satisfy the AND condition of these settings are excluded.

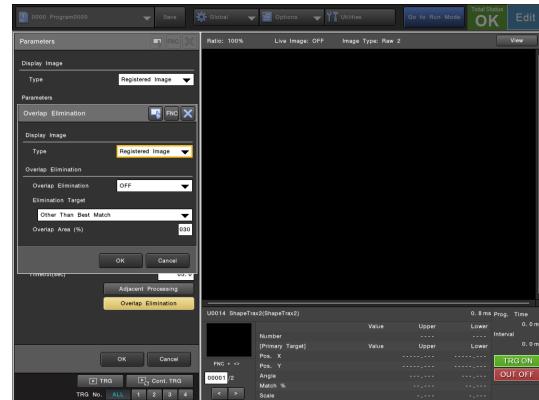


By excluding more candidates, you may improve the detection by avoiding repeated detection of one target or preventing erroneous detection of nearby similar targets. Note, however, that this may prevent proper detection when targets are located in close proximity during multiple target detection.

- **Minimum Distance:** Specify the range to exclude detection candidates using the distance (number of pixels) from the center of the circumscribed rectangle of the registered feature (Fine).
- **Minimum Angle:**
 - **Angle:** Specify the angle range to exclude detection candidates with the angle of the detection target (starting angle) as center.
 - **Starting Angle:** Select the reference angle to exclude adjacent candidates by setting the angle of the detection target as 0 degrees. To exclude the case where reversed patterns are erroneously detected, select [0/180 degree]. This excludes candidates located at around 0 degrees or 180 degrees (this means reversed images) from the angle of the detection target, while patterns appearing at intersecting angles (such as 90 degrees) remain as candidates.
- **Minimum Scale:** Specify the range to exclude detection candidates using a scale (%) based on the detection target.

Overlap Elimination

If multiple search results overlap on the detection target, candidates are omitted by the degree in which the area of the detection candidates overlap.

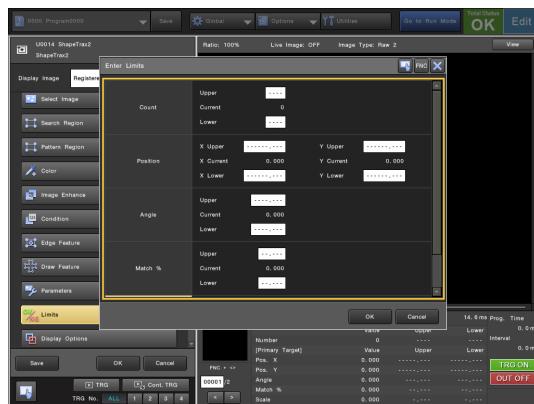


- **Overlap Elimination:** Select [ON] to use overlap elimination.
- **Elimination Target:** If multiple search results overlap on the detection target, specify the basis of omission from detection candidates.
 - **Other Than Best Match:** Of the multiple candidates that overlap, the candidate with the highest match percentage is left behind.
 - **All:** If multiple candidates overlap, all candidates are omitted.
- **Overlap Area (%):** Specify the extent of overlap of the areas of the detected candidates that is to serve as the criterion for elimination from the detected candidates when multiple search results overlap on the detection target.

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the measurement result of the tolerance judgment target is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.

Reference

- [----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Count

Specify the tolerance for the pattern detection count.

The measurement value is the number of detected patterns.

Position

Specify the tolerance for the coordinates of the detected pattern.

The measurement value is the number of pixels indicating position.

Angle

Specify the tolerance for the tilt angle of the pattern.

The measurement value is an angle in degrees.

Match %

Specify the tolerance for the correlation value of the pattern. The measurement value is a numerical value in the range of 0 to 99.999.

Scale

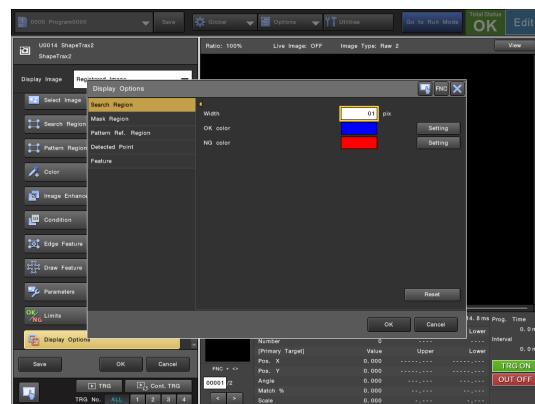
Specify the tolerance for the scale of the pattern.

The measurement value is a numerical value in the range of 0 to 9.999.

Display Options

Specify the display methods for things such as the search and mask regions.

You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Search region

Specify the line thickness and display color of the search region.

Mask region

Specify the line thickness and display color of the mask region.

Pattern Ref. Region

Specify the line thickness and display color of the pattern region.

Detected Point

Primary Target

Specify the thickness and display color of the detected pattern region and detection point (center of the pattern region) for the detected pattern.

Point When the detection point offset has been set, the detected point shifts according to the offset value.

Other target

Specify the thickness and display color of the detected pattern region and detection point (center of the pattern region) for detected patterns not specified in [Primary Target].

Point When the detection point offset has been set, the detected point shifts according to the offset value.

Target No. Display

Specify the size and enables or disables the target number display.

Feature

Specify how to display the feature points displayed for [Filtered image] and [Contrast image].

Pattern region

To hide the display of the pattern region, select [OFF] (default setting: ON).

Trained feature

Select what to display for registered features.

- OFF: Do not display the registered features.
- Fine segment (default setting): Display fine features.
- Coarse segment: Display coarse features.

Run feature

Select features to be displayed in the search region of the current image.

- OFF (default setting): Do not display detected edge points.
- Fine segment: Display fine features.
- Coarse segment: Display coarse features.

 **Point** Setting [Trained Feature] or [Run Feature] to a value other than [OFF] consumes the program memory. Check the amount of remaining program memory before enabling this setting.

Detailed display

Select whether to display feature points in high-definition for high pixel images captured with the 21 megapixel camera (21 megapixel mode) or line scan camera that exceed five megapixels.

- OFF: Display feature points in low-resolution.
- ON: Display feature points in high-definition.

 **Point**

- The default setting is [ON] when the detection point offset is set and the connected camera is a 21 megapixel camera (21 megapixel mode) or line scan camera; in all other cases, the default setting is [OFF].
- The [Detailed display] setting is enabled only for images that exceed five megapixels.
- Setting [Run Feature] to a value other than [OFF] and setting [Detailed display] to [ON] consumes even more program memory.

Reset

Restores the display options to their default settings.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

PatternTrax

PatternTrax Tool

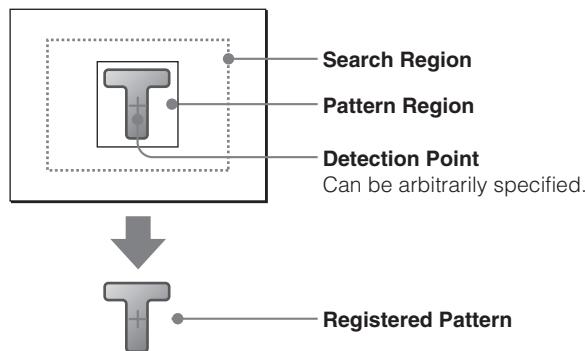
It searches for similar parts using tone information that fluctuates around the boundary of image patterns that are pre-registered and outputs the detected target's position, inclination, and match result. Since targets are searched for by means of the tone information change around the boundary of image patterns, the measurement target is tracked even if there is a flaw, overlapping, or the surface state changes.



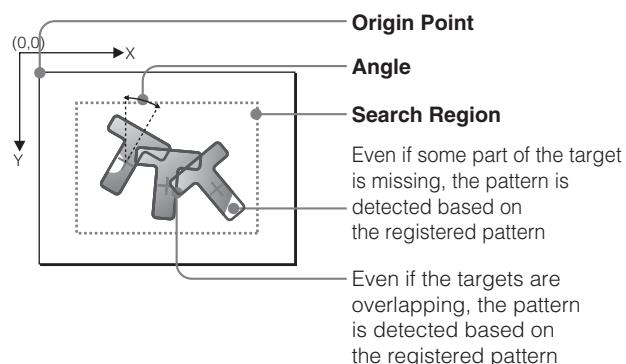
- There are restrictions due to processing memory capacity. In PatternTrax measurement, processing capacity is consumed in order to register image patterns. As the processing capacity is shared amongst the units within 1 program, resources for all units including PatternTrax must fit into this device's processing memory. The amount of processing memory used is displayed as [Processing capacity] while configuring region and image enhancement settings, and configuration may not be possible if the value nears 100%.
- Processing time may change depending on the state of the captured image. If there is an issue with processing time fluctuations, we recommend that you configure the timeout settings (Page 2-85) and check the actual line.

Measurement Overview

When a pattern is registered



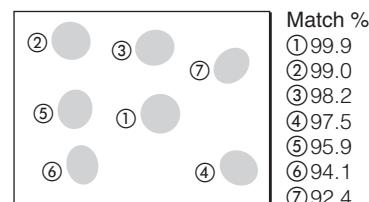
When the system is in operation



The detected patterns are managed with label numbers

There are 16 types of ways to apply label numbers as shown below.

- X: Ascend
- X: Descend
- Y: Ascend
- Y: Descend
- Match%: Ascend
- Match%: Descend



- Clockwise
- Counter Clockwise
- From Upper Left (Rightward)
- From Upper Left (Downward)
- From Upper Right (Leftward)
- From Upper Right (Downward)
- From Lower Left (Rightward)
- From Lower Left (Upward)
- From Lower Right (Leftward)
- From Lower Right (Upward)

To select a different order, see "Detection Order" (Page 2-82).

Main measurement results

The standard results and data returned by PatternTrax tool are as follows:

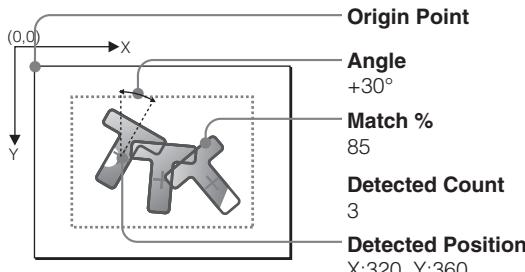
Count	Outputs the number of detected patterns. [Tolerance inspection target]
Detected point (X, Y) []	All the detected pattern position coordinates are output by pixel count. [Tolerance inspection target] [Label specification target]
Angle []	All angle deviations between the registered pattern and detected pattern are output. Deviations in the clockwise direction are represented by a plus (+) sign and counter clockwise deviations with a minus (-) sign. [Tolerance inspection target] [Label specification target]
Correlation Value % []	Outputs the similarity level between the pattern detected within the search region and the registered pattern using a numerical value in the range of 0 to 99.999. [Tolerance inspection target] [Label specification target]
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper/lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

Reference For the lists of available measurement output values and setting parameters, see "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

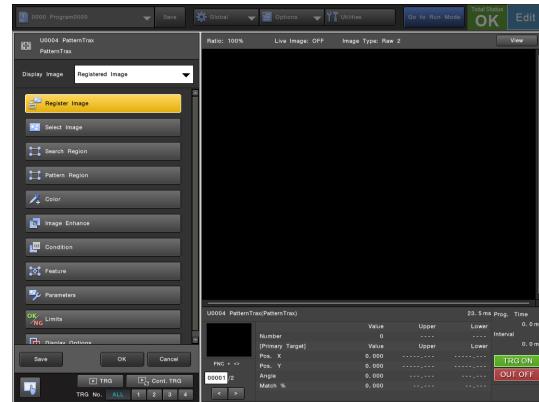
Example showing the results of a measurement performed under the following conditions:

- Detection order: From Upper Left (Downward)
- Primary Target: 0



Top Menu

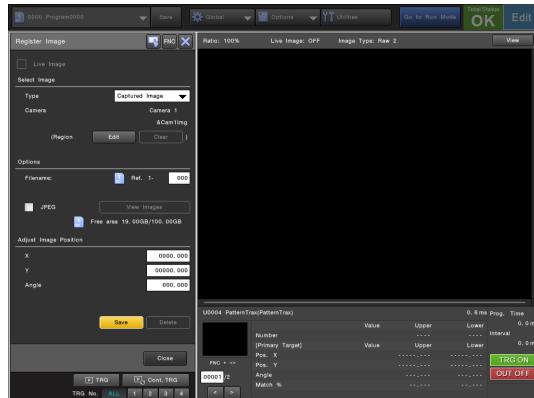
The top menu of the PatternTrax tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-80)	Register an image to be used as a template for settings.
Select Image (Page 2-80)	Specify the captured image and registered image to use for measurement.
Search Region (Page 2-80)	Set a detection range (search region) in the image to search for the model registered in the pattern region.
Pattern Region (Page 2-80)	Register the image of the model that you want to detect as a [Pattern Region].
Color (Page 2-81)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-81)	Specify the filter processing to apply to the image.
Condition (Page 2-81)	Specify the conditions to detect patterns during measurement.
Feature (Page 2-83)	Specify the conditions to detect the boundaries of registered and captured images.
Parameters (Page 2-84)	Specify other conditions for the PatternTrax tool as required.
Limits (Page 2-86)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-87)	Specify the display methods for things such as the search and mask regions.
Save (Page 2-87)	Save the current state to the program file.

Register Image

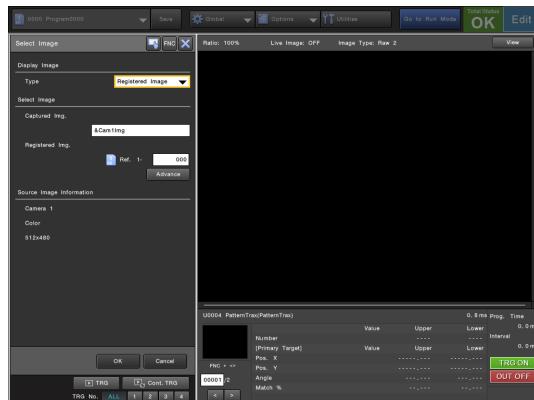
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

Specify the captured image and registered image to use for measurement.



For more details, see "Select Image" (Page 2-471).

Search Region

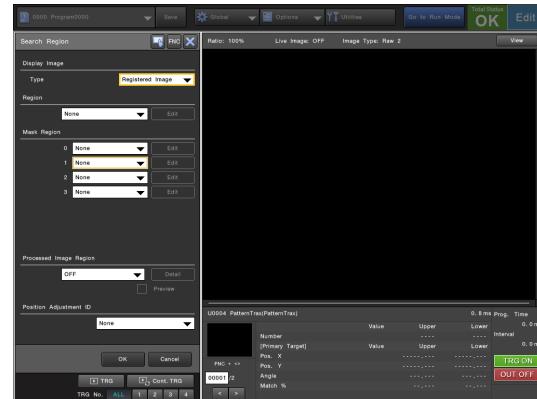
Set a detection range (search region) in the image to search for the model registered in the pattern region (Page 2-80).

Reference

The smaller the search region, the shorter the processing time.

Point

If the width or height of the region size is 2,432 pixels or 2,050 pixels or more respectively, [Large Area Search] (Page 2-84) needs to be enabled.



For more details, see "Region Settings" (Page 2-473).

Pattern Region

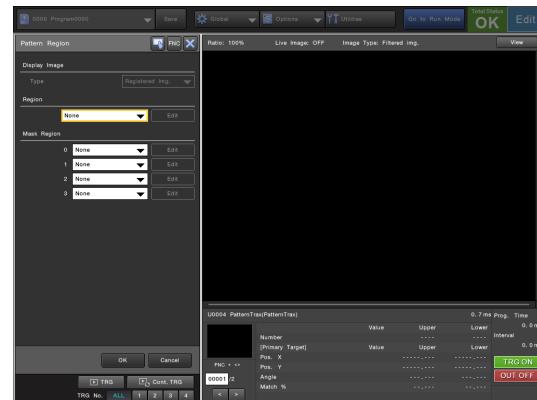
Register the image of the model that you want to detect as a [Pattern Region].

Reference

If the pattern region has a complicated shape, you can set a mask region later to hide the unwanted parts. You can also use [Multiple Area] as one of the mask regions for the PatternTrax pattern region.

Point

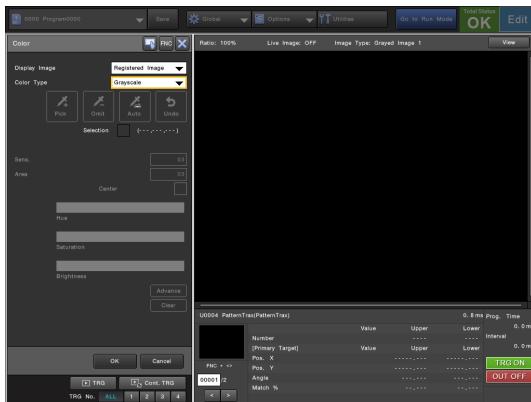
If the width or height of the region size is 2,432 pixels or 2,050 pixels or more respectively, [Large Area Search] (Page 2-84) needs to be enabled.



For more details, see "Region Settings" (Page 2-473).

Color

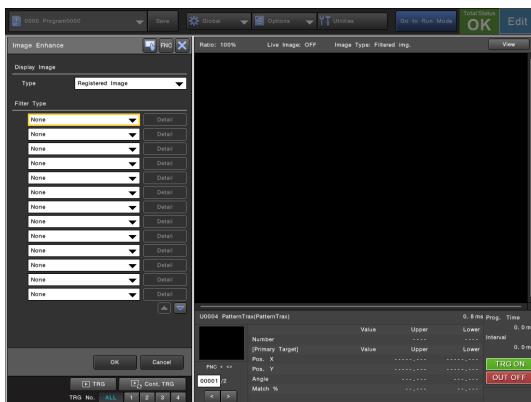
When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.



For more details, see "Color Extraction" (Page 2-483).

Image Enhance

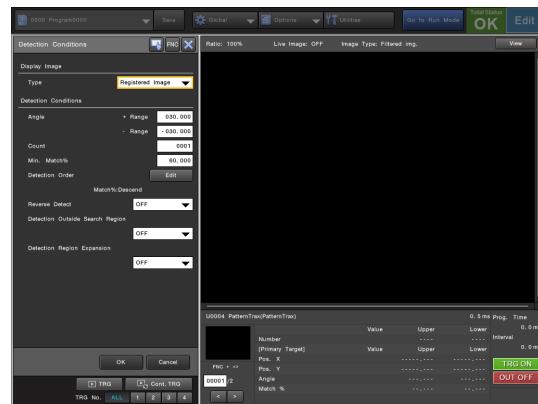
Specify the filter processing to apply to the image.



For more details, see "Image Enhance" (Page 2-489).

Condition

Specify the conditions to detect patterns during measurement.



Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Detection Conditions

Angle

When a pattern is rotated, specify the angle to be measured in the range between -179.999° and 180.000° .

- Select [+ Range] (clockwise rotation) and set the maximum range of the angle to be measured (default setting: +30).
- Select [- Range] (counter-clockwise rotation) and set the maximum range of the angle to be measured (default setting: -30).

Count

Specifies the maximum number of patterns to detect within the range of 1 to 2000 for PatternTrax measurement (default setting: 1). For example, if you specify [3], the maximum number of pattern positions that will be detected is 3.



Point Even if there is only one detection target, by setting the [Count] to a higher count, internal search processing increases and as a result, detections may be stable.

Min. Match %

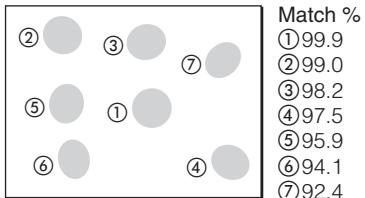
Specify the minimum match value for measurement detection candidates. (default setting:60.000). This option is useful when you want to prevent erroneous detections. For example, if [Min. Match%] is set to 80%, only those patterns having a correlation value of 80% or more are actually processed.

Detection Order

Select [Edit] and set the detection order specification method.

- **Detection Order:** Specify the identification order of the detected patterns.

- X: Ascend
- X: Descend
- Y: Ascend
- Y: Descend
- Match%: Ascend
- Match%: Descend (default setting) : Order from highest to lowest match result.



- Clockwise
- Counterclockwise
- From Upper Left (Rightward)
- From Upper Left (Downward)
- From Upper Right (Leftward)
- From Upper Right (Downward)
- From Lower Left (Rightward)
- From Lower Left (Upward)
- From Lower Right (Leftward)
- From Lower Right (Upward)
- **Starting Angle:** Specifies the angle that is the numbering start position if you selected [Clockwise] or [Counterclockwise] for [Detection Order] (default setting: 0.000).

- **Grouping Method:** Specifies the range for considering detected points as being on the same row or column when sorting using detection order if you selected [From Upper Left (Rightward)], [From Upper Left (Downward)], [From Upper Right (Leftward)], [From Upper Right (Downward)], [From Lower Left (Rightward)], [From Lower Left (Upward)], [From Lower Right (Leftward)], or [From Lower Right (Upward)] for [Detection Order].

- **Pattern Length (Long Side)** (default setting): Uses in the XY direction the length of the long side of the pattern region's bounding rectangle as the range for considering detected points as being on the same row or column.

- **Pattern Length (XY Individual)**: When the range for considering detected points as being on the same row is required, uses the vertical side length of the pattern region's bounding rectangle. In turn, when the range for considering detected points as being on the same column is required, uses the horizontal side length of the pattern region's bounding rectangle.

- **Specified Value:** Specifies the range for considering detected points as being on the same row or column in pixels.

- **Grouping Range (Pixel):** Specifies the range in pixels if you selected [Specified Value] for [Grouping Method] (1 to 9,999; default setting: 20).

Point If the [Detection Order] is something other than [Clockwise] or [Counterclockwise], the [Starting Angle] setting is not used.

Reverse Detect

Select this option to continue detection even when the image was reversed due to an image capture condition.

- **OFF** (default setting): Cancel detection when the image is reversed.
- **ON:** Continue detection even when the image is reversed.

Detection Outside Search Region

Set whether to issue a search error when the detection point strays outside the search region.

- **OFF** (default setting): Continue processing even when the detection point strays outside the search region, as long as detection is possible.
- **ON:** Issue a search error when the detection point strays outside the search region and set all output values to 0.

Point The [Detection Outside Search Region] option is not effective when the pattern region strays outside the search region.

Detection Region Expansion

If the detection point is in the search region, it sets registered patterns that are outside of the search region as search targets as well.

- **OFF** (default setting) (0): The detection point is excluded from the search if it is outside of the search region.
- **ON** (1): Searches even for targets which are, when compared to the registered pattern, halfway outside of the search region as long as the detection point is within the search region.

Feature

Specifies the conditions to detect the boundaries of registered and captured images. Highly accurate measurements are made possible by setting to accurately detect boundaries of registered and captured images. In PatternTrax, after executing a coarse feature search that uses a scaled-down image and its pattern model to roughly and quickly detect the position, a fine feature search accurately detects the position.

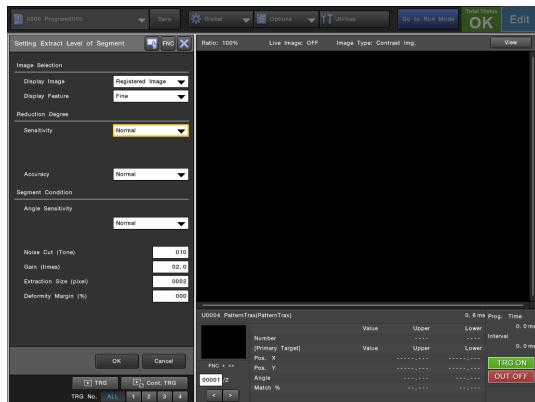


Image Selection

Display Image

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Display Feature

Select the features you want to display.

- Fine**(default setting): Displays the fine features to be used in a fine feature search.
- Coarse**: Displays the coarse features to be used in a coarse feature search.

Reduction Degree

Sensitivity

Priority can be given to search speed or stability by changing the reduction rate of the image and features.

- Low** Select this to prioritize search speed.
- Normal** (default setting): Select this during normal operation.
- High**: Select this to prioritize stability.
- Custom**: if none of the above settings provide stability, use this setting to adjust the reduction rate of each item.
 - Coarse Image Reduction**:
0 (small degree of reduction) - 16 (large degree of reduction) (default setting: 8)
 - Fine Image Reduction**:
0 (small degree of reduction) - 16 (large degree of reduction) (default setting: 4)

Point

- Setting all of the reduction rates to "0 (smallest)" will drastically increase processing time, and will not necessarily improve search accuracy.
- If the fine reduction rate is set high, the change in match % may also become large.
- If the reduction rate is set high, features in the mask region may be extracted.
- You cannot specify a value for [Fine Image Reduction] that is larger than [Coarse Image Reduction].
- If the size of the image that is the target of measurement is large, the features may deviate from the actual edge, even if [Large Area Search] is disabled or the degree of reduction is set to a low value, and may be coarsely displayed.

Accuracy

Specifies the accuracy of the fine feature search.

- Low**: Select this to prioritize search speed.
- Normal** (default setting): Select this during normal operation.
- High**: Select to prioritize accuracy.
- Highest**: Select to maximally prioritize the search accuracy.

Segment Condition

Angle Sensitivity

Changes the angle step width and specifies the priority of the stability and speed of the rotation direction.

- Low** (1): Select this to prioritize search speed.
- Normal** (default setting) (2): Select this during normal operation.
- High** (3): Select to prioritize stability and accuracy of the rotation direction.
- Custom** (0): Specify the angle step width with a numerical value.

If there are many round areas in the feature and the angle detection result is not stable, increase the angle sensitivity. However, as the search is executed using a finer angle step width, the search processing time increases.

Angle Step Width (times)

If you selected [Custom] for [Angle Sensitivity], set the size of the angle step width when executing a search with a numerical value (default setting: 1.0). By reducing the size, the stability and accuracy of the rotation direction improves, but the processing time increases.

Noise Cut (Tone)

Ignores tone changes equal to or below the specified tone (default setting: 10).

If tone changes for places other than the object boundary, such as the object surface roughness, are extracted as features, increase the value. Adjust while checking the contrast image.

PatternTrax

Gain (Times)

Sets the gain to emphasize the extracted tone change (default setting: 2.0). If the tone change is small, increase the value.

Extraction Size (Pixel)

Specifies the tone change size that you wish to extract (default setting: 2). If you wish to detect gradual tone changes, increase the value.

Deformity Margin (%)

Sets the fluctuation size of the boundary that you wish to extract as a ratio of the feature extraction size (default setting: 0). If the boundary deviates in comparison to the registered pattern due to the angle of view or object tilting, increase the value.

If you increase the deformity margin, the decrease of match result against the distorted object lessens, and you can reduce the detected position bias.

Large Area Search

Select when setting a large area for the pattern region and search region.

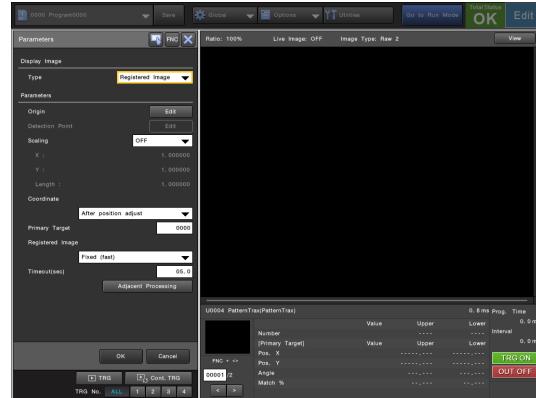
- **OFF** (default setting) (0): Does not use Large Area Search mode.
- **ON** (1): Uses Large Area Search mode. It is necessary to enable Large Area Search mode when the region size is more than 2432 pixels in width or more than 2050 pixels in height.

Point

- Only displayed when the 21 megapixel camera (21 megapixel mode), line scan camera, or LJ-V Series sensor head are being used.
- When Large Area Search mode is enabled, the minimum setting for the rough search and detailed search reduction rates (Page 2-83) is limited to four.

Parameters

Specify other conditions for the PatternTrax tool as required.



Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

Reference

The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Detection Point

Change the position of the detection point.

- **Specified Point** (default setting): The desired coordinate based on the center position of the set pattern region specified by X offset and Y offset is the detection point. If you wish to set an offset for the detection point, select [Edit] and then specify a numerical value or variable for the offset value.
- **Center Of Gravity:** The center of gravity of the set pattern region is the detection point.

Point

- The origin of the offset is the center of the pattern region.
- If pattern region is not set, you cannot set offset.

Scaling

The controller processes image data in pixels internally. However, you can convert the result data and setting parameters used for on-screen display, judgment, and calculation to the desired units, such as actual dimension values. (This process is called "scaling".)

- **OFF** (default setting): Do not use scaling.
- **ON**: Use scaling.

Reference

- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, see "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate value

Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- **After position adjust** (default setting): The inspection uses the adjusted coordinate value determined after position adjustment.
- **Before position adjust**: The distance from the position specified for the [Origin] of the inspection will be measured.

Primary Target

Specifies the unit pass/fail judgment target from the multiple patterns detected (default setting is 0). While you can set the value from 0 to 1999, normally set it to [0].

Point

Only the one pattern set here is the target of a check of pass/fail conditions (excluding the measurement count).

Registered Image

Select the operation for determining the speed of this unit.

- **Fixed (fast)** (default setting) (1): Fast processing that uses processing capacity will be performed. In this mode, variables cannot be assigned for pattern region settings, color extraction, or image enhancement.
- **Updated each process (slow)** (0): While processing time increases as the image memory is used to recalculate image reference information for each measurement, variables can be used and referenced for the registered image and for pattern region settings, color extraction, and preprocessing.

- **User updated (fast)**: By using both processing capacity and image memory, processing is faster than the [Updated each process (slow)] setting while supporting the use of variables. Parameter changes related to pattern registration due to use of variables are applied to image processing by issuing the recalculation command for the image reference information (RU) at the desired time. For more details, see the XG-X2000 Series Communications Control Manual.

Point

- Parameters related to image reference information include pattern region, color extraction, image enhancement, and detection conditions (angle range, search sensitivity, and search accuracy).
- Even if [User updated (fast)] is selected, changes in settings made via the Region menu, Color menu and Edit Unit menu are applied without the need of the recalculation (RU) command. (The recalculation of the registered image information and reflection to the target unit are done immediately in the case of the Edit Unit menu, and when [OK] is selected in the case of the other menus.)
- If there is not enough memory for each operation, a setting error occurs.
- You cannot select [Fixed (fast)] in the following cases:
 - When variables are used in the settings below; Pattern Region, Color, Height Extraction, Image Enhance Feature: Accuracy, Reduction degree, Noise Cut, Gain, Deformity Margin, Extraction Size, Angle Step Width Parameters: Detection Point Offset
 - When one of the Shading Correction, Scratch Defect Extraction, or Noise Isolation filters is set and when one of the following cases is true:
 - Variables are used in the search region.
 - An image region is set.
 - Image variable is used for registered image
 - When [Real time extraction] is set for [Height extraction] and when one of the following cases is true:
 - Variables are used in the search region.
 - An image region is set.
- In such cases, cancel the assignment of the variable and then change the setting.
- If the captured image size from any camera exceeds 26214400 pixels, it is not possible to set [Updated each process (slow)] for high speed mode.

Timeout

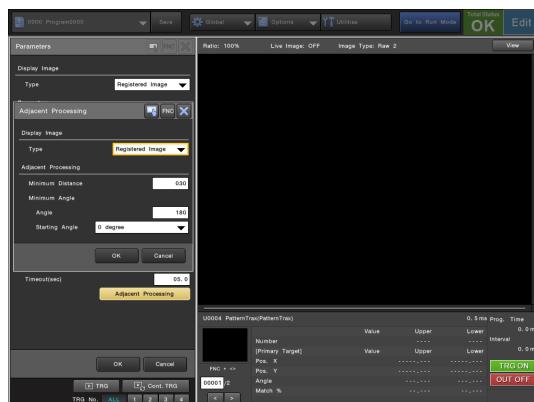
Set a maximum processing time. When the processing time for a given single unit exceeds the limit set for it (0.5 to 60 seconds, default: 5 seconds) due to the state of the current image, the unit will return a timeout error and all outputs will be set to 0.

Point

Setting values are only rough targets. There may be some errors until the actual timeout occurs.

Adjacent Processing

If search results overlap for a detection target, set the range of [Distance] and [Angle] between detection points to omit them from the candidates, and specify the conditions that omit the candidate close to the center of the registered feature's bounding rectangle. Candidates that meet the AND conditions of those settings are omitted.



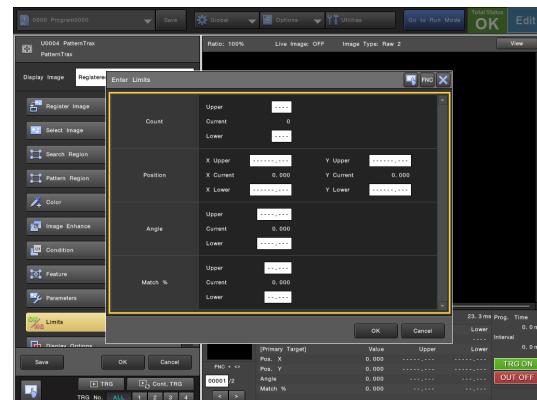
Increasing the displacement may remedy the problems of duplicate detections of one object and erroneous detections of similar objects. However, if objects are close to each other when performing multiple detections, they may not be detected correctly.

- Minimum Distance:** It specifies the range to eliminate from detection candidates with the distance (pixels) from the center of the registered feature's bounding rectangle (default setting is 30).
- Minimum Angle:**
 - Angle:** Specify the angle range to exclude detection candidates with the angle of the detection target (starting angle) as center.
 - Starting Angle:** Select the reference angle to exclude adjacent candidates by setting the angle of the detection target as 0 degrees. To exclude the case where reversed patterns are erroneously detected, select [0/180 degree]. This excludes candidates located at around 0 degrees or 180 degrees (this means reversed images) from the angle of the detection target, while patterns appearing at intersecting angles (such as 90 degrees) remain as candidates.

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.

Reference

- indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Count

It specifies the tolerance for the pattern detection count. The measurement value is the number of detected patterns.

Position

Specify the tolerance for the coordinates of the detected pattern.

The measurement value is the number of pixels indicating position.

Angle

Specify the tolerance for the angle of the pattern. The measurement value is an angle in degrees.

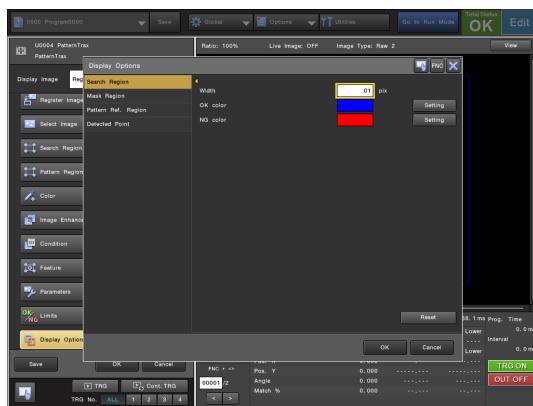
Match %

Specify the tolerance for the correlation value of the pattern. The measurement value is a numerical value in the range of 0 to 99.999%.

Display Options

Specify the display methods for things such as the search and mask regions.

You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Search region

Specify the line thickness and display color of the search region.

Mask region

Specify the line thickness and display color of the mask region.

Pattern reference region

Specify the line thickness and display color of the pattern region.

Detected Point

Primary Target

Specify the thickness and display color of the detected pattern region and detection point (center of the pattern region) for the detected pattern.

-  **Point** When the detection point offset has been set, the detected point shifts according to the offset value.

Other target

Specify the thickness and display color of the detected pattern region and detection point (center of the pattern region) for detected patterns not specified in [Primary Target].

-  **Point** When the detection point offset has been set, the detected point shifts according to the offset value.

Target No. Display

It specifies the size and enables/disables the target number display.

Detection Mark

Specify the type (None, Rotated Rectangle, Circle, and Cross) and size of the detection mark display. By setting the detection mark on the location that shows the work feature, it is easier to determine whether the detected position for the work is appropriate or not.

Reset

Restores the display options to their default settings.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

Point

- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

Edge Position

Edge Position Tool

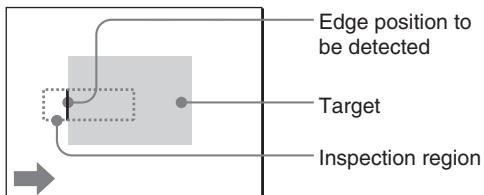
The Edge Position tool scans across a target in a user specified direction within a specified region detecting contrast changes. Based on these contrast changes (edge positions) the tool measures the position of a user specified edge.

Because edge detection is based on the transition from bright to dark (or dark to bright), not on absolute intensity values, it is less affected by changes in illumination during image capturing.

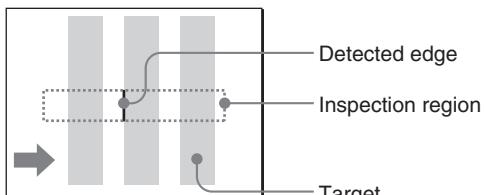
Measurement Overview

Example showing the results of an edge position inspection performed under the following conditions:

- Primary Target: 0
- Scan Direction: →
- Edge Direction: Light to Dark



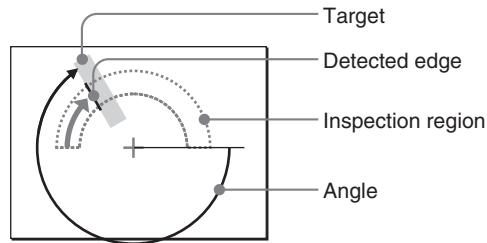
- Primary Target: 1
- Scan Direction: →
- Edge Direction: Light to Dark



When the inspection region is an arc

Example showing the results of an Edge Position inspection performed under the following conditions:

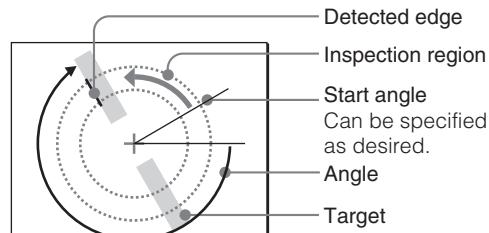
- Primary Target: 0
- Scan Direction: (Clockwise)
- Edge Direction: Light to Dark



When the inspection region is a ring

Example showing the results of an Edge Position inspection performed under the following conditions:

- Primary Target: 0
- Scan Direction: (Counterclockwise)
- Edge Direction: Dark to Light



Main measurement results

The standard results and data returned by the Edge Position tool are as follows:

 Point	Processing results may vary depending on the shape of the inspection region. The result for an item which is not processed is always 0.
--	---

When the inspection region is not a ring or an arc

Number of edges	Outputs the number of detected edges. <small>Tolerance inspection target</small>
Edge position coordinates (X, Y) []	Outputs the position coordinates of all detected edges in pixels. <small>Tolerance inspection target Label specification target</small>
Distance []	Outputs the distances from the start of the inspection region to the position coordinates of all edges in pixels. <small>Label specification target</small>
Intensity []	Outputs the intensity differential of all detected edges. <small>Label specification target</small>
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

When the inspection region is a ring or an arc

Number of edges	Outputs the number of detected edges. <small>Tolerance inspection target</small>
Edge position coordinates (X, Y) []	Outputs the position coordinates of all the intersection points between the projected lines (radial) of the detected edges and the center line (circular) of the inspection region. <small>Label specification target</small>
Angle []	Outputs the angles of all detected edges. <small>Tolerance inspection target Label specification target</small>
Distance []	Outputs the angles from the start of the inspection region to the positions of all edges. <small>Label specification target</small>
Intensity []	Outputs the maximum edge intensity differential of all detected edges. <small>Label specification target</small>
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

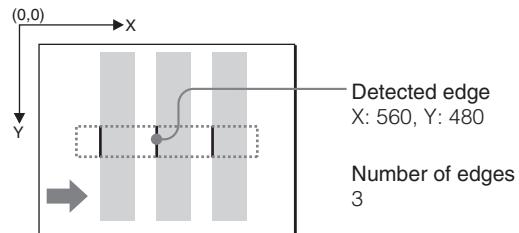
 For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

When the inspection region is a rectangle

Example showing the results of an Edge Position inspection performed under the following conditions:

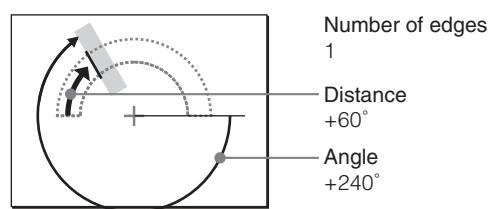
- Primary Target: 1
- Scan Direction: →
- Edge Direction: Light to Dark



When the inspection region is an arc

Example showing the results of an Edge Position inspection performed under the following conditions:

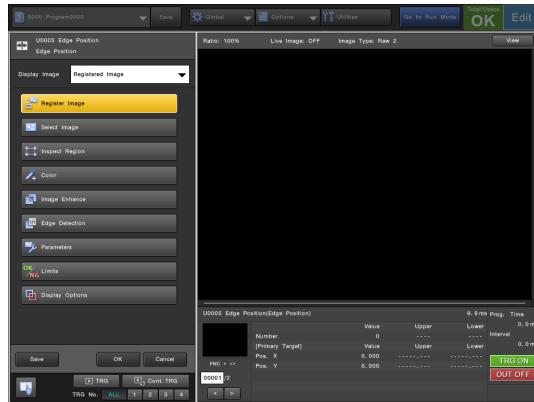
- Primary Target: 0
- Scan Direction: (Clockwise)
- Edge Direction: Light to Dark



Edge Position

Top Menu

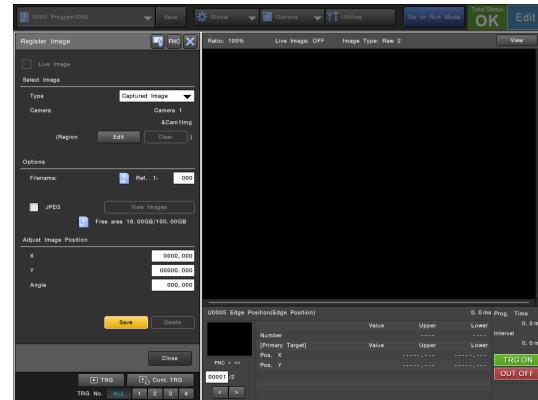
The top menu of the Edge Position tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-90)	Register an image to be used as a template for settings.
Select Image (Page 2-90)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-90)	Define the region to be used for unit processing.
Color (Page 2-91)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-91)	Specify the filter processing to apply to the image.
Edge Detection (Page 2-91)	Specify the scan direction and edge direction for detecting edges, as well as other detailed conditions for edge detection.
Parameters (Page 2-92)	Specify other conditions for the Edge Position tool as required.
Limits (Page 2-93)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-94)	Specify the display methods for things such as the inspection region and mask region.
Save (Page 2-94)	Save the current state to the program file.

Register Image

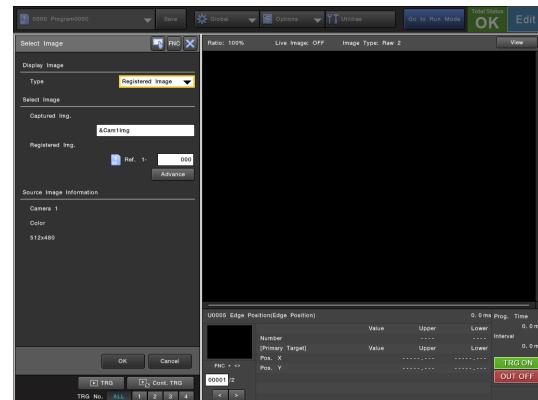
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

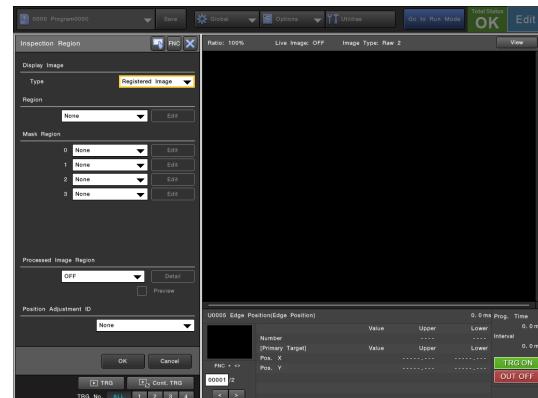
Specify the captured image and registered image to use for measurement.



For more details, see "Select Image" (Page 2-471).

Inspect Region

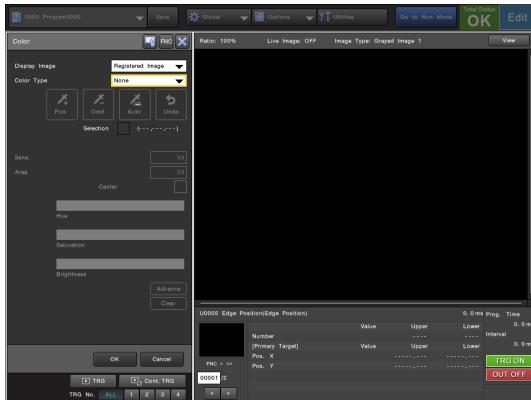
Define the region to be used for unit processing.



For more details, see "Region Settings" (Page 2-473).

Color

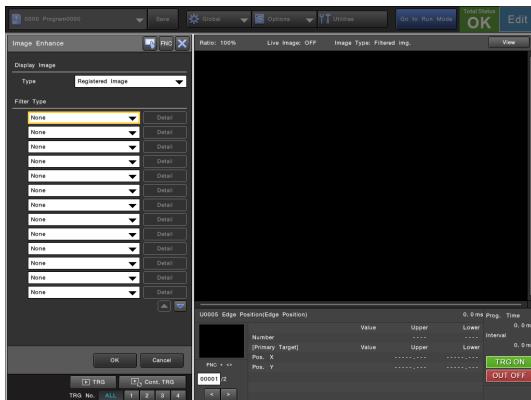
When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.



For more details, see "Color Extraction" (Page 2-483).

Image Enhance

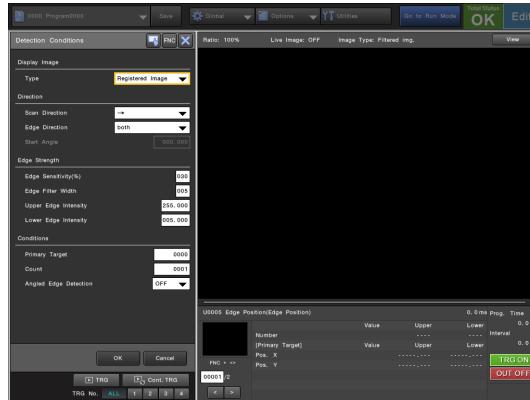
Specify the filter processing to apply to the image.



For more details, see "Image Enhance" (Page 2-489).

Edge Detection

Specify the scan direction and edge direction for detecting edges, as well as other detailed conditions for edge detection.



Reference

Refer to "What is an Edge?" (Page 2-95) for the technical description of edge detection.

Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Direction

Scan Direction

Select the scan direction to detect an edge.

- When the inspection region is a rectangle, circle, oval, polygon or composition:** →, ←, ↑, ↓
- When the inspection region is a rotated rectangle:** Forward or reverse with respect to the horizontal axis (X axis) of the region Since the scan direction depends on the rotation angle of the inspection region, this should be taken into consideration when selecting this option.
- When the inspection region is a ring or an arc:** Clockwise, Counterclockwise

Edge Direction

Select the change in contrast for detecting an edge.

- Light to Dark:** Detect edges in a transition that changes from a bright area to a dark area.
- Dark to Light:** Detect edges in a transition that changes from a dark area to a bright area.
- both** (default): Detect edges in a transition that can change either from a bright area to a dark area or from a dark area to a bright area.

Start Angle

When [Ring] is selected for the inspection region, specify a position to start the edge scan. The setting range is 0° to 359.999°.

Point

If the start angle is changed, the detection angle will be calculated with reference to the 3 o'clock position being 0°.

Edge Position

Edge Strength

Edge Sensitivity (%)

Set the percentage threshold (0% to 100%) for detecting edges.

Edge Filter Width

Set the width (0 to 100 pixels) of the smoothing filter applied to the differential graph for detecting edges.

Upper Edge Intensity

Specify the upper limit (0.000 to 255.000) of edge intensity for detecting edges.

Lower Edge Intensity

Specify the lower limit (0.000 to 255.000) of edge intensity for detecting edges.

Reference Unwanted edges can be excluded from detection by adjusting the upper and lower edge intensity values referring the highest edge intensity in the region (shown on the left of the edge graph). See "What is an Edge?" (Page 2-95) for more details.

Conditions

Primary Target

Specify the edge number (0 through 3599) to be used as the primary target for judgment from the detected patterns. Edge numbers are assigned in order based on the scan direction. (If the primary target is not found the detected point position defaults to 0).

Count

Specify the maximum number of edges (1 to 3600) to be detected.

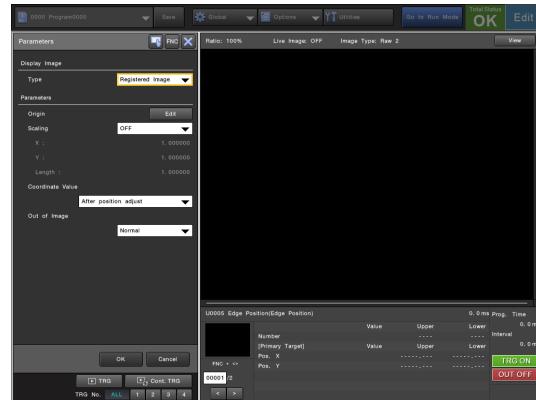
Point The maximum number of edges available for detection can change based on other settings.

Angled Edge Detection

Set to [ON] to stabilize the detection of slanted edges in the inspection region. Using this option may affect the edge X, Y position accuracy.

Parameters

Specify other conditions for the Edge Position tool as required.



Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

Reference The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels. The result data and setting parameters used for display, judgment and calculations can be converted and scaled to real life values and dimensions by using the pre-set scaling factor option.

- **OFF:** Do not use scaling.
- **ON:** Use scaling.

Reference The scaling value can be changed in the [Options] menu (Page 4-18).

- For a summary list of the result data for which scaling can be used, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate Value

Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- **After position adjust:** The inspection uses the adjusted coordinate axes determined after position adjustment.
- **Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Out of Image

Specify whether to incorporate data that falls outside of the inspection region. This maybe required when position adjustment is used.

- **Normal** (default): Edge detection outside of the region is disabled as the image data outside of the region is masked. Since masking requires time to process, the inspection time may vary depending on the quantity image data outside the region. Processing will take longer when the inspection region is a ring or an arc.
- **Fast:** The image data outside of the region is not masked, allowing for faster processing. As the image data outside the region has not been masked so there is an increased chance of detecting an edge outside the region. Select [Normal] to avoid incorrect edge detection.

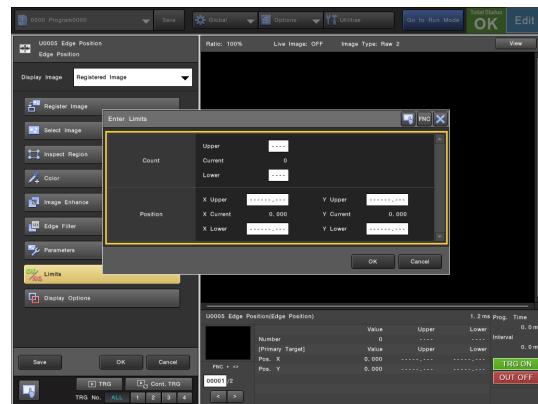


Image data which is already located outside of the region during the inspection region setting will always be masked regardless of the [Out of Image] setting.

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.



- [----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Count

Specify the tolerance for the detected edge count.

The unit of measurement is the "number of edges" detected.

Position

Specify the tolerance for the position of the detected edge (primary target) (When the inspection region is not a ring or an arc).

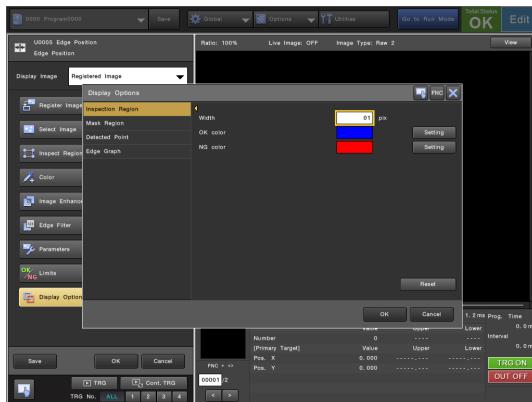
The unit of measurement is the "number of pixels" indicating

Edge Position

Display Options

Specify the display methods for things such as the inspection and mask regions, and detected edges and edge graph.

You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection region

Specify the line width and display color of the inspection region.

Mask region

Specify the line width and display color of the mask region.

Detect Point

Primary target

Specify the width and display color of the line indicating the detected edge.

Other target

Specify the width and display color of the line indicating the detected edge other than the one specified as the primary target (Page 2-92).

Edge graph

Edge graph

Select whether to display the edge graph.

- **ON:** Show the edge graph.
- **OFF:** Hide the edge graph.

Wave

Specify the width and display color of the edge graph waveform.

Frame

Specify the width and display color of the edge graph frame.

Sensitivity reference line

Specify the width and display color of the line representing the edge sensitivity threshold.



Point

Setting [Edge graph] to [ON] consumes additional program memory. Check the amount of remaining program memory before enabling.

Reset

Returns the display options to their defaults.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



Point

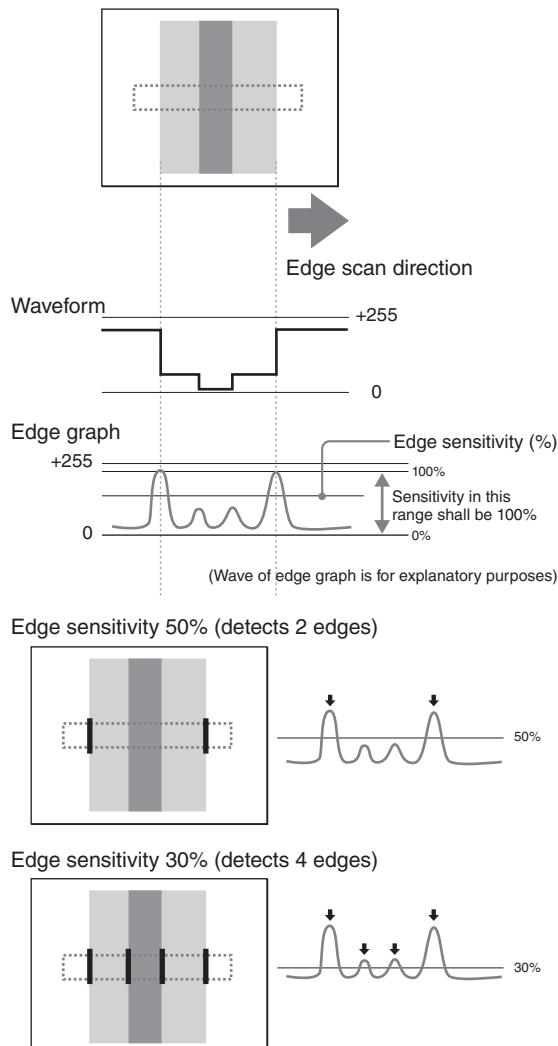
- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

What is an Edge?

In this system edge processing is used to detect transitional changes of a target in an inspection region for positioning or measurement. Edge detection is performed based on the change of intensity in the region perpendicular to the edge scan direction. The amount of change detected is known as the edge intensity.

Edge sensitivity

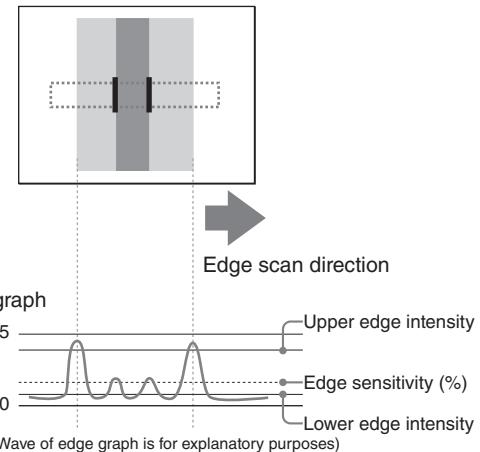
Edge sensitivity refers to the level of intensity that is detected as an edge, where 100% represents the maximum edge intensity in the region. By specifying the edge sensitivity in relation to the maximum edge intensity in the region edge detection is very stable and robust against fluctuations in illumination.



Edge intensity upper and lower limit

For increased functionality edges can be filtered out based on their edge intensity value. The maximum edge intensity serves as an upper limit and the minimum edge intensity serves as a lower limit.

Only the edges that lie between the upper and lower limit will be detected. Any edge outside this range will be ignored.



Differences between edge sensitivity and edge intensity upper / lower limits

While the edge sensitivity is specified using a relative value with a maximum edge intensity of 100%, the upper limit and lower limit of edge intensity are specified using an absolute value of the edge intensity.



Edges excluded from detection due to the edge intensity upper limit are also excluded from the edge sensitivity calculation. Thus, if the edge intensity upper limit is changed, the edge detection result may also change.

Checking edges

The maximum edge intensity within the inspection region can be checked with the numeric values displayed next to the edge graph in the screen.

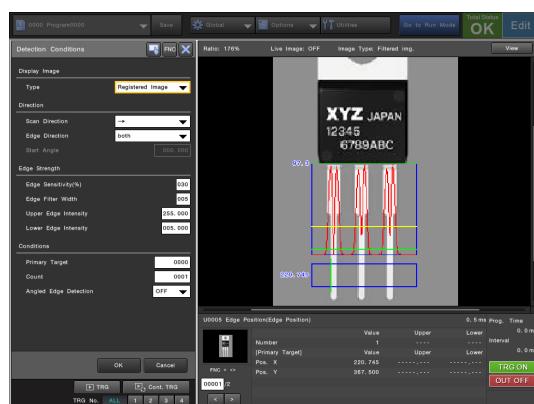
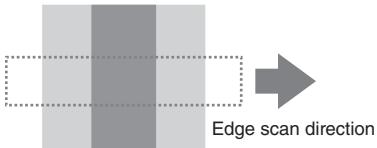
Edge Position

Filter Width

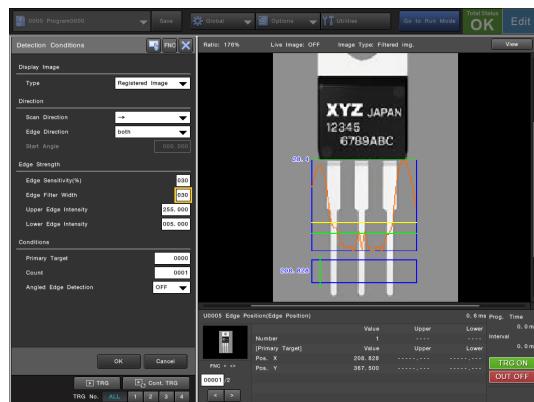
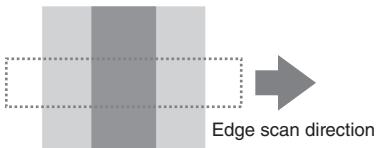
By changing the filter width, the edge graph can be averaged as desired helping to eliminate noise. As the filter width is increased more data is used and noise has less of an impact on the edge detection.

To avoid mis-detection for rounded or angled targets where there is a gradual change in contrast the filter width can also be adjusted accordingly.

Filter width default setting (filter width = 5)



After the filter width setting is changed (filter width = 30)



Edge Width

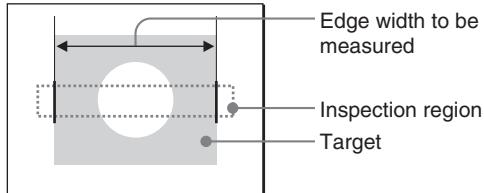
Edge Width Tool

The Edge Width tool scans across a target in a user specified direction within a specified region detecting contrast changes. Based on these contrast changes the width between two user specified points can be measured. Because edge detection is based on the transition from bright to dark (or dark to bright), not on absolute intensity values, it is less affected by illumination fluctuations during image capturing.

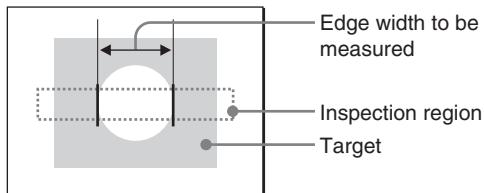
Measurement Overview

When the inspection region is a rectangle or a rotated rectangle

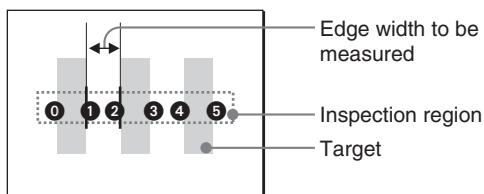
- When [Outer Gap] is the selected measurement mode



- When [Inner Gap] is the selected measurement mode

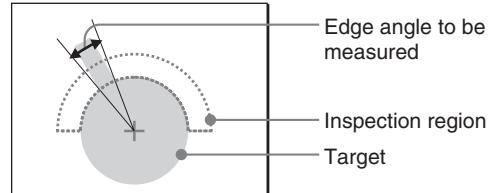


- When [Specified Edges] is the selected measurement mode (example: 1→2)

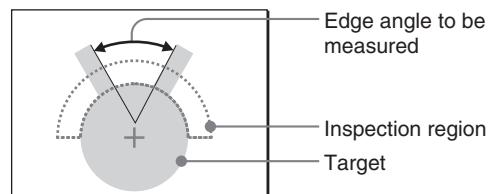


When the inspection region is a ring or an arc

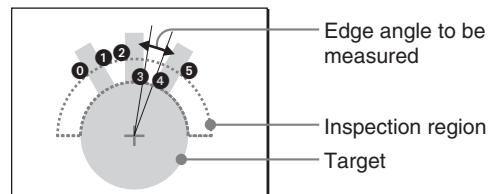
- When [Outer Gap] is the selected measurement mode



- When [Inner Gap] is the selected measurement mode



- When [Specified Edges] is the selected measurement mode (example: 3→4)



Edge Width

Main measurement results

The standard results and data returned by Edge Width tool are as follows:

 Point	Processing results may vary depending on the shape of the inspection region. The result for an item which is not processed is always 0.
--	---

When the inspection region is not a ring or an arc

Edge width	Outputs the average width in pixels. 
Number of pairs	Outputs (1) if a pair is detected (0) if not.
Edge position 1 (X, Y)	Outputs the position coordinates for the first identified edge (typically the one nearest the start of the inspection region) of the edge width pair in pixels.
Distance 1	Outputs the distance from the start of the inspection region to the edge identified in segment 1 in pixels.
Intensity 1	Outputs the intensity differential for the identified edge in segment 1.
Edge position 2 (X, Y)	Outputs the position coordinates for the second identified edge (typically the one nearest the end of the inspection region) of the edge width pair in pixels.
Distance 2	Outputs the distance from the start of the inspection region to the second identified edge (typically the one nearest the end of the inspection region) of the edge width pair in pixels.
Intensity 2	Outputs the intensity differential of the edge at edge position 2.
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

When the inspection region is a ring or an arc

Edge width	Outputs the average width as an angle. 
Number of pairs	Outputs (1) if a pair is detected (0) if not.
Edge position 1 (X, Y)	Outputs the position coordinates of the intersection point between the projected line (radial) of the first identified edge (typically the one nearest the start of the inspection region) and the center line (circular) of the inspection region.
Angle 1	Outputs the first identified edge of the edge width pair as an angle.
Distance 1	Outputs the distance from the start of the inspection region to the first identified edge (typically the one nearest the start of the inspection region) of the edge width pair as an angle.
Intensity 1	Outputs the intensity differential for the identified edge in segment 1.

Edge position 2 (X, Y) Outputs the position coordinates of the intersection point between the projected line (radial) of the second identified edge (typically the one nearest the end of the inspection region) and the center line (circular) of the inspection region.

Angle 2 Outputs the second identified edge (typically the one nearest the end of the inspection region) of the edge width pair as an angle.

Distance 2 Outputs the distance from the start of the inspection region to the second identified edge (typically the one nearest the end of the inspection region) of the edge width pair as an angle.

Intensity 2 Outputs the intensity differential of the edge at edge position 2.

Unit judgment value Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

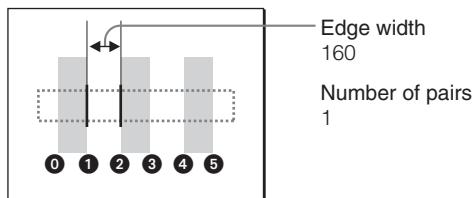
 For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

When the inspection region is a rectangle

Example showing the results of an Edge Width inspection performed under the following conditions:

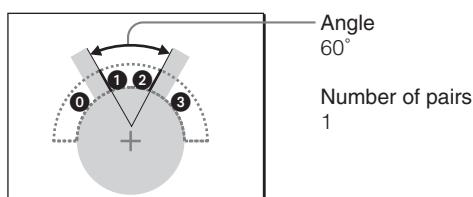
- Scan Direction: →
- Edge Direction: Both
- Specified Edge 1: 1
- Specified Edge 2: 2



When the inspection region is an arc

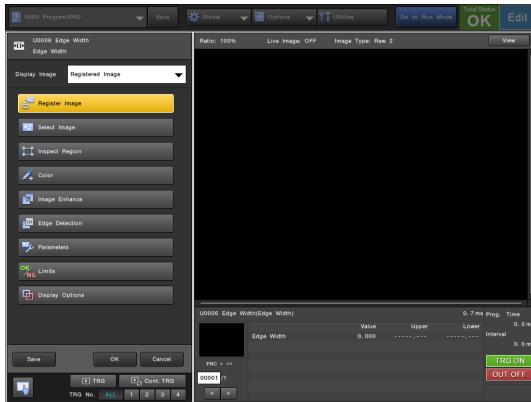
Example showing the results of an Edge Width inspection performed under the following conditions:

- Scan Direction: (Clockwise)
- Edge Direction: Both
- Specified Edge 1: 1
- Specified Edge 2: 2



Top Menu

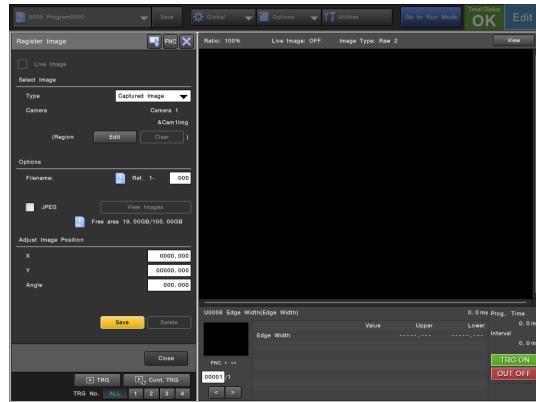
The top menu of the Edge Width tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-99)	Register an image to be used as a template for settings.
Select Image (Page 2-99)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-100)	Define the region to be used for unit processing.
Color (Page 2-100)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-100)	Specify the filter processing to apply to the image.
Edge Detection (Page 2-101)	Specify the scan direction and edge direction for detecting edges, as well as other detailed conditions for edge detection.
Parameters (Page 2-103)	Specify other conditions for the Edge Width tool as required.
Limits (Page 2-104)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-104)	Specify the display methods for things such as the inspection region and mask region.
Save (Page 2-105)	Save the current state to the program file.

Register Image

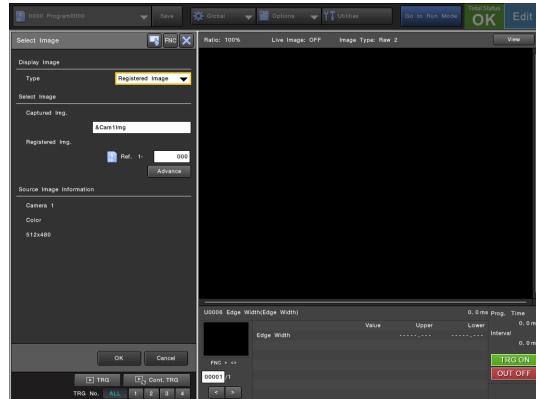
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

Specify the captured image and registered image to use for measurement.

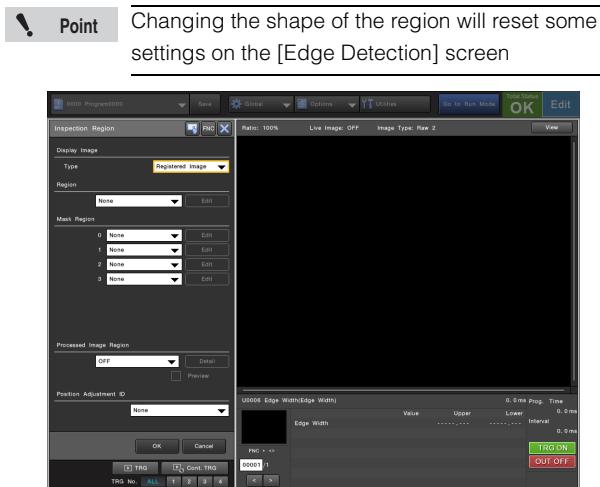


For more details, see "Select Image" (Page 2-471).

Edge Width

Inspect Region

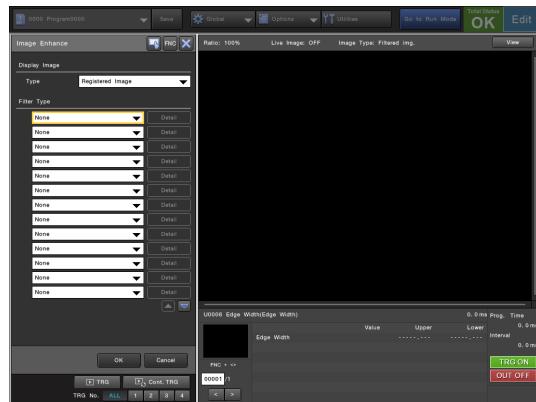
Define the region to be used for unit processing.



For more details, see "Region Settings" (Page 2-473).

Image Enhance

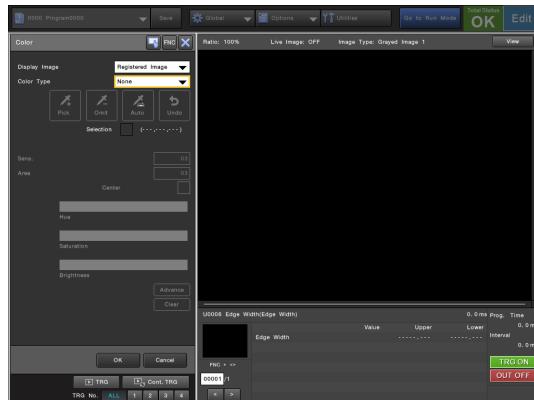
Specify the filter processing to apply to the image.



For more details, see "Image Enhance" (Page 2-489).

Color

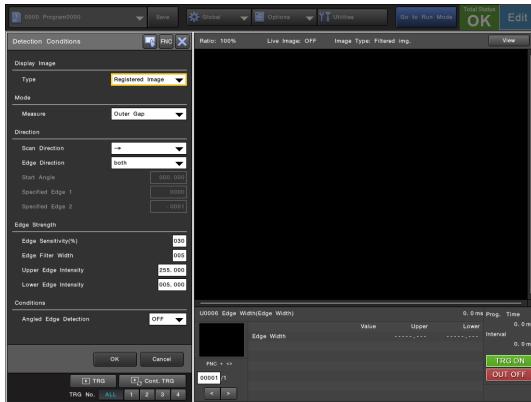
When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.



For more details, see "Color Extraction" (Page 2-483).

Edge Detection

Specify the scan direction and edge direction for detecting edges, as well as other detailed conditions for edge detection.



Reference Refer to "What is an Edge?" (Page 2-95) for the technical description of edge detection.

Display Image

Type

Switch the image displayed on the screen.

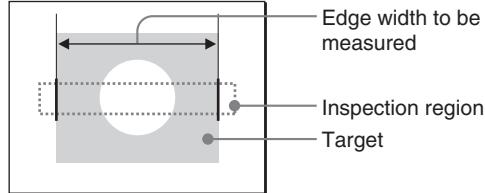
- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Mode

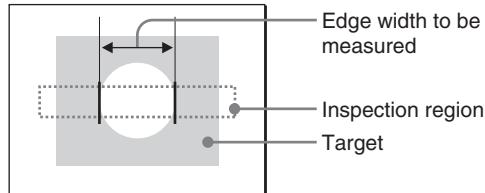
Measure

Select the type of Edge Width measurement.

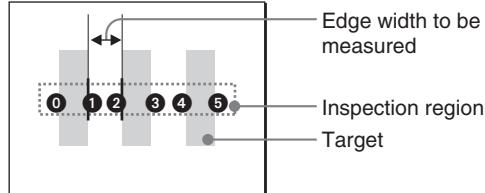
- **Outer Gap:** Measure the distance between the two outermost edges in the inspection region.



- **Inner Gap:** Measure the distance between the two innermost edges in the inspection region.



- **Specified Edges:** Measure the width between specified edges in the inspection region.



Point When the mode is changed from [Specified Edges] to [Inner Gap] or [Outer Gap], the settings for [Specified Edge 1] and [Specified Edge 2] are reset. (If a variable is referenced for any parameter, the reference will be cleared as well.)

Direction

Scan Direction

Select the scan direction to detect an edge.

- **When the inspection region is a rectangle, circle, oval, polygon or composition:** →, ←, ↑, ↓
- **When the inspection region is a rotated rectangle:** Forward or reverse with respect to the horizontal axis (X axis) of the region Since the scan direction depends on the rotation angle of the inspection region, this should be taken into consideration when selecting this option.
- **When the inspection region is a ring or an arc:** Clockwise, Counterclockwise

Edge Width

Edge Direction

Select the change in contrast for detecting an edge.

- **Light to Dark:** Detect edges in a transition that changes from a bright area to a dark area.
- **Dark to Light:** Detect edges in a transition that changes from a dark area to a bright area.
- **both** (default): Detect edges in a transition that can change either from a bright area to a dark area or from a dark area to a bright area.

Start Angle

When [Ring] is selected for the inspection region, specify a starting angle (0° to 359.999°) for the edge scan.

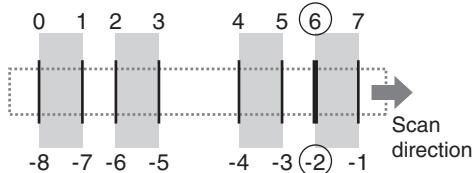
 **Point** If the start angle is changed, the detection angle will be calculated with reference to the 3 o'clock position being 0° .

Specified Edge 1 / Specified Edge 2

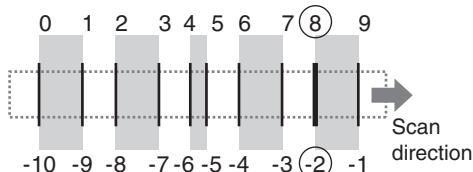
When using [Specified Edge] for [Measure], select [Specified Edge 1] and specify the edge number for the start of the width to measure. Use [Specified Edge 2] to specify the edge number for the end of the width to measure.

 **Reference** Negative values can be used for [Specified Edge 1] and/or [Specified Edge 2] to specify the edge number in the opposite scan direction. This technique is useful when the number of edges is always changing. Example: When the scan direction is set to $[→]$, when "-2" is set for [Specified Edge 2], then the second edge from the right is used as the edge for the end of the width. In this case if more edges are detected due to noise or part changes inside of the two edges specified the proper edges are still detected

Normal case



When a noisy edge exists



If [Specified Edge 2] is set to "6", false measurement occurs from extra edges. Using "-2" prevents false detection.

Edge Strength

Edge Sensitivity (%)

Set the percentage threshold (0% to 100%) for detecting edges.

Edge Filter Width

Set the width (0 to 100 pixels) of the smoothing filter applied to the differential graph for detecting edges.

Upper Edge Intensity

Specify the upper limit (0.000 to 255.000) of edge intensity for detecting edges.

Lower Edge Intensity

Specify the lower limit (0.000 to 255.000) of edge intensity for detecting edges.

 **Reference** Unwanted edges can be excluded from detection by adjusting the upper and lower edge intensity values referring to the highest edge intensity in the region (shown on the left of the edge graph). See "What is an Edge?" (Page 2-95) for more details.

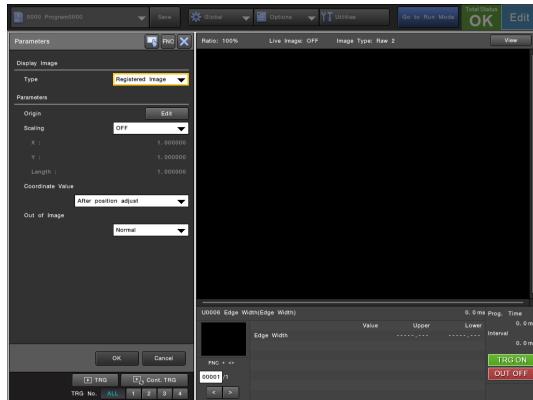
Conditions

Angled Edge Detection

Set to [ON] to stabilize the detection of slanted edges in the inspection region. Using this option may affect the edge X, Y position accuracy.

Parameters

Specify other conditions for the Edge Width tool as required.



Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

Reference The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels. The result data and setting parameters used for display, judgment and calculations can be converted and scaled to real life values and dimensions by using the pre-set scaling factor option.

- OFF:** Do not use scaling.
- ON:** Use scaling.

Reference

- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate Value

Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- After position adjust:** The inspection uses the adjusted coordinate axes determined after position adjustment.
- Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Out of Image

Specify whether to incorporate data that falls outside of the inspection region. This maybe required when position adjustment is used.

- Normal** (default): Edge detection outside of the region is disabled as the image data outside of the region is masked. Since masking requires time to process, the inspection time may vary depending on the quantity image data outside the region. Processing will take longer when the inspection region is a ring or an arc.
- Fast:** The image data outside of the region is not masked, allowing for faster processing. As the image data outside the region has not been masked so there is an increased chance of detecting an edge outside the region. Select [Normal] to avoid incorrect edge detection.



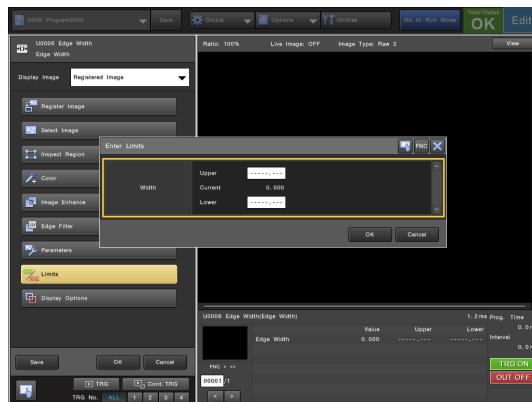
Image data which is already located outside of the region during the inspection region setting will always be masked regardless of the [Out of Image] setting.

Edge Width

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.

Reference

- [----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Width

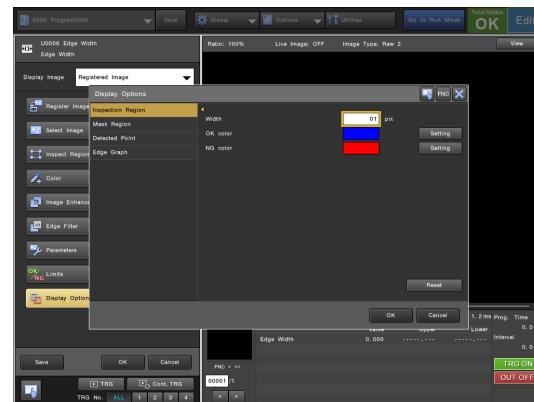
Specify the tolerance for the edge width (When the inspection region is not a ring or an arc).

The unit of measurement is the "number of pixels" indicating the width.

Display Options

Specify the display methods for things such as the inspection and mask regions, and detected edge and edge graph.

You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection Region

Specify the line width and display color of the inspection region.

Mask Region

Specify the line width and display color of the mask region.

Detected Point

Specify the width and display color of the line indicating the detected edge.

Edge Graph

Edge graph

Select whether to display the edge graph.

- **ON:** Show the edge graph.
- **OFF:** Hide the edge graph.

Wave

Specify the width and display color of the edge graph waveform.

Frame

Specify the width and display color of the edge graph frame.

Sensitivity

Specify the width and display color of the line representing the edge sensitivity threshold.



Point

Setting [Edge graph] to [ON] consumes additional program memory. Check the amount of remaining program memory before enabling.

Reset

Returns the display options to their defaults.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

Edge Pitch

Edge Pitch Tool

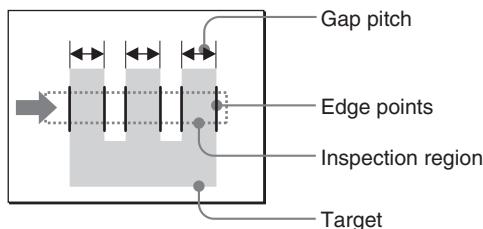
The Edge Pitch tool scans across a target in a user specified direction within a specified region detecting contrast changes. Based on these contrast changes the maximum, minimum and average center pitch or gap pitch between edges can be measured.

Because edge detection is based on the transition from bright to dark (or dark to bright), not on absolute intensity values, it is less affected by illumination fluctuations during image capturing.

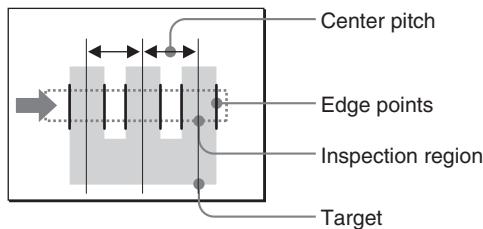
Measurement Overview

When the inspection region is a rectangle

- Example of measuring the gap pitch

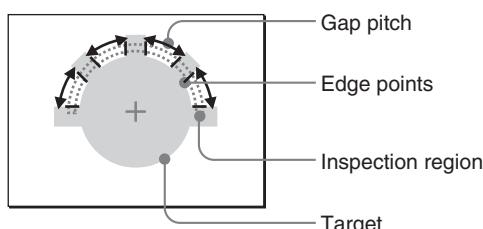


- Example of measuring the center pitch

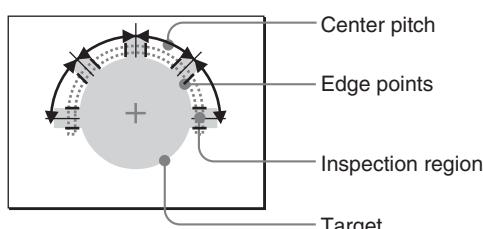


When the inspection region is a ring or an arc

- Example of measuring the gap pitch



- Example of measuring the center pitch



Main measurement results

The standard results and data returned by Edge Pitch tool are as follows:



Point

Processing results may vary depending on the shape of the inspection region. The result for an item which is not processed is always 0.

When the inspection region is not a ring or an arc

Number of pitches	Outputs the number of detected pitches. <small>Tolerance inspection target</small>
Maximum edge pitch	Outputs the maximum width in pixels. <small>Tolerance inspection target</small>
Minimum edge pitch	Outputs the minimum width in pixels. <small>Tolerance inspection target</small>
Average edge pitch	Outputs the average width in pixels.
Pitches []	Outputs all detected pitches in pixels. <small>Label specification target</small>
Edge position 1 (X, Y) []	Outputs the position coordinates for all the first identified edges (typically the ones nearest the start of the inspection region) of each edge pitch in pixels. <small>Label specification target</small>
Distance 1 []	Outputs the distances from the start of the inspection region to all the first identified edges (typically the ones nearest the start of the inspection region) of each edge pitch in pixels. <small>Label specification target</small>
Intensity 1 []	Outputs the intensity differential for all the first identified edges (typically the ones nearest the start of the inspection region) of each edge pitch. <small>Label specification target</small>
Edge position 2 (X, Y) []	Outputs the position coordinates for all the second identified edges (typically the ones nearest the end of the inspection region) of each edge pitch in pixels. <small>Label specification target</small>
Distance 2 []	Outputs the distances from the start of the inspection region to all the second identified edges (typically the one nearest the end of the inspection region) of each edge pitch in pixels. <small>Label specification target</small>
Intensity 2 []	Outputs the intensity differential for all the second identified edges (typically the ones nearest the end of the inspection region) of each edge pitch. <small>Label specification target</small>
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

When the inspection region is a ring or an arc

Number of pitches	Outputs the number of detected pitches. [Tolerance inspection target]
Maximum edge pitch	Outputs the maximum width as an angle. [Tolerance inspection target]
Minimum edge pitch	Outputs the minimum width as an angle. [Tolerance inspection target]
Average edge pitch	Outputs the average width as an angle.
Pitches []	Outputs all detected pitches as angles. [Label specification target]
Edge position 1 (X, Y) []	Outputs the position coordinates of all the intersection points between the projected lines (radial) of the first identified edges (typically the one nearest the start of the inspection region) and the center line (circular) of the inspection region. [Label specification target]
Angle 1 []	Outputs the first identified edge of the edge width pair as an angle. [Label specification target]
Distance1 []	Outputs the distances from the start of the inspection region to all the first identified edges (typically the ones nearest the start of the inspection region) of each edge pitch in pixels. [Label specification target]
Intensity1 []	Outputs the intensity differential for all the first identified edges (typically the ones nearest the start of the inspection region) of each edge pitch. [Label specification target]
Edge position 2 (X, Y) []	Outputs the position coordinates of all the intersection points between the projected lines (radial) of the second identified edges (typically the one nearest the end of the inspection region) and the center line (circular) of the inspection region. [Label specification target]
Angle 2 []	Outputs the second identified edge (typically the one nearest the end of the inspection region) of the edge width pair as an angle. [Label specification target]
Distance 2 []	Outputs the distances from the start of the inspection region to all the second identified edges (typically the one nearest the end of the inspection region) of each edge pitch in pixels. [Label specification target]
Intensity 2 []	Outputs the intensity differential for all the first identified edges (typically the ones nearest the end of the inspection region) of each edge pitch. [Label specification target]
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

Point

For the edge pitch judgment, the upper tolerance limit is applied to the value of the maximum edge pitch, and the lower tolerance limit is applied to the value of the minimum edge pitch.

Reference

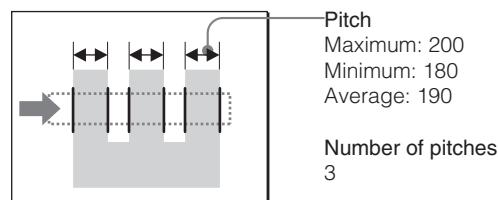
For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

When the inspection region is a rectangle or a rotated rectangle

Example showing the results of an Edge Pitch inspection performed under the following conditions:

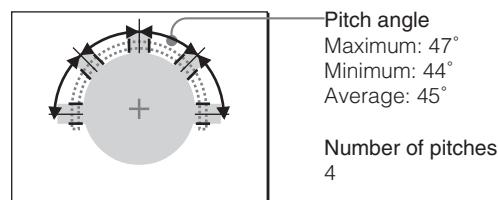
- Measure: Gap pitch
- Scan Direction: →
- Edge Direction: Both



When the inspection region is a ring or an arc

Example showing the results of an Edge Pitch inspection performed under the following conditions:

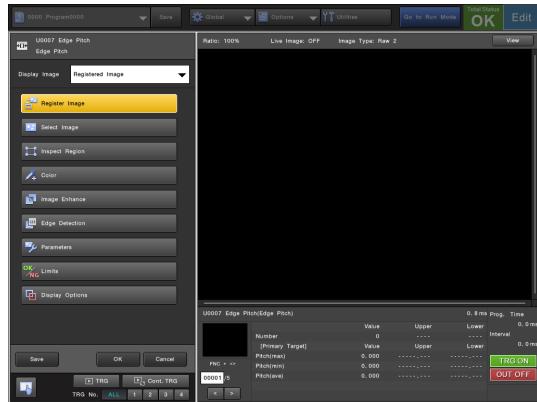
- Measure: Center pitch
- Scan Direction: (Counterclockwise)
- Edge Direction: Both



Edge Pitch

Top Menu

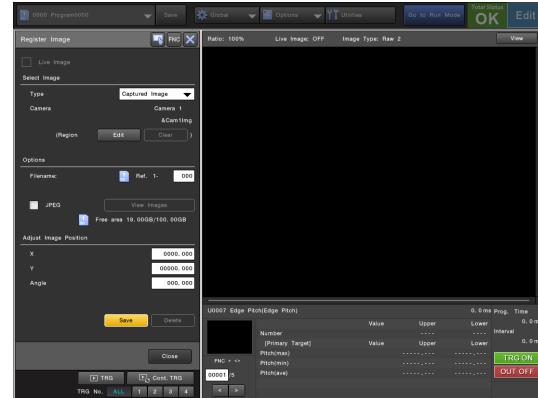
The top menu of the Edge Pitch tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-108)	Register an image to be used as a template for settings.
Select Image (Page 2-108)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-109)	Define the region to be used for unit processing.
Color (Page 2-109)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-109)	Specify the filter processing to apply to the image.
Edge Detection (Page 2-110)	Specify the scan direction and edge direction for detecting edges, as well as other detailed conditions for edge detection.
Parameters (Page 2-111)	Specify other conditions for the Edge Pitch tool as required.
Limits (Page 2-112)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-113)	Specify the display methods for things such as the inspection region and mask region.
Save (Page 2-113)	Save the current state to the program file.

Register Image

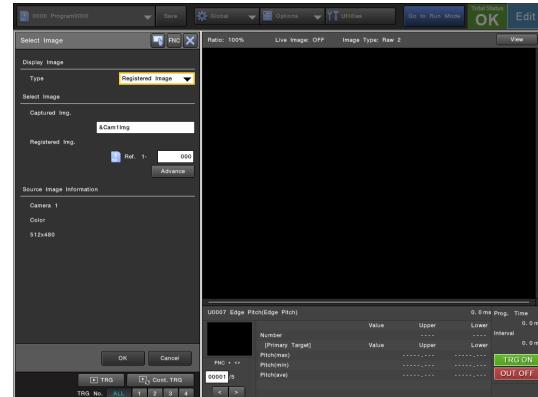
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

Specify the captured image and registered image to use for measurement.

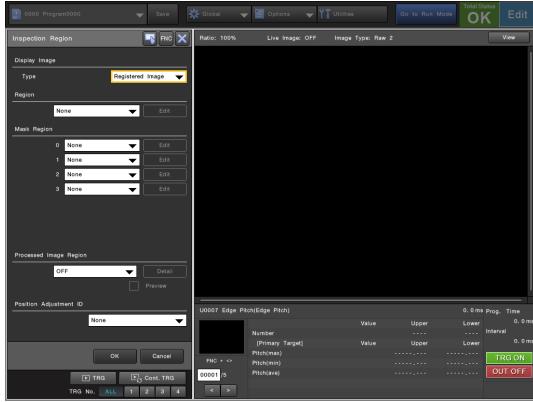


For more details, see "Select Image" (Page 2-471).

Inspect Region

Define the region to be used for unit processing.

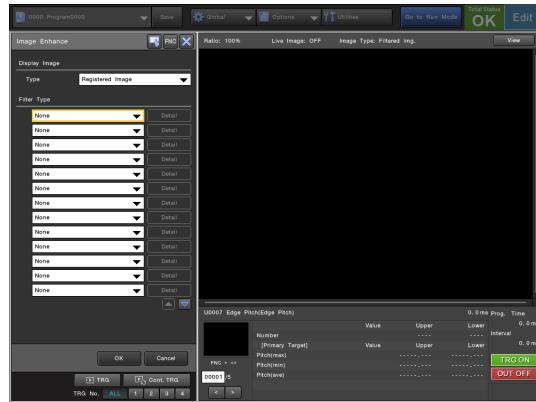
Point Changing the shape of the region will reset some settings on the [Edge Detection] screen.



For more details, see "Region Settings" (Page 2-473).

Image Enhance

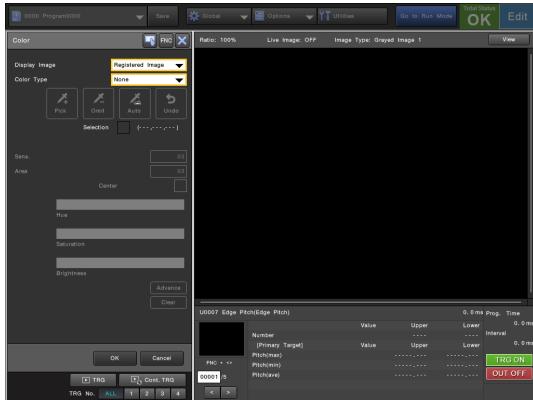
Specify the filter processing to apply to the image.



For more details, see "Image Enhance" (Page 2-489).

Color

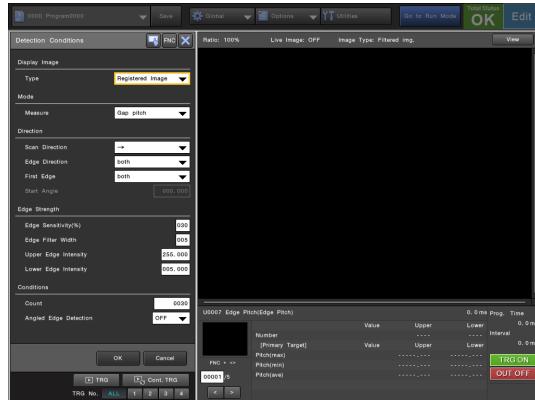
When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.



For more details, see "Color Extraction" (Page 2-483).

Edge Detection

Specify the scan direction and edge direction for detecting edges, as well as other detailed conditions for edge detection.



Refer to "What is an Edge?" (Page 2-95) for the technical description of edge detection.

Display Image

Type

Switch the image displayed on the screen.

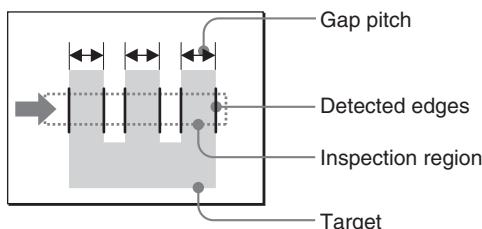
- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Mode

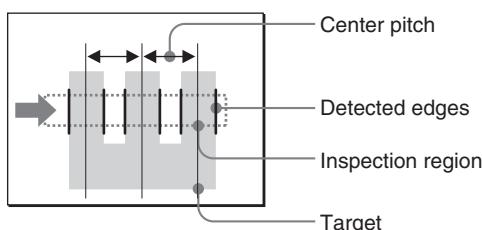
Measure

Select the type of Edge Pitch measurement.

- Gap pitch:** Detect edges in the specified scan direction and measure the maximum, minimum, and average distance between odd and even edges.



- Center pitch:** Measure the maximum, minimum, and average distance between the center points of pairs of edges.



Direction

Scan Direction

Select the scan direction to detect an edge.

- When the inspection region is a rectangle, circle, oval, polygon or composition:** →, ←, ↑, ↓
- When the inspection region is a rotated rectangle:** Forward or reverse with respect to the horizontal axis (X axis) of the region Since the scan direction depends on the rotation angle of the inspection region, this should be taken into consideration when selecting this option.
- When the inspection region is a ring or an arc:** Clockwise, Counterclockwise

Edge Direction

Select the change in contrast for detecting an edge.

- Light to Dark:** Detect edges in a transition that changes from a bright area to a dark area.
- Dark to Light:** Detect edges in a transition that changes from a dark area to a bright area.
- both** (default): Detect edges in a transition that can change either from a bright area to a dark area or from a dark area to a bright area.

First Edge

Specify the type of transition for starting the Edge Pitch measurement (only when [Edge Direction] is set to [both]).

- both** (default): Start measurement edges in a transition that changes either from a bright area to a dark area or from a dark area to a bright area.
- Light to Dark:** Start measurement edges in a transition that changes from a bright area to a dark area.
- Dark to Light:** Start measurement edges in a transition that changes from a dark area to a bright area.



When the edge direction is set to either [Light to Dark] or [Dark to Light] and the first edge is set to the opposite transition, Edge Pitch measurements are not possible.

Start Angle

When [Ring] is selected for the inspection region, specify a starting angle (0° to 359.999°) for detecting edges.



If the start angle is changed, the detection angle will be calculated with reference to the 3 o'clock position being 0°.

Edge Strength

Edge Sensitivity (%)

Set the percentage threshold (0% to 100%) for detecting edges.

Edge Filter Width

Set the width (0 to 100 pixels) of the smoothing filter applied to the differential graph for detecting edges.

Upper Edge Intensity

Specify the upper limit (0.000 to 255.000) of edge intensity for detecting edges.

Lower Edge Intensity

Specify the lower limit (0.000 to 255.000) of edge intensity for detecting edges.

Reference Unwanted edges can be excluded from detection by adjusting the upper and lower edge intensity values referring the highest edge intensity in the region (shown on the left of the edge graph). See "What is an Edge?" (Page 2-95) for more details.

Conditions

Count

Specify the maximum number of pitches (1 to 3600) to be measured. The pitch count cannot exceed the [Maximum Count] value.

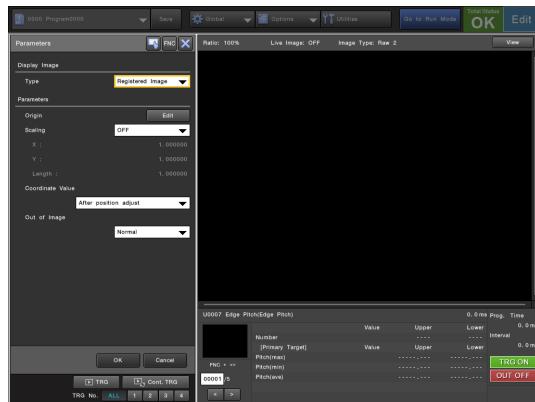
- Point**
- The maximum number of pitches that can actually be detected changes depending on the settings.
 - With some settings, the maximum number of pitches cannot be changed.
 - It may be possible to specify the [Count] value exceeding the [Maximum] value (Maximum: 1800) depending on the account setting. Note, however, that this also increases the [Maximum] value, resulting in more consumption of the program memory.

Angled Edge Detection

Set to [ON] to stabilize the detection of slanted edges in the inspection region. Using this option may affect the edge X, Y position accuracy.

Parameters

Specify other conditions for the Edge Pitch tool as required.



Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

Reference The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels. The result data and setting parameters used for display, judgment and calculations can be converted and scaled to real life values and dimensions by using the pre-set scaling factor option.

- OFF:** Do not use scaling.
- ON:** Use scaling.

Reference The scaling value can be changed in the [Options] menu (Page 4-18).

- For a summary list of the result data for which scaling can be used, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Edge Pitch

Coordinate Value

Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- After position adjust:** The inspection uses the adjusted coordinate axes determined after position adjustment.
- Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Out of Image

Specify whether to incorporate data that falls outside of the inspection region. This maybe required when position adjustment is used.

- Normal** (default): Edge detection outside of the region is disabled as the image data outside of the region is masked. Since masking requires time to process, the inspection time may vary depending on the quantity image data outside the region. Processing will take longer when the inspection region is a ring or an arc.
- Fast:** The image data outside of the region is not masked, allowing for faster processing. As the image data outside the region has not been masked so there is an increased chance of detecting an edge outside the region. Select [Normal] to avoid incorrect edge detection.

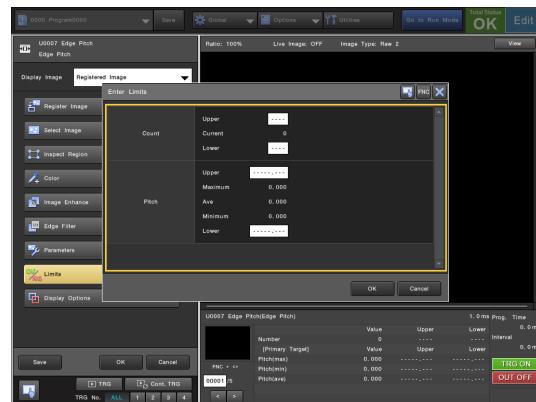
Point

Image data which is already located outside of the region during the inspection region setting will always be masked regardless of the [Out of Image] setting.

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.

Point

For the edge pitch judgment, the upper tolerance limit is applied to the value of the maximum edge pitch, and the lower tolerance limit is applied to the value of the minimum edge pitch.

Reference

- [----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Count

Specify the tolerance for the number of detected edge pitches.

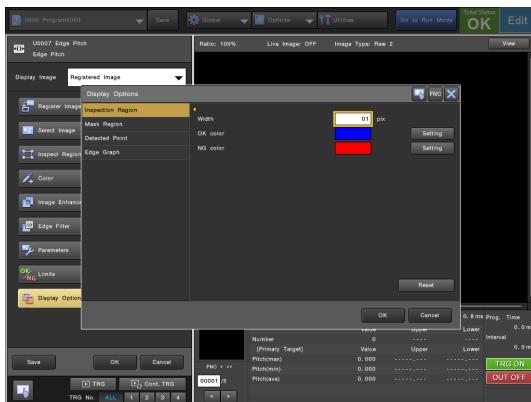
The unit of measurement is the "number of pixels" (when the inspection region is not a ring or an arc) or "angle" (only when the inspection region is a ring or an arc) of the pitches.

Pitch

Specify the tolerance for the width of the detected edge pitches. The unit of measurement is the "number of pixels" (when the inspection region is not a ring or an arc) or "angle" (only when the inspection region is a ring or an arc) of the pitches.

Display Options

Specify the display methods for things such as the inspection region and mask region, and detected edge and edge graph. You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection region

Specify the line width and display color of the inspection region.

Mask region

Specify the line width and display color of the mask region.

Detected point

Specify the width and display color of the line indicating the detected edge.

Edge Graph

Edge graph

Select whether to display the edge graph.

- **ON:** Show the edge graph.
- **OFF:** Hide the edge graph.

Wave

Specify the width and display color of the edge graph waveform.

Frame

Specify the width and display color of the edge graph frame.

Sensitivity reference line

Specify the width and display color of the line representing the edge sensitivity threshold.

Point

Setting [Edge graph] to [ON] consumes additional program memory. Check the amount of remaining program memory before enabling.

Reset

Returns the display options to their defaults.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

Point

- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

Edge Angle

Edge Angle Tool

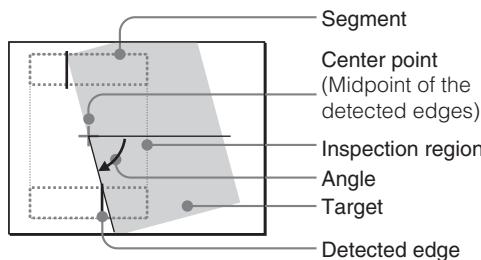
The Edge Angle tool scans across a target in a user specified direction within two segments of a specified region detecting contrast changes. Based on these contrast changes two edges can be specified and the angle between the two can be measured. Based on a horizontal reference line and the edge scanning direction the edge angle can be negative (-0.001 to -179.999) when measured counterclockwise and positive (0.000 to 180.000) when measured clockwise.

Because edge detection is based on the transition from bright to dark (or dark to bright), not on absolute intensity values, it is less affected by illumination fluctuations during image capturing.

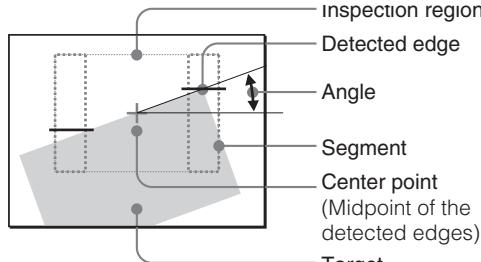
Reference You can specify the edge detection options, such as a scan direction or edge direction, for each segment individually. This makes it easier to detect the tilt angle of a target in a single unit even when target with a complicated shape is measured.

Measurement Overview

When the edge angle is "+75°"



When the edge angle is "-20°"



Main measurement results

The standard results and data returned by Edge Angle tool are as follows:

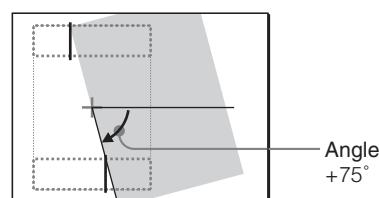
Point	<ul style="list-style-type: none"> Processing results may vary depending on the shape of the inspection region. The result for an item which is not processed is always 0.
Angle	Outputs the angle of the target by detecting two edge positions (-179.999° to 180.000°). <small>Tolerance inspection target</small>
Center (X, Y)	Outputs the position coordinates of the midpoint between the two identified edges from the two segments in pixels.
Edge position 1 (X, Y)	Outputs the position coordinates of the identified edge detected in the 1st area (The edge detected in the upper segment when the rotation angle is 0°) in pixels.
Distance 1	Outputs the distance from the start of the inspection region to the edge identified in segment 1 in pixels.
Intensity 1	Outputs the intensity differential for the identified edge in segment 1.
Edge position 2 (X, Y)	Outputs the position coordinates of the identified edge detected in the 2nd area (The edge detected in the lower segment when the rotation angle is 0°) in pixels.
Distance 2	Outputs the distance from the start of the inspection region to the edge identified in segment 2 in pixels.
Intensity 2	Outputs the intensity differential for the identified edge in segment 2.
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

Reference For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

Example showing the results of an Edge Angle inspection performed under the following conditions:

- Edge Direction: Both

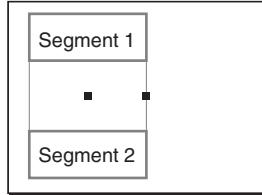


Reference The Edge Angle measurement value is the angle between the horizontal and the straight line connecting the two identified edges in the two segments.

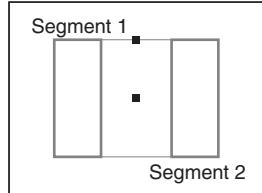
Definition of edge position 1 and edge position 2

This system labels an edge found in segment 1 as edge position 1 and the edge found in segment 2 as edge position 2. When the rotation angle of the region is 0° (default), the upper rectangle is segment 1 and the lower rectangle is segment 2. When the rotation angle is 180° the segment order is changed. If the edge scanning direction is also changed angle measurement values will be reversed. Negative angles will become positive and positive angles will become negative.

When the rotation angle is 0°

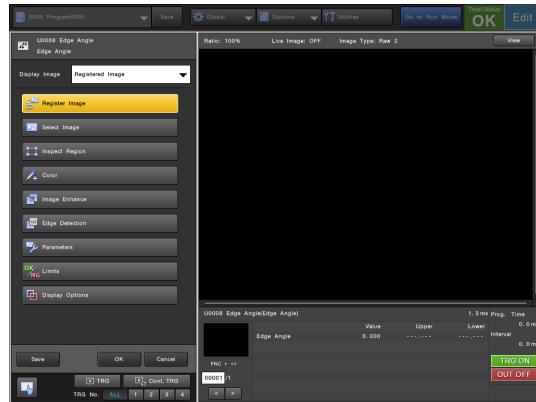


When the rotation angle is 270°



Top Menu

The top menu of the Edge Angle tool consists of the following options. Configure settings under each option as required for the inspection.

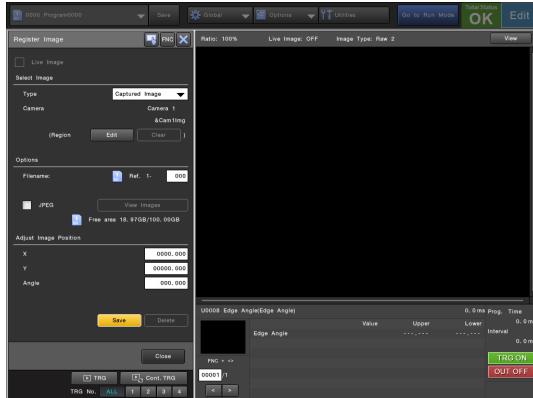


Register Image (Page 2-116)	Register an image to be used as a template for settings.
Select Image (Page 2-116)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-116)	Define the region to be used for unit processing.
Color (Page 2-116)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-116)	Specify the filter processing to apply to the image.
Edge Detection (Page 2-117)	Specify the scan direction and edge direction for detecting edges, as well as other detailed conditions for edge detection.
Parameters (Page 2-118)	Specify other conditions for the Edge Angle tool as required.
Limits (Page 2-119)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-119)	Specify the display methods for things such as the inspection region.
Save (Page 2-120)	Save the current state to the program file.

Edge Angle

Register Image

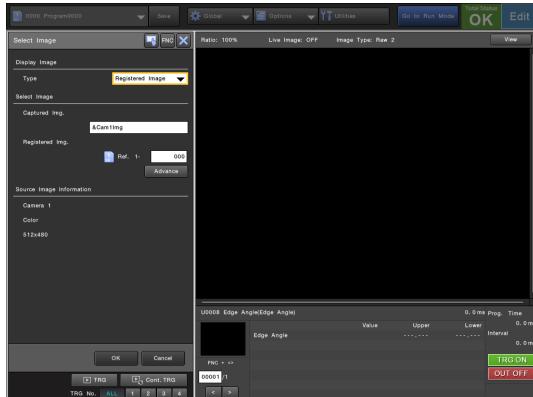
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

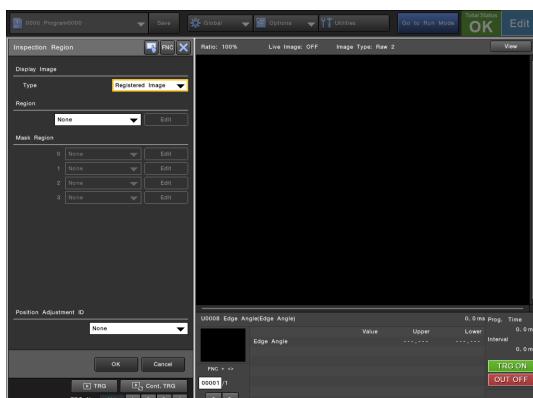
Specify the captured image and registered image to use for measurement.



For more details, see "Select Image" (Page 2-471).

Inspect Region

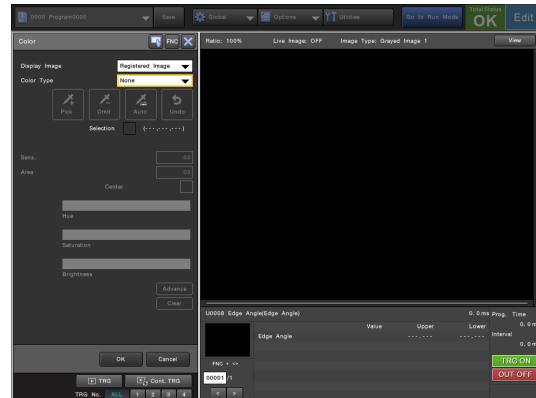
Define the region to be used for unit processing.



For more details, see "Region Settings" (Page 2-473).

Color

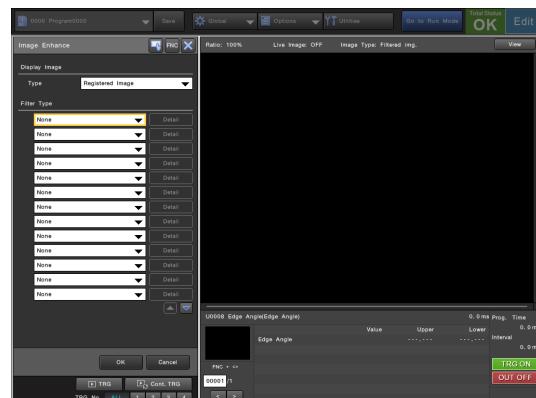
When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.



For more details, see "Color Extraction" (Page 2-483).

Image Enhance

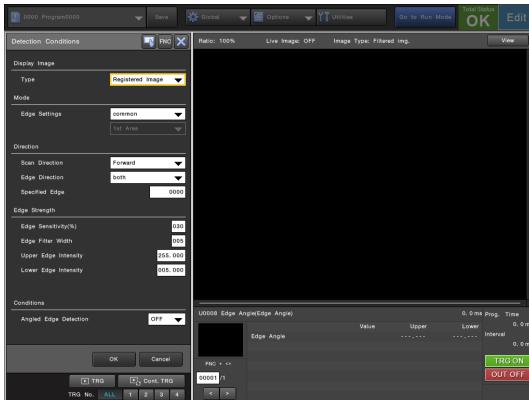
Specify the filter processing to apply to the image.



For more details, see "Image Enhance" (Page 2-489).

Edge Detection

Specify the scan direction and edge direction for detecting edges, as well as other detailed conditions for edge detection.



Reference Refer to "What is an Edge?" (Page 2-95) for the technical description of edge detection.

Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Mode

Edge Settings

Select [individual] to specify the edge detection conditions of each segment individually, or select [common] to use the same conditions for both segments.

Use [Individual] when working with a complex shaped target or differing contrasts within the two segments. As each segment has individual edge detection parameters, stable detection can be maintained.

If using [Individual], select [1st Area] and set the parameters for the first segment, then select [2nd Area] and set the parameters for the second segment.

Direction

Scan Direction

Select the scan direction to detect an edge.

- **Forward:** Scan in the direction of the rotation of the inspection region.
- **Reverse:** Scan in the opposite direction of the rotation of the inspection region.

Edge Direction

Select the change in contrast for detecting an edge.

- **Light to Dark:** Detect edges in a transition that changes from a bright area to a dark area.
- **Dark to Light:** Detect edges in a transition that changes from a dark area to a bright area.
- **both** (default): Detect edges in a transition that can change either from a bright area to a dark area or from a dark area to a bright area.

Specified Edge

Specify the edge used when multiple edges are detected. Edge numbers are assigned in order based on the scan direction. When a negative value is specified, the edge numbers will be assigned in the opposite direction. This setting can be omitted when not required.

Edge Strength

Edge Sensitivity (%)

Set the percentage threshold (0% to 100%) for detecting edges.

Edge Filter Width

Set the width (0 to 100 pixels) of the smoothing filter applied to the differential graph for detecting edges.

Upper Edge Intensity

Specify the upper limit (0.000 to 255.000) of edge intensity for detecting edges.

Lower Edge Intensity

Specify the lower limit (0.000 to 255.000) of edge intensity for detecting edges.

Reference Unwanted edges can be excluded from detection by adjusting the upper and lower edge intensity values referring the highest edge intensity in the region (shown on the left of the edge graph). See "What is an Edge?" (Page 2-95) for more details.

Conditions

Angled Edge Detection

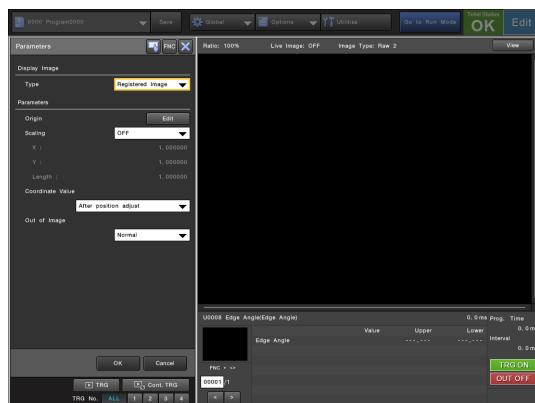
Set to [ON] to stabilize the detection of slanted edges in the inspection region. Using this option may affect the edge X, Y position accuracy.

Point The [Conditions] parameters are commonly applied to both the 1st and 2nd segments.

Edge Angle

Parameters

Specify other conditions for the Edge Angle tool as required.



Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

Reference The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels. The result data and setting parameters used for display, judgment and calculations can be converted and scaled to real life values and dimensions by using the pre-set scaling factor option.

- OFF:** Do not use scaling.
- ON:** Use scaling.

Reference

- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate Value

Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- After position adjust:** The inspection uses the adjusted coordinate axes determined after position adjustment.
- Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Out of Image

Specify whether to incorporate data that falls outside of the inspection region. This maybe required when position adjustment is used.

- Normal** (default): Edge detection outside of the region is disabled as the image data outside of the region is masked. Since masking requires time to process, the inspection time may vary depending on the quantity image data outside the region. Processing will take longer when the inspection region is a ring or an arc.
- Fast:** The image data outside of the region is not masked, allowing for faster processing. As the image data outside the region has not been masked so there is an increased chance of detecting an edge outside the region. Select [Normal] to avoid incorrect edge detection.



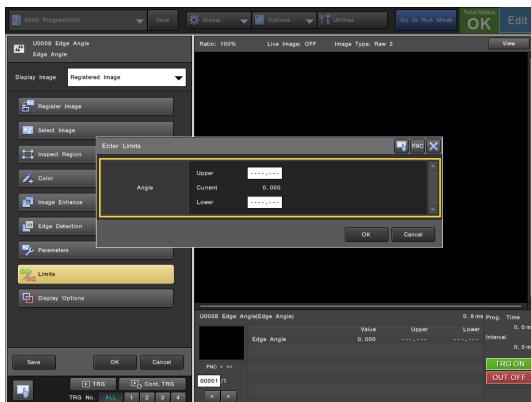
Point

Image data which is already located outside of the region during the inspection region setting will always be masked regardless of the [Out of Image] setting.

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.



The result for an item which is not processed is always 0.



- [----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

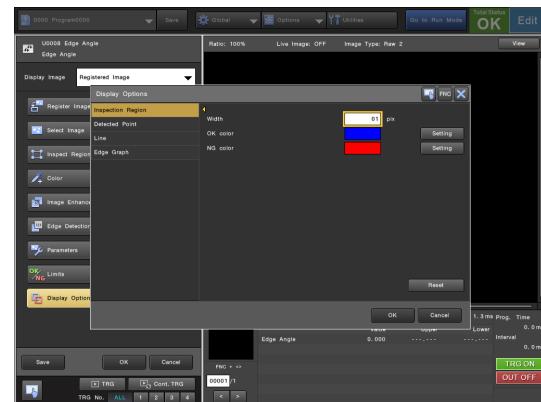
Angle

Specify the tolerance for the angle from the two detected edges.

The unit of measurement is the angle in degrees.

Display Options

Specify the display methods for things such as the inspection region, detected edge and edge graph. You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection region

Specify the line width and display color of the inspection region.

Detected Point

Specify the width and display color of the line indicating the detected edge.

Line

Specify the width and display color of the straight line connecting the two detected edges.

Edge graph

Edge graph

Select whether to display the edge graph.

- **ON:** Show the edge graph.
- **OFF:** Hide the edge graph.

Wave

Specify the width and display color of the edge graph waveform.

Frame

Specify the width and display color of the edge graph frame.

Sensitivity

Specify the width and display color of the line representing the edge sensitivity threshold.



Setting [Edge graph] to [ON] consumes additional program memory. Check the amount of remaining program memory before enabling.

Reset

Returns the display options to their defaults.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

-  **Point**
- If the controller is turned off before any settings are saved, all of those changes will be deleted.
 - Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
 - Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

Edge Pairs

Edge Pairs Tool

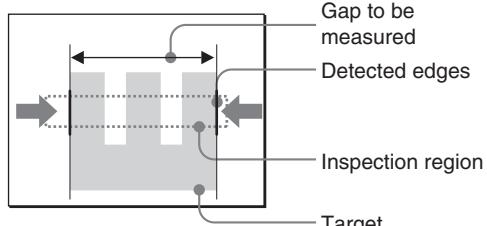
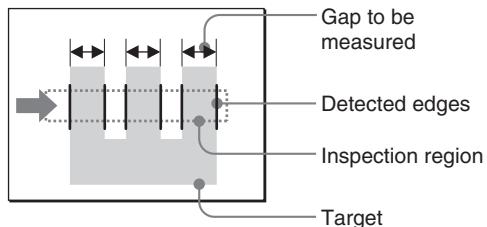
The Edge Pairs tool scans across a target twice in a user specified direction within a specified region detecting contrast changes. Based on these contrast changes (edges) gaps and widths can be measured. Due to the double scan method the edge detection criteria can be specified individually for a more stable inspection than a standard edge tool.

Because edge detection is based on the transition from bright to dark (or dark to bright), not on absolute intensity values, it is less affected by illumination fluctuations during image capturing.

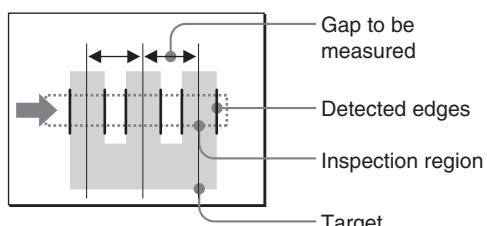
Measurement Overview

When the inspection region is a rectangle or a rotated rectangle

- Example of measuring the gap pitch

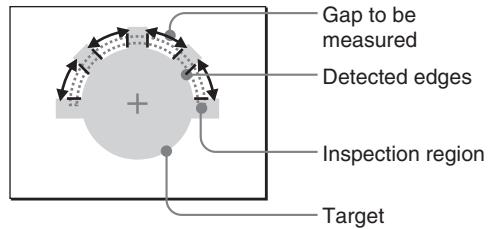


- Example of measuring the center pitch

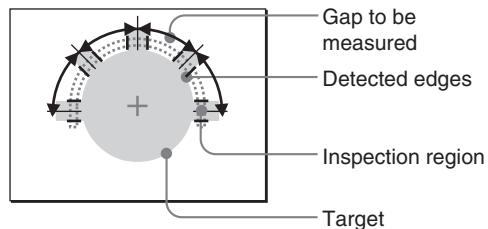


When the inspection region is a ring or an arc

- Example of measuring the gap pitch



- Example of measuring the center pitch



Edge Pairs

Main measurement results

The standard results and data returned by the Edge Pairs tool are as follows:

 Point	Processing results may vary depending on the shape of the inspection region. The result for an item which is not processed is always 0.
--	---

When the inspection region is not a ring or an arc

Number of pairs	Outputs the number of detected pairs. <small>(Tolerance inspection target)</small>
Maximum width	Outputs the maximum width in pixels. <small>(Tolerance inspection target)</small>
Minimum width	Outputs the average width in pixels. <small>(Tolerance inspection target)</small>
Average width	Outputs the minimum width in pixels.
Width []	Outputs the widths of all detected pairs in pixels. <small>(Tolerance inspection target) (Label specification target)</small>
Edge position 1 (X, Y) []	Outputs the position coordinates for the first identified edge (typically the one nearest the start of the inspection region) of the edge width pair in pixels. <small>(Label specification target)</small>
Distance 1 []	Outputs the distance from the start of the inspection region to the first identified edge (typically the one nearest the start of the inspection region) of the edge width pair in pixels. <small>(Label specification target)</small>
Intensity 1 []	Outputs the intensity differential for all the first identified edges (typically the ones nearest the start of the inspection region) of each edge pitch. <small>(Label specification target)</small>
Edge position 2 (X, Y) []	Outputs the position coordinates for the second identified edge (typically the one nearest the end of the inspection region) of the edge width pair in pixels. <small>(Label specification target)</small>
Distance 2 []	Outputs the distances from the start of the inspection region to all the second identified edges (typically the one nearest the end of the inspection region) of each edge pitch in pixels. <small>(Label specification target)</small>
Intensity 2 []	Outputs the intensity differential for all the first identified edges (typically the ones nearest the end of the inspection region) of each edge pitch. <small>(Label specification target)</small>
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

When the inspection region is a ring or an arc

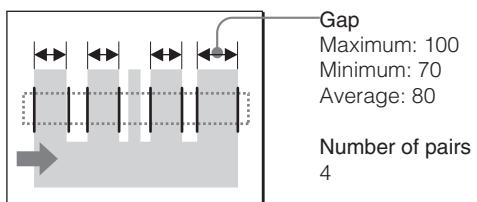
Number of pairs	Outputs the number of detected pairs. <small>(Tolerance inspection target)</small>
Maximum width	Outputs the maximum width as an angle. <small>(Tolerance inspection target)</small>
Minimum width	Outputs the minimum width as an angle. <small>(Tolerance inspection target)</small>
Average width	Outputs the average width as an angle.
Width []	Outputs the widths of all detected pairs as angles. <small>(Tolerance inspection target) (Label specification target)</small>
Edge position 1 (X, Y) []	Outputs the position coordinates of the intersection points between the projected lines (radial) of the first identified edges (typically the one nearest the start of the inspection region) and the center line (circular) of the inspection region. <small>(Label specification target)</small>
Angle 1 []	Outputs the first identified edge of the edge width pair as an angle. <small>(Label specification target)</small>
Distance 1 []	Outputs the distances from the start of the inspection region to all the first identified edges (typically the ones nearest the start of the inspection region) of each edge pitch in pixels. <small>(Label specification target)</small>
Intensity 1 []	Outputs the intensity differential for all the first identified edges (typically the ones nearest the start of the inspection region) of each edge pitch. <small>(Label specification target)</small>
Edge position 2 (X, Y) []	Outputs the position coordinates of the intersection points between the projected lines (radial) of the second identified edge (typically the one nearest the end of the inspection region) and the center line (circular) of the inspection region. <small>(Label specification target)</small>
Angle 2 []	Outputs the second identified edge (typically the one nearest the end of the inspection region) of the edge width pair as an angle. <small>(Label specification target)</small>
Distance 2 []	Outputs the distances from the start of the inspection region to all the second identified edges (typically the one nearest the end of the inspection region) of each edge pitch in pixels. <small>(Label specification target)</small>
Intensity 2 []	Outputs the intensity differential for all the first identified edges (typically the ones nearest the end of the inspection region) of each edge pitch. <small>(Label specification target)</small>
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.
 Point	When primary target (Page 2-127) is set to [All] (Default), the maximum pair width is used as the upper limit and the minimum pair width is used as the lower limit.
 Reference	For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

When the inspection region is a rectangle or a rotated rectangle

Example 1: Example showing the results of a gap pitch inspection performed under the following conditions

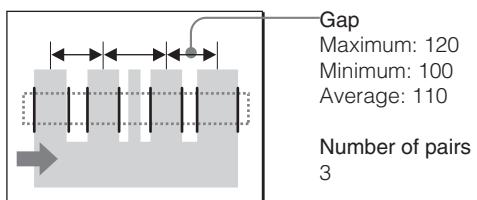
- Measure: Gap pitch
- Scan direction (1st scan): →
- Scan direction (2nd scan): →
- Edge direction (1st scan): Light to Dark
- Edge direction (2nd scan): Dark to Light
- Maximum edge gap: 99999.999
- Minimum edge gap: 0050.000



Point The central pin is below the minimum edge gap and is therefore excluded from the search.

Example 2: Example showing the results of a center pitch inspection performed under the following conditions

- Measure: Center pitch
- Scan direction (1st scan): →
- Scan direction (2nd scan): →
- Edge direction (1st scan): Light to Dark
- Edge direction (2nd scan): Dark to Light
- Maximum edge gap: 99999.999
- Minimum edge gap: 0050.000

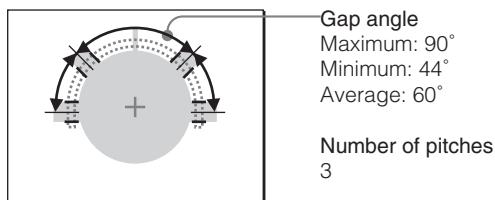


Point The central pin is below the minimum edge gap and is therefore excluded from the search.

When the inspection region is a ring or an arc

Example showing the results of a center pitch inspection performed under the following conditions:

- Measure: Center pitch
- Scan direction (1st scan): Clockwise
- Scan direction (2nd scan): Clockwise
- Edge direction (1st scan): Light to Dark
- Edge direction (2nd scan): Dark to Light
- Maximum edge gap: 99999.999
- Minimum edge gap: 0005.000

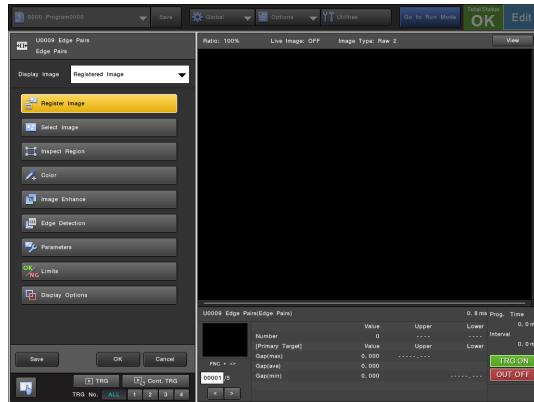


Point The third pin is below the minimum edge gap and is therefore excluded from the search.

Edge Pairs

Top Menu

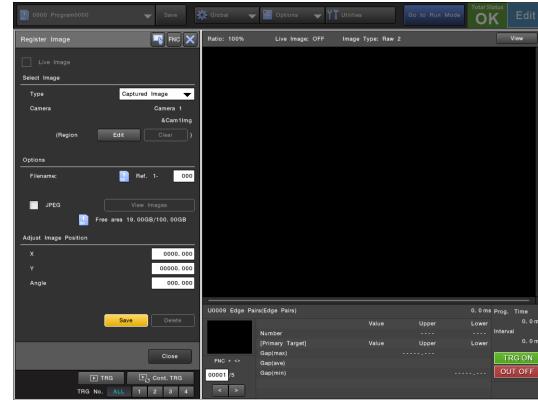
The top menu of the Edge Pairs tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-124)	Register an image to be used as a template for settings.
Select Image (Page 2-124)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-125)	Define the region to be used for unit processing.
Color (Page 2-125)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-125)	Specify the filter processing to apply to the image.
Edge Detection (Page 2-126)	Specify the scan direction and edge direction for detecting edges, as well as other detailed conditions for edge detection.
Parameters (Page 2-127)	Specify other conditions for the Edge Pairs tool as required.
Limits (Page 2-128)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-129)	Specify the display methods for things such as the inspection region and mask region.
Save (Page 2-129)	Save the current state to the program file.

Register Image

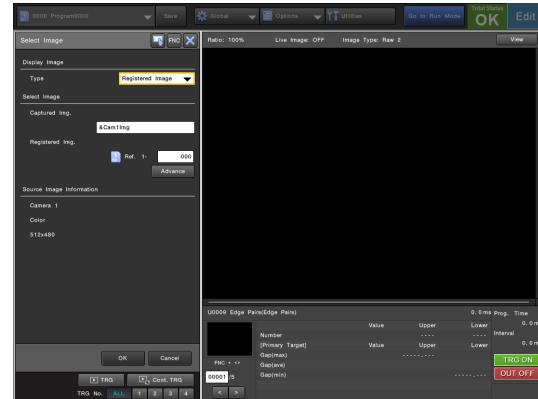
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

Specify the captured image and registered image to use for measurement.

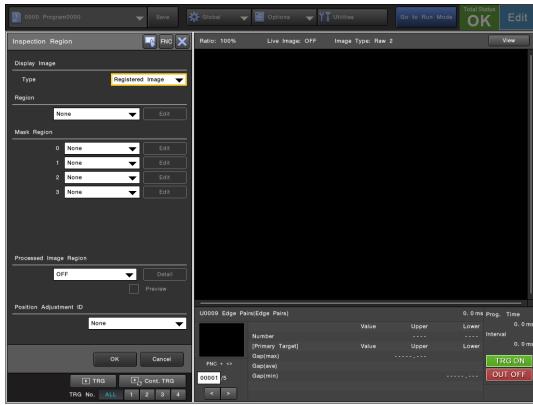


For more details, see "Select Image" (Page 2-471).

Inspect Region

Define the region to be used for unit processing.

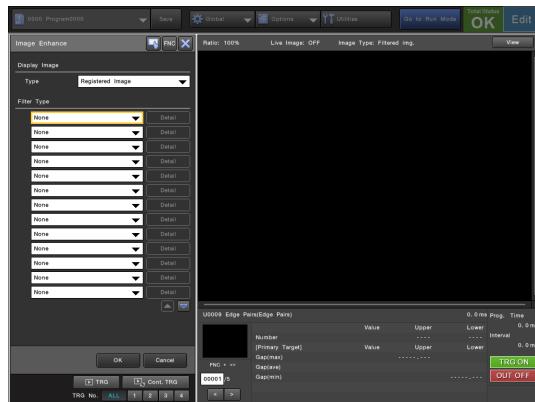
Point Changing the shape of the region will reset some settings on the [Edge Detection] screen.



For more details, see "Region Settings" (Page 2-473).

Image Enhance

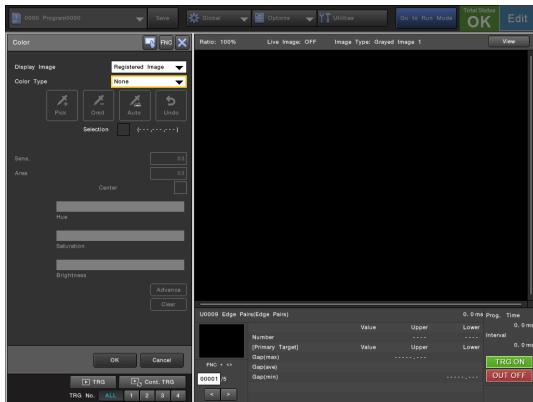
Specify the filter processing to apply to the image.



For more details, see "Image Enhance" (Page 2-489).

Color

When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.

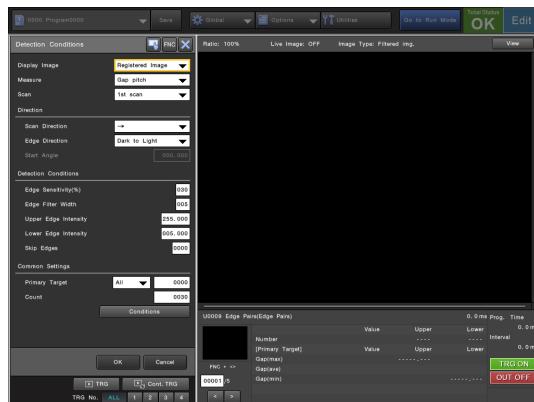


For more details, see "Color Extraction" (Page 2-483).

Edge Pairs

Edge Detection

Specify the scan direction and edge direction for detecting edges, as well as other detailed conditions for edge detection.



Reference Refer to "What is an Edge?" (Page 2-95) for the technical description of edge detection.

Display Image

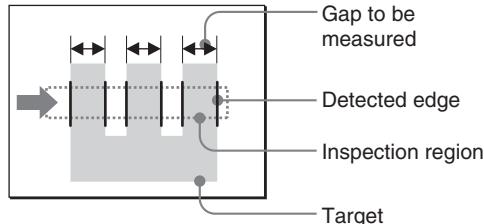
Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

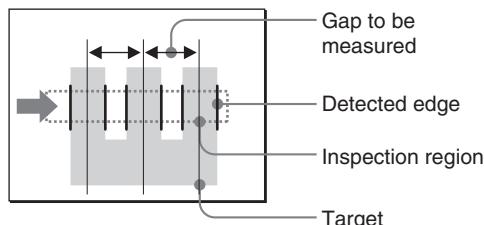
Measure

Select the type of edge gap measurement.

- Gap pitch:** Detect edges in the specified scan direction and measure the maximum, minimum, and average gap values between each pair of odd and even edges.



- Center pitch:** Measure the maximum, minimum, and average values between the center points of the pairs of odd and even edges.



Scan

Select [1st scan] and set the parameters for the first scan, and then select [2nd scan] and set the parameters for the second scan.

Direction

Scan Direction

Select the scan direction to detect an edge.

- When the inspection region is a rectangle, circle, oval, polygon or composition:** →, ←, ↑, ↓

- When the inspection region is a rotated rectangle:**

Forward or reverse with respect to the horizontal axis (X axis) of the region Since the scan direction depends on the rotation angle of the inspection region, this should be taken into consideration when selecting this option.

- When the inspection region is a ring or an arc:**

Clockwise, Counterclockwise

Edge Direction

Select the change in contrast for detecting an edge.

- Light to Dark:** Detect edges in a transition that changes from a bright area to a dark area.
- Dark to Light:** Detect edges in a transition that changes from a dark area to a bright area.
- both** (default): Detect edges in a transition that can change either from a bright area to a dark area or from a dark area to a bright area.

Start Angle

When [Ring] is selected for the inspection region, specify a starting angle (0° to 359.999°) for detecting edges.

Point If the start angle is changed, the detection angle will be calculated with reference to the 3 o'clock position being 0°.

Detection Conditions

Edge Sensitivity (%)

Set the percentage threshold (0% to 100%) for detecting edges.

Edge Filter Width

Set the width (0 to 100 pixels) of the smoothing filter applied to the differential graph for detecting edges.

Upper Edge Intensity

Specify the upper limit (0.000 to 255.000) of edge intensity for detecting edges.

Lower Edge Intensity

Specify the lower limit (0.000 to 255.000) of edge intensity for detecting edges.

Reference Unwanted edges can be excluded from detection by adjusting the upper and lower edge intensity values referring the highest edge intensity in the region (shown on the left of the edge graph). See "What is an Edge?" (Page 2-95) for more details.

Skip Edges

Specify the number of edges to be excluded before the first desired edge.

Common Settings

Primary Target

Use [All] to scan for all pairs and measure the maximum and minimum gap / pitch. To measure a single pair gap / pitch, select [Specified] and then specify the edge pair number. The pair that is specified here provides the measurement data for judgment in the unit.

Count

Specify the maximum number of edge pairs (0 to 3600) to be measured.



- The edge pair count cannot exceed the value set for [Maximum].
- With some settings, the maximum number of pairs cannot be changed.
- It may be possible to specify the [Count] value exceeding the [Maximum] value (Maximum: 3600) depending on the account setting. Note, however, that this also increases the [Maximum] value, resulting in more consumption of the program memory.

Conditions

By selecting [Conditions], you can change the following settings:

Max Edge Gap

Specify the maximum distance between edges in a pair. Edge pairs that exceed the maximum distance will not be returned as pairs.

Min Edge Gap

Specify the minimum distance between edges in a pair. Edge pairs with a pitch below the minimum distance will not be returned as pairs.



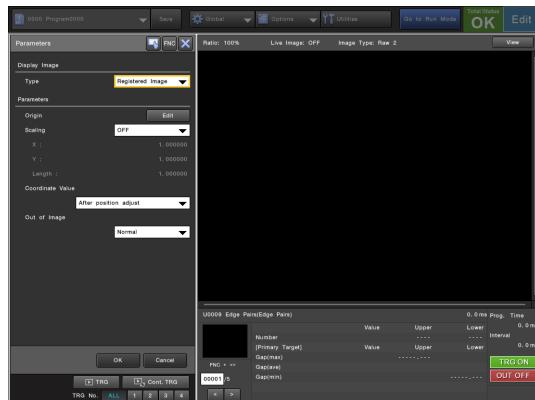
- The maximum and minimum distances specified in the [Edge Gap] will be applied to the results before the scaling operation, even if [Scaling] (Page 2-127) is set to [ON].

Angled Edge Detection

Set to [ON] to stabilize the detection of slanted edges in the inspection region. Using this option may affect the edge X, Y position accuracy.

Parameters

Specify other conditions for the Edge Pairs tool as required.



Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.



The origin can be set outside the process region.

The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels. The result data and setting parameters used for display, judgment and calculations can be converted and scaled to real life values and dimensions by using the pre-set scaling factor option.

- OFF:** Do not use scaling.
- ON:** Use scaling.



The scaling value can be changed in the [Options] menu (Page 4-18).

- For a summary list of the result data for which scaling can be used, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Edge Pairs

Coordinate Value

Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- **After position adjust:** The inspection uses the adjusted coordinate axes determined after position adjustment.
- **Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Out of Image

Specify whether to incorporate data that falls outside of the inspection region. This maybe required when position adjustment is used.

- **Normal** (default): Edge detection outside of the region is disabled as the image data outside of the region is masked. Since masking requires time to process, the inspection time may vary depending on the quantity image data outside the region. Processing will take longer when the inspection region is a ring or an arc.
- **Fast:** The image data outside of the region is not masked, allowing for faster processing. As the image data outside the region has not been masked so there is an increased chance of detecting an edge outside the region. Select [Normal] to avoid incorrect edge detection.

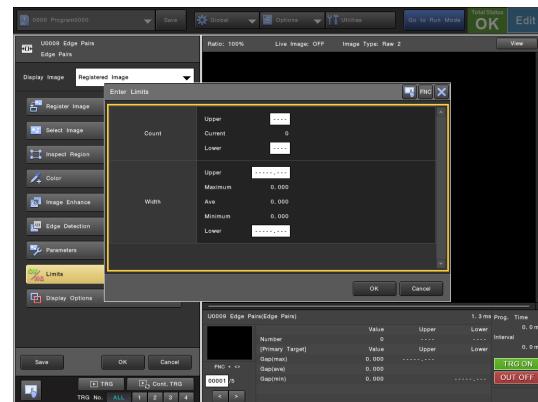


Image data which is already located outside of the region during the inspection region setting will always be masked regardless of the [Out of Image] setting.

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.



- [----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Count

Specify the tolerance for the edge pairs detection count. The unit of measurement is the "number of pairs" detected.

Width

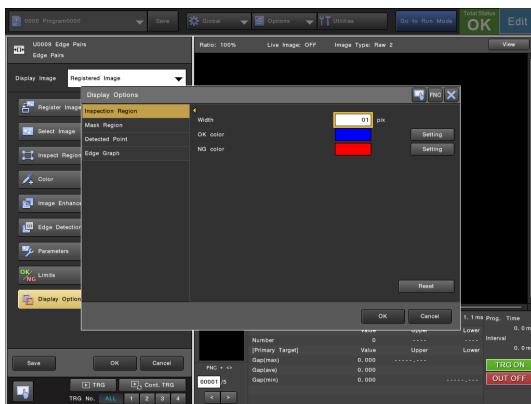
Specify the tolerance for the width for the detected edge pairs.

The unit of measurement is the "number of pixels" (when the inspection region is not a ring or an arc) or "angle" (only when the inspection region is a ring or an arc) of the width between the pairs of edges.

Display Options

Specify the display methods for things such as the inspection region and mask region, and detected edge and edge graph.

You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection region

Specify the line width and display color of the inspection region.

Mask region

Specify the line width and display color of the mask region.

Detected Point

Primary target

Specify the width and display color of the line indicating the detected edge.

Other target

Specify the width and display color of the line indicating the detected edge other than the one specified as the primary target (Page 2-127).

Edge graph

Edge graph

Select whether to display the edge graph.

- OFF (default): Hide the edge graph.
- Both: Show both 1st and 2nd scan edge graph.
- 1st scan: Show only the 1st scan edge graph.
- 2nd scan: Show only the 2nd scan edge graph.

Wave

Specify the width and display color of the edge graph waveform.

Frame

Specify the width and display color of the edge graph frame.

Sensitivity

Specify the width and display color of the line representing the edge sensitivity threshold.



Point

Setting [Edge graph] to [ON] consumes additional program memory. Check the amount of remaining program memory before enabling.

Reset

Returns the display options to their defaults.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



Point

- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

Defect

Defect Tool

The defect tool is convenient when precise detection is required for detecting flaws on targets. With the inspection region a small group of pixels (element) is defined and the average intensity calculated. Nearby elements are compared with each other to check average intensity differences.

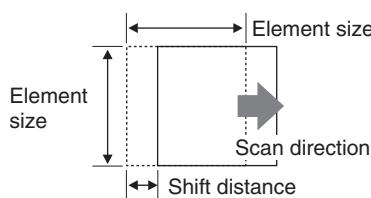
Elements that have an intensity difference greater than the threshold specified when compared are identified as defects. Adjacent defects can be grouped together for blob based processing and subtraction image enhancement filters (Page 2-494) can also be used for detecting flaws on complex images.

Reference

- Because defect detection is based on the transition from bright to dark (or dark to bright), not on absolute intensity values, it is less affected by illumination fluctuations during image capturing.
- The [Fine Color] (defect tool specific function) can be used to detect defects based on color and not intensity. Making the defect tool capable of detecting color defects only and ignoring intensity changes caused by lighting or changes in target reflectivity.

Measurement Overview

The defect tool indexes the element by the shift distance in the specified scan direction within the inspection region measuring the average intensity of each element.



Difference between defect level and defect area

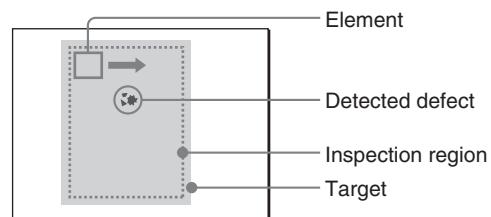
The [Defect Level] is the difference between the maximum and minimum intensities across the last 4 elements, including the current element.

In the following example, the defect level is obtained as follows: [Maximum intensity of 120] (Intensity of the segment at position number 4) - [Minimum intensity of 80] (Intensity of the segment at position number 2) = 40 (Defect level).

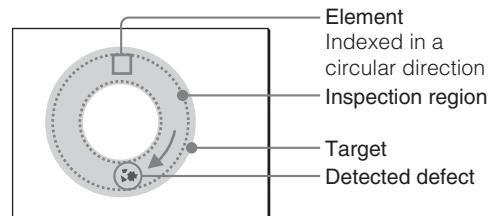
- ① Current element (Average intensity: 95)
 - ② Current element + 1 (Average intensity: 80)
 - ③ Current element + 2 (Average intensity: 100)
 - ④ Current element + 3 (Average intensity: 120)
-

If the threshold set in the [Defect Level] is exceeded, the current element is judged to be a defect and is added to the [Defect Area] ([Defect Area] is the number of elements that exceed the defect level).

Example when the detection direction is either X or Y or XY



Example when the detection direction is circular



Main measurement results

The standard results and data returned by Defect tool are as follows:

Point	Processing results may vary depending on the group settings (Page 2-136). The result for an item which is not processed is always 0.
Detected defect level	Outputs the intensity difference from the element with the highest defect level.
Total defect area	Outputs the total number of elements with defect levels exceeding the defect level threshold in the inspection region. <small>(Tolerance inspection target)</small>
Position (X, Y)	Outputs the position coordinates of the element with the highest defect level.
Number of groups	Outputs the number of groups detected by the defect grouping function (when the defect grouping function is ON). <small>(Tolerance inspection target)</small>
Defect Area []	Outputs the total number of elements for each group which have defect levels exceeding the defect level threshold (when the defect grouping function is ON). <small>(Tolerance inspection target) (Label specification target)</small>
Position (X, Y) []	Outputs the coordinates of the centers of all groups in pixels. The general location of a defect can be measured. If the defect tool is being used for position adjustment (Page 2-306), this is result that needs to be used for stable processing. <small>(Tolerance inspection target) (Label specification target)</small>
Angle (T) []	Outputs angles relative to the horizontal (X axis) for all detected defects (only when [Additional Group Result] in [Group Setting] is enabled). <small>(Label specification target)</small>
Area []	Outputs the surface area as a number of pixels for all defects (only when the defect grouping function is ON). <small>(Label specification target)</small>
Feret Diameter (X, Y) []	Outputs the feret diameter (length and width calculated from the circumscribed rectangle created with parallel horizontal (X axis) and vertical (Y axis) boundaries) of all detected blobs after filtering in pixels (only when [Additional Group Result] in [Group Setting] is enabled). <small>(Label specification target)</small>
Perimeter []	Outputs the perimeters as a number of pixels for all detected defects (only when [Additional Group Result] in [Group Setting] is enabled). <small>(Label specification target)</small>

Roundness

Outputs the degree of similarity (1.000 to 0.000) to a perfect circle of all defects. (only when [Additional Group Result] in [Group Setting] is enabled). A perfect circle is considered as a value of 1.000, and the value will reduce to 0.000 as the similarity decreases. (Label specification target)



Similar to a perfect circle
Roundness: 0.950

Less similar to a perfect circle
Roundness: 0.345

Major Axis []

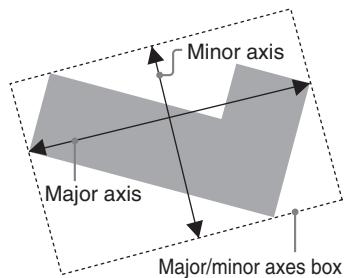
Outputs the major axis' as a number of pixels (only when [Additional Group Result] in [Group Setting] is enabled.) (Label specification target)

Minor Axis []

Outputs the minor axis' as a number of pixels (only when [Additional Group Result] in [Group Setting] is enabled.) (Label specification target)

Axes Ratio []

Outputs the ratio of the major and minor axes as a number of pixels (only when [Additional Group Result] in [Group Setting] is enabled) The axes ratio is a value of the "Major axis/Minor axis," and a larger value represents a thinner shape. (Label specification target)



Distributed Oval

Outputs the major axis' of an equivalent distributed oval as a number of pixels (only when [Additional Group Result] in [Group Setting] is enabled).

(Label specification target)

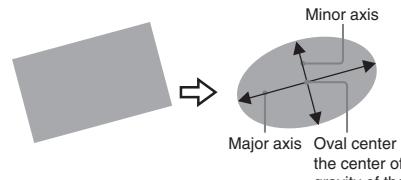
Distributed Oval

Outputs the minor axis' of an equivalent distributed oval as a number of pixels (only when [Additional Group Result] in [Group Setting] is enabled).

(Label specification target)

Aspect Ratio []

Outputs the ratio of the major and minor axes of an equivalent distributed oval (only when [Additional Group Result] in [Group Setting] is enabled). A larger value represents a thinner shape.) (Label specification target)



The equivalent oval of a defect is an approximate oval obtained from the shape of the defect and is useful for stable measurement of shapes that have spikes or strands that skew major/minor axis measurements.

Defect axes box

position

Outputs the coordinates for the circumscribed rectangle based on the major and minor axis for all detected defects ([Additional Group Result] in [Group Setting] is enabled). (Label specification target)

(Upper left,

lower left, upper

right, lower

right) []

Defect

Distributed Oval	Outputs the coordinates for the major and minor axis points for the equivalent distributed oval for all detected defects ([Additional Group Result] in [Group Setting] is enabled) The position relationship (up/down/right/left) is based on the angle of the major axis. <small>(Label specification target)</small>
-------------------------	---

Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.
----------------------------	---

- Point**
- When the result is within the tolerance range, it is judged as [OK] (binary 0).
 - When target classification is ON, the results are also output for each classification type No. (in the format !U[****].RSLT.CLS[*1].****, *1 is the type No.) For more details, see "List of Setting Parameters / Result Data" in the XG-X2000 Series Communications Control Manual.
 - If the region is a [Rotated Rectangle], all [Bounding Box] values are 0.

Reference

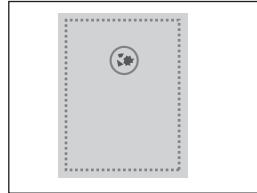
For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

Example showing the results of a defect inspection performed under the following conditions.

When a defect on the surface of a target is detected

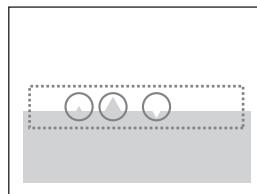
- Direction: XY



Total area
20

When a crack or burr on the surface of a target is detected

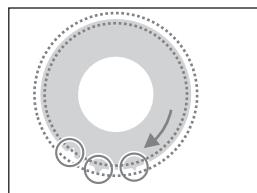
- Direction: X



Total area
55

When a crack or burr on the round surface of a target is detected

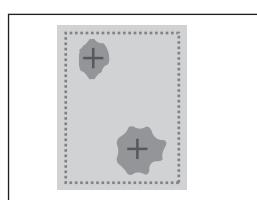
- Direction: Circular



Total area
35

When the position of a defect on the surface of a target is detected

- Direction: XY
- Defect Grouping Function: ON
- Detection count: 2
- Detection order: X>Y: Ascend

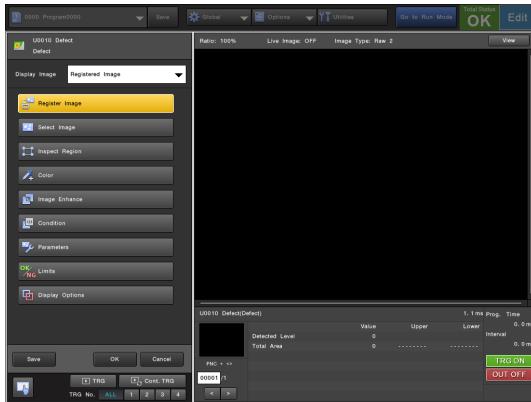


Result of the first defect
Defect area: 70
Center:
X100, Y100

Result of the second defect
Defect area: 100
Center:
X200, Y400

Top Menu

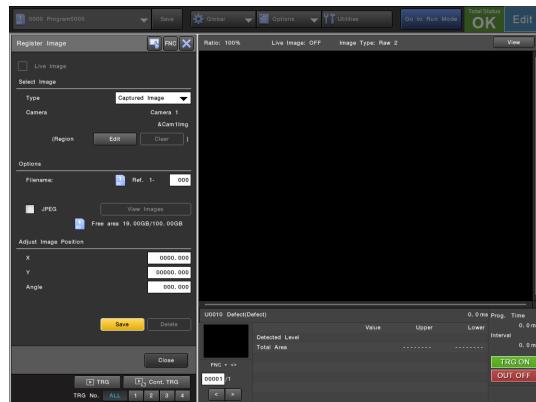
The top menu of the Defect tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-133)	Register an image to be used as a template for settings.
Select Image (Page 2-133)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-134)	Define the region to be used for unit processing.
Color (Page 2-134)	Set whether to directly process CCD color information with [Fine Color] or convert to a monochrome image with your desired extraction method when you specify color image variables for the captured image.
Image Enhance (Page 2-134)	Specify the filter processing to apply to the image.
Condition (Page 2-135)	Specify the conditions to detect Defect during measurement.
Parameters (Page 2-138)	Specify other conditions for the Defect tool as required.
Limits (Page 2-139)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-140)	Specify the display methods for things such as the inspection region and mask region.
Save (Page 2-140)	Save the current state to the program file.

Register Image

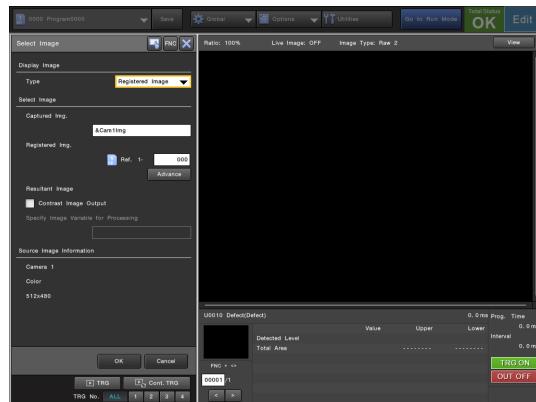
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

Specify the captured image and registered image to use for measurement.



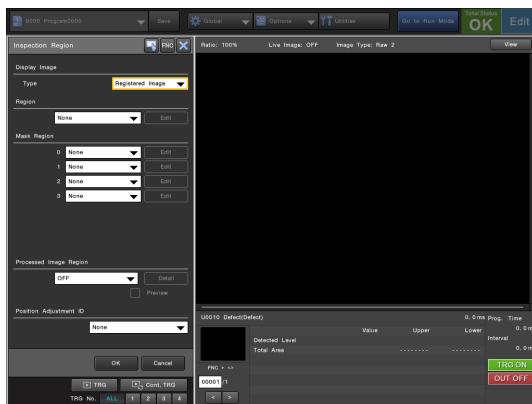
For more details, see "Select Image" (Page 2-471).

Inspect Region

Define the region to be used for unit processing.



Changing the shape of the region will reset some settings on the [Condition] and [Limits] screens.



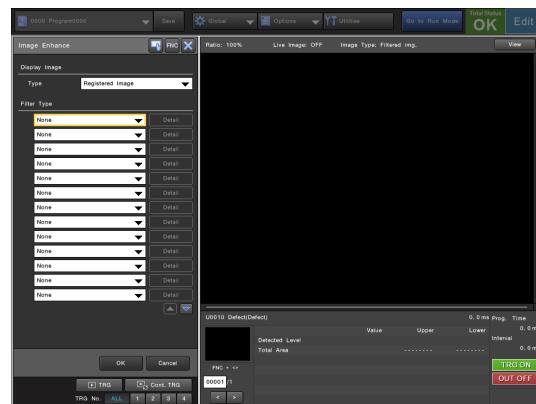
For more details, see "Region Settings" (Page 2-473).

Image Enhance

Specify the filter processing to apply to the image.



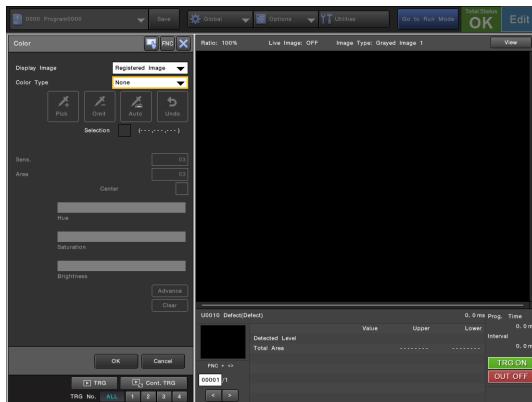
Filter processing cannot be applied when [Fine color] is selected for [Color].



For more details, see "Image Enhance" (Page 2-489).

Color

Set whether to directly process CCD color information with [Fine Color] or convert to a monochrome image with your desired extraction method when you specify color image variables for the captured image.



For more details, see "Color Extraction" (Page 2-483).

Operation when [Fine Color] is selected for [Color Type] (Color Defect Mode)

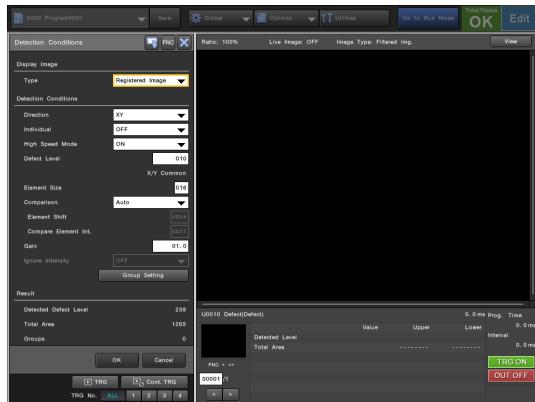
Selecting [Fine Color] will cause changes in color to be detected as defects, rather than specific colors.

- As in the case where [Grayscale] or [RGB Grayscale] is selected, selecting [Fine Color] initializes the color extraction settings and no further settings are possible.
- Filter processing cannot be applied in color defect mode.
- In color defect mode, the [Ignore Intensity] setting is available on the [Condition] screen (Page 2-136).

For more details, see "What is Fine Color Mode?" (Page 2-142).

Condition

Specify the conditions to detect Defects during measurement.



Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Detection Conditions

Direction

Select the direction to search for defects.

- **XY:** Detect intensity differences together in both the X-direction and Y-directions.
- **X:** Detect intensity differences only in the X-direction.
- **Y:** Detect intensity differences only in the Y-direction.
- **Cir.:** Detect intensity differences only in a circular direction.
- **Rad.:** Detect intensity differences radially from the inside of a ring/arc outward.



- Circular and radial directions are only available when the inspection region is [Ring] or [Arc].
- If the inspection region is [Ring] and the search direction is [Cir.] or [Rad.], the defect [Grouping] and [Additional Data] are not available.
- When the inspection region is [Rotated Rect], the XY coordinates move according to the rotation of the region.
- If the search direction is [Cir.] or [Rad.], no filter can be applied to the [Grouping].
- If the inspection region is [Arc] and the search direction is [Cir.] or [Rad.], [Additional Data] is not available.

Individual

Select [ON] to set element parameters individually for each search direction.

- **OFF:** Use the same segment parameters for different search directions.
- **ON:** Set segment parameters individually for each search direction.

This allows the independent setting of the segment size and shift in the X and Y directions (or in the circular and radial directions when the inspection region is a ring or an arc).

High Speed Mode

Use High speed mode to decrease unit processing time or enable fine detection.

- **ON :** High speed processing.
- **OFF:** Fine detection.

When the high speed mode is set to [ON], the segment size and shift can be set in multiples of 4 only. (If a variable is referenced the value is rounded off to the nearest integer and then rounded up to the nearest multiple of 4.)

If the inspection region extends off the screen, a measurement error (Total defect area: 99999999) will result and the contrast view within the inspection region will be cancelled.

Defect Level

Set the deviation from the average change in intensity for identifying a defect.

Defects that deviate from the average by less than this parameter will not be considered defects. The defect level can be specified within the range 0 to 254.

Element Size

Set the element (pixel group) size (1 to 256 pixels) which moves inside the inspection region in the X (horizontal) and Y (vertical) directions respectively.



- If the element size is larger than the inspection region, the measurement is disabled and the total defect area is shown as "99999999".
- When [Cir.] or [Rad.] is selected for [Direction], the settings are changed to [Rad.] or [Cir.].
- To specify different sizes in the direction of X/Y and Radial/Circular individually, set [Individual] to [ON].

Comparison

To record gradual changes in intensity as a greater amount of defect, select [Manual] and then make the necessary settings (default: Auto).

The defect measurement is initially set to detect sharp changes in contrast within the inspection region. This is because it calculates the difference in intensity between 2 neighboring segment scans, and by default those neighboring scans are only a few pixels apart. However, there may be instances where it is necessary to detect gradual changes in contrast, such as when trying to detect color irregularities on a target surface.

In such a case, large defects can be detected by changing the settings of [Element Shift] or [Compare Element Interval] to allow detection of intensity differences across long distances.

Element Shift

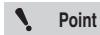
Specify the number of pixels within the range 1 to 2432 as the distance to shift the element for calculating the next average intensity value. When [Auto] is selected, this is automatically set to 1/4 of the element size. If the high speed mode is [ON], this value must be a multiple of 4.



If the value of [Element Shift] is larger than [Element Size], some parts of the inspection region will not be reflected in the intensity average. To detect defects smaller than the segment size, use [Auto] or specify an element shift smaller than the element size.

Compare Element Interval

Specify the number of elements within the range 1 to 2432 as the interval distance when comparing the difference in intensity between elements. When [Auto] is selected, this is always set to [1].



Increasing the [Compare Element Interval] value increases the risk of a single defect being detected more than once. When using the grouping function (Page 2-136) to process defects as blobs, lower the value of [Compare Element Interval].

Gain

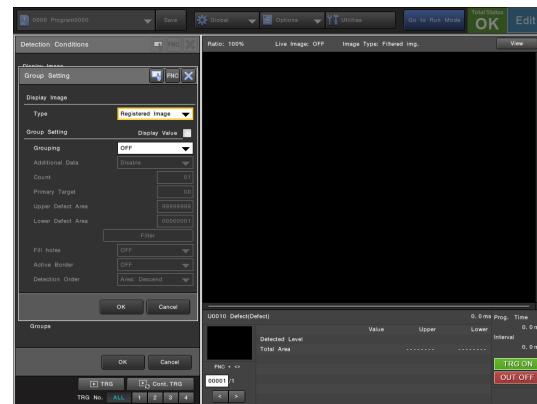
Set the gain for the intensity difference for detecting defects. If you want to detect defects with a small difference in intensity, set the gain value to a large number.

Ignore Intensity

Detect only changes in the pure color information (hue and saturation) as defects, and exclude any brightness / intensity information.

- **OFF**(default): Changes in intensity are processed as part of the defect level measurement.
- **ON**: Only changes in hue and saturation are used for the defect level measurement (this setting cannot be selected for camera images for which MultiSpectrum Mode is enabled).

Group Setting



Display Value

Use this function to display the defect area value for the displayed image next to the [Lower Defect Area] field.

Grouping

If turned [ON], adjacent defects are grouped together so that the center point, area and size aspects of each group can be processed.

- **ON**: Group defects.
- **OFF**: Do not group defects.



- Grouping is disabled when the inspection region is a ring and [Direction] (Page 2-135) is set to [Cir.] or [Rad.].
- If the grouping is set to [OFF], all group-related functions are disabled.
- If grouping is changed from [ON] to [OFF], group-related settings and associated limits previously set are reset.
- If grouping is changed from [ON] to [OFF], Count is initialized to 1.

Additional Data

This option enables additional result data to be obtained through group processing.

See "Main measurement results" (Page 2-131) for details about the individual items.



If the inspection region is an arc and the search direction is circular or radial, additional group result data is not available.

Count

Specify the maximum number of groups (1 to 99) to be detected. When [Grouping] is [OFF], this setting is disabled.

Primary target

Specify the group data (0 to 98) to be used for judgment, set to [0] for normal operation.



When the primary target is changed, it is possible to change the defect area value shown in the current value display to the value of any group.

Upper Defect Area

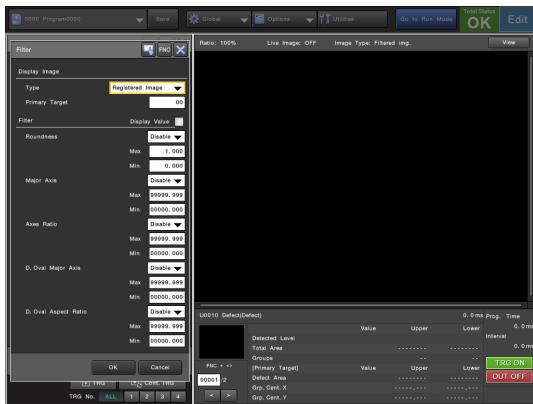
Specify the maximum area for a defect to be detected as a group. Groups with an area higher than this value are not detected as groups. When [Grouping] is [OFF], this setting is disabled.

Lower Defect Area

Specify the minimum area for a defect to be detected as a group. Groups with an area lower than this value are not detected as groups. When [Grouping] is [OFF], this setting is disabled.

Filter

Specify the maximum / minimum range for each selection parameter used to identify a group.



- Display Image:** Switch the image displayed on the screen.
 - Captured image:** Displays the latest image from the specified camera (image variable).
 - Registered image:** Displays the registered image specified under [Select Image].
- Primary Target:** Specify the group data (0 to 98) to be used for judgment, set to [0] for normal operation.
- Display value:** Use this function to display the values of each parameter for the displayed image in blue.
- Filter:** Choose to enable / disable each filter and set the maximum and minimum range.
 - Roundness:** Groups that have their roundness values higher than the specified maximum value (0.000 to 1.000, where 1.000 is a perfect circle) or groups that have roundness values lower than the specified minimum value are not detected as defect groups.
 - Major Axis:** Groups that have their major axis values higher than the specified maximum value or groups that have major axis values lower than the specified minimum value are not detected as defect groups.
 - Axes Ratio:** Groups that have their axes ratios (major axis / minor axis) higher than the specified maximum value (thinner groups) or groups that have axes ratios lower than the specified minimum value (proportionally correct groups) are not detected as defect groups.

- **Dist. Oval Major Axis:** Groups that have their distributed oval major axis value of the group higher than the specified maximum value or groups that have their distributed oval major axis value of the group lower than the specified minimum value are not detected as defect groups.

- **Dist. Oval Aspect Ratio:** Groups that have their aspect ratio (distributed oval major axis / minor axis) of the group higher than the specified maximum value (thinner groups) or groups that have their aspect ratio (distributed oval major axis / minor axis) of the group lower than the specified minimum value (proportionally correct groups) are not detected as defect groups.



- The filter functions cannot be used when [Cir.] or [Rad.] is selected for [Direction] (Page 2-135).
- When [Additional Data] in the group settings is OFF, current values are shown as [0] even when the [Display Value] box is checked.



When the primary target is changed, it is possible to also change the defect area value shown in the current value display to the value of any group.

Fill holes

Select whether to fill the holes inside a group to include them as part of a detected defect.



Fill holes: OFF



Fill holes: ON

- OFF:** Do not fill the holes.
- ON:** Fill the holes.



The results of fill holes are not reflected in [Total Area] or [Contrast view].

Active Border

Specify whether to treat groups found on the frame of the inspection region as a detection target.

- OFF:** Groups found on the inspection region frame are also detected.
- ON:** Groups found on the inspection region frame are excluded and not detected.



The active border ON/OFF can only be specified when the inspection region is a rectangle, rotated rectangle, arc ([Direction] is [Cir.] or [Rad.]), and when no mask and image regions have been set. If any other type of inspection region is selected, the active border is always set to OFF.

Defect

Detection order

Select the identification order of the detected groups. When [Grouping] is [OFF], this setting is disabled.

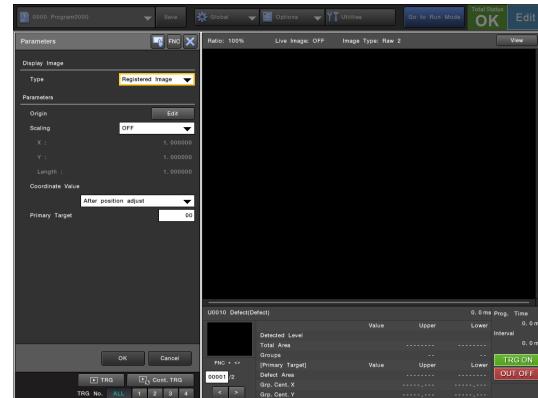
- If the inspection region is not set to [Arc] and the detection direction is not [Cir.] or [Rad.], select the conditions for ordering groups from the following 8 methods.
 - Y>X: Ascend:** Sort groups in ascending Y order. If Y values are the same, then sort the groups in ascending X order.
 - X>Y: Ascend:** Sort groups in ascending X order. If X values are the same, then sort the groups in ascending Y order.
 - X: Ascend:** Sort groups in ascending X order.
 - X: Descend:** Sort groups in descending X order.
 - Y: Ascend:** Sort groups in ascending Y order.
 - Y: Descend:** Sort groups in descending Y order.
 - Area: Ascend:** Sort groups from the lowest defect area to highest.
 - Area: Descend** (default): Sort groups from the highest defect area to lowest.
- If the inspection region is set to [arc] and the detection direction is either [Cir.] or [Rad.], select the conditions for ordering groups from the following 6 methods.
 - Clockwise:** Sort groups based on angle, clockwise from the start of inspection region.
 - Counterclockwise:** Sort groups based on angle, counterclockwise from the start of inspection region.
 - Out → Center:** Sort groups based on the distance from the center of the inspection region, starting with the longest.
 - Center → Out:** Sort groups based on the distance from the center of the inspection region, starting with the shortest.
 - Area: Ascend:** Sort groups from the lowest defect area to highest.
 - Area: Descend** (default): Sort groups from the highest defect area to lowest.



When the inspection region is a rotated rectangle, the XY coordinates move according to the rotation of the region.

Parameters

Specify other conditions for the Defect tool as required.



Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.



The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels. The result data and setting parameters used for display, judgment and calculations can be converted and scaled to real life values and dimensions by using the pre-set scaling factor option.

- OFF:** Do not use scaling.
- ON:** Use scaling.



- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate Value

Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- **After position adjust:** The inspection uses the adjusted coordinate axes determined after position adjustment.
- **Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Primary Target

Specify the group data (0 to 98) to be used for judgment, set to [0] for normal operation.

When [Grouping] is [OFF], this setting is disabled.

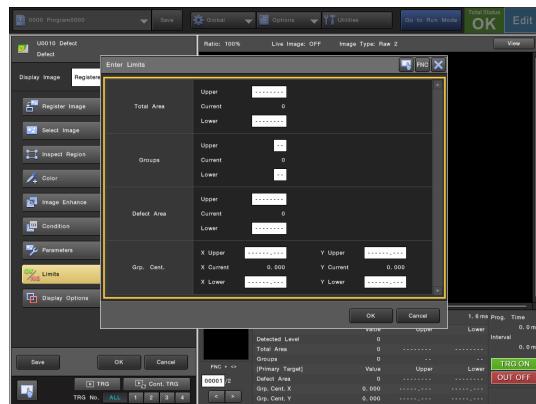


Only the data from the primary target will be used for judgment (excluding the total defect area and group count).

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.



- [----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Total Area

Specify the tolerance for the total defect area in the inspection region.

The unit of measurement is the "defect area", denoting the number of elements of the detected defect.

Groups

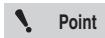
Specify the tolerance for the defect group count. The unit of measurement is the "number of groups".



This limit is disabled when [Grouping] (Page 2-136) is set to [OFF].

Defect Area

Specify the tolerance for the defect area of the group. The unit of measurement is the "defect area", denoting the number of elements of the detected defect.



This limit is disabled when [Grouping] (Page 2-136) is set to [OFF].

Grp. cent.

Specify the tolerance for the center co-ordinate of the group. The unit of tolerance is the "number of pixels" indicating the center co-ordinates.

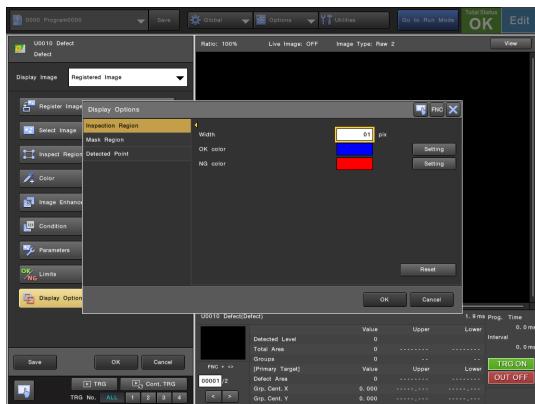


This limit is disabled when [Grouping] (Page 2-136) is set to [OFF].

Defect

Display Options

Specify the display methods for things such as the inspection region and mask region, and detected defects. You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection region

Specify the line width and display color of the inspection region.

Mask region

Specify the line width and display color of the mask region.

Detected Point

Primary target

Specify the width and display color of the detected point (center) of the detected defect.

Other target

Specify the width and display color of the detected point (center) of the detected defect other than the one specified as the primary target (Page 2-139).

Reset

Returns the display options to their defaults.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

Point

- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

What is the Defect Grouping Function?

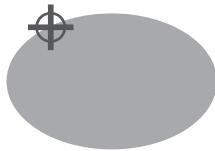
The defect grouping function in the defect unit (Page 2-130) allows successive small areas that have been detected as a defect to be grouped together.

A normal defect inspection identifies the segment with the maximum intensity difference (defect level) among multiple segments. The defect area represents the total number of segments (defects) that exceed the threshold (defect level) in the inspection region. The defect grouping function treats successive segments that exceed the defect level threshold value as a group for processing.

The grouping function is useful for finding the position of flaws and defects larger than the segment size, and for features (defects, etc.) that are larger in area than their intensity difference.

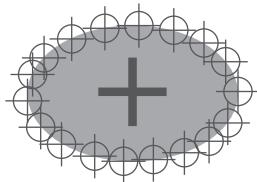
Detecting positions

Defect grouping function [OFF]



The position of the segment that has the maximum intensity difference is detected.

Defect grouping function [ON]



The center of gravity from the grouping of several segments is used for the position.

Reference The detection segment in the illustration is a conceptual image and may differ from actual inspection. Check the defect detection in the [Contrast Image] to setup defect grouping correctly.

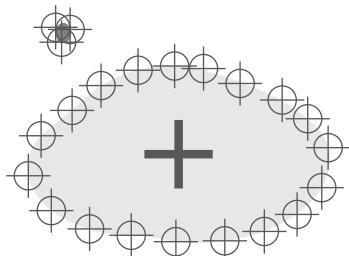
Detecting large flaws

Defect grouping function [OFF]



The segment that has the maximum intensity difference is detected.

Defect grouping function [ON]



The group that has the larger number of segments (defect area) that exceed the defect level at the boundary (a subtle defect, in the example above) can be detected.

Reference The detection segment in the illustration is a conceptual image and may differ from actual inspection. Check the defect detection in the [Contrast Image] to setup defect grouping correctly.

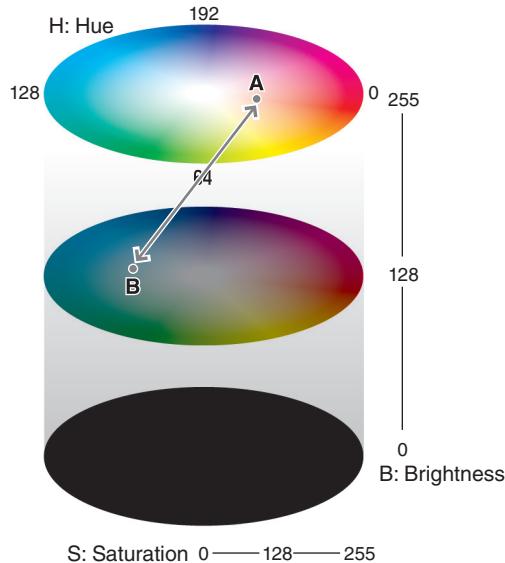
Point

- When [Ring] is selected for the inspection region and [Cir.] or [Rad.] is selected for the scan direction, the defect grouping function is disabled.
- When [Arc] is selected for the inspection region and [Cir.] or [Rad.] is selected for scan direction, the [Filter] is disabled.

What is Fine Color Mode?

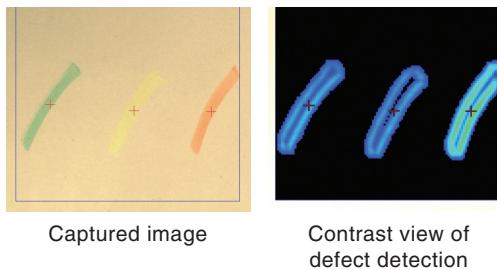
The Fine Color mode of this system utilizes the real color information, H (hue), S (saturation), and B (brightness) for detection. The HSB information of each segment is compared and is used as the base line for defect mode. The differences in the color information determine the defect level.

The calculated defect level is illustrated in the below graphic as the straight line between points A and B, which are two different colors in the HSB color space.



The Ignore Intensity function can be used so that B (Brightness) information can be excluded and only changes in H (Hue) and S (Saturation) are used for calculation of the defect level. In this situation, defects are only detected as color differences, without the influence of brightness that doesn't contain color components.

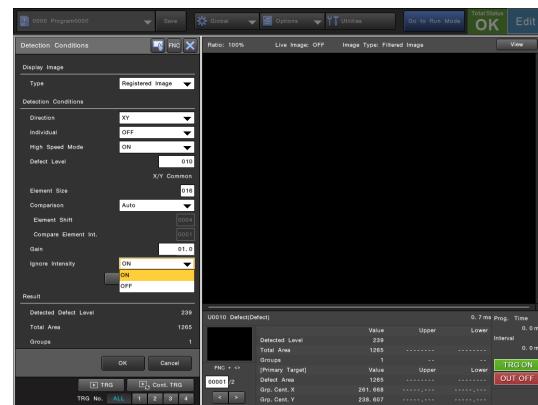
Detection image with fine color defect



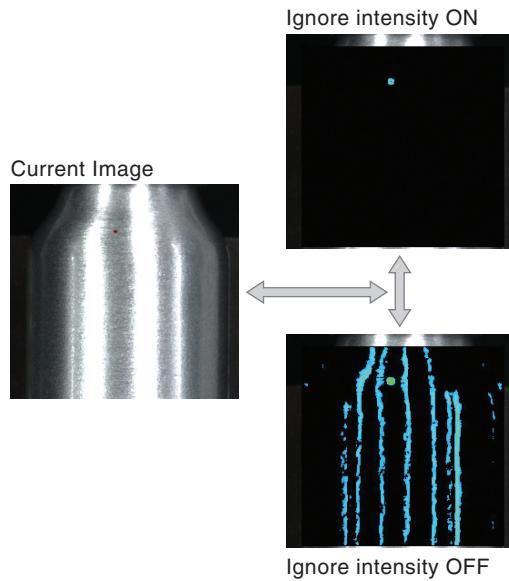
Eliminating intensity (brightness) and detecting defects

The defect detection can be set to ignore intensity (brightness) information and use only the color differences for detection.

To eliminate brightness information, select [ON] for [Ignore Intensity] on the [Condition] screen (Page 2-135).



- **OFF** (default): Applies brightness changes to the [Defect Level] as well.
- **ON**: Detects only changes in H (Hue) and S (Saturation).



When Ignore Intensity is enabled, black and white defects are also removed. To detect black and white defects use [Grayscale] for [Color Type] and use the Shading Correction filter for stable processing (Page 2-497).

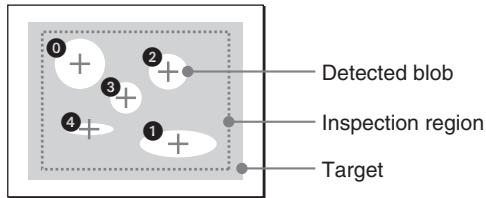
Blob

Blob Tool

The blob tool identifies a continuous group of pixels that have the same grayscale intensity binary conversion range (0 to 255) as a blob. The blob tool identifies and counts all the blobs in the inspection region and for each blob calculates its area, center of gravity, angle and length of major / minor axis, feret diameter, perimeter, and roundness.

Measurement Overview

Blobs are measured, filtered and identified based on numerous criteria. When identified they can be ordered based on size or detection direction.



Main measurement results

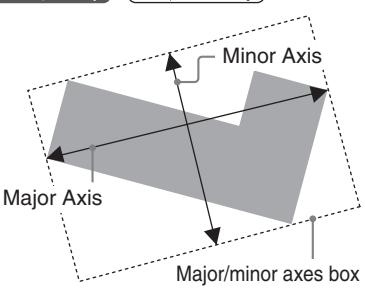
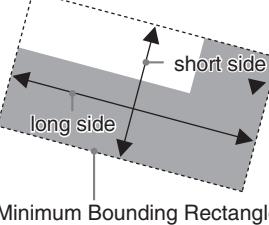
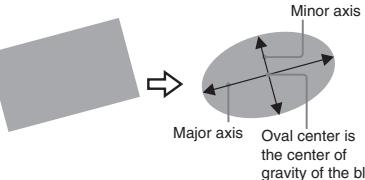
The standard results and data returned by Blob tool are as follows:

- Point** Processing results may vary depending on the shape of the inspection region. The result for an item which is not processed is always 0.

Number of Blobs	Outputs the number of detected blobs after filtering. [Tolerance inspection target] [Label specification target]
Position (X, Y) []	Outputs the center of gravity position coordinates for all detected targets after filtering. [Tolerance inspection target] [Label specification target]
Position (X, Y) (max, min)	Outputs the maximum and minimum center of gravity position coordinates in pixels from the range of detected targets after filtering. [Tolerance inspection target]
Angle (T) []	Outputs the major axis angle (with reference to the horizontal X axis) of all detected blobs after filtering. [Tolerance inspection target] [Label specification target]
Angle (T) (max, min)	Outputs the maximum and minimum angle of the major axis from the range of detected blobs after filtering. [Tolerance inspection target]

Area []	Outputs the areas for all detected targets after filtering in pixels. [Tolerance inspection target] [Label specification target]
Area (max, min)	Outputs the maximum and minimum areas in pixels from the range of detected blobs after filtering. [Tolerance inspection target]
Feret diameter (X, Y) []	Outputs the feret diameter in pixels (length and width calculated from the circumscribed rectangle created with parallel horizontal (X axis) and vertical (Y axis) boundaries) of all detected blobs after filtering. [Tolerance inspection target] [Label specification target]
Feret Diameter (X, Y) (max, min)	Outputs the maximum and minimum feret diameters in pixels from the range of detected targets after filtering. [Tolerance inspection target]
Perimeter []	Outputs the perimeters in pixels for all detected targets after filtering. [Tolerance inspection target] [Label specification target]
Perimeter (max, min)	Outputs the maximum and minimum perimeters in pixels from the range of detected targets after filtering. [Tolerance inspection target]
Roundness	Outputs the degree of similarity (1.000 to 0.000) to a perfect circle for all targets after filtering. A perfect circle is output as a value of 1.000. The number will close in on 0.000 as the similarity to a perfect circle decreases. [Tolerance inspection target] [Label specification target]
Roundness (max, min)	Outputs the maximum and minimum roundness values from the range of detected targets after filtering. [Tolerance inspection target]
Major Axis []	Outputs the major axis' in pixels when [Major / Minor Axis] in [Target Data] is enabled. [Tolerance inspection target] [Label specification target]
Major Axis (max, min)	the maximum and minimum major axis' in pixels when [Major / Minor Axis] in [Target Data] is enabled. [Tolerance inspection target]
Minor Axis []	Outputs the minor axis' in pixels when [Major / Minor Axis] in [Target Data] is enabled. [Tolerance inspection target] [Label specification target]
Minor Axis (max, min)	The maximum and minimum minor axis' in pixels when [Major / Minor Axis] in [Target Data] is enabled. [Tolerance inspection target]

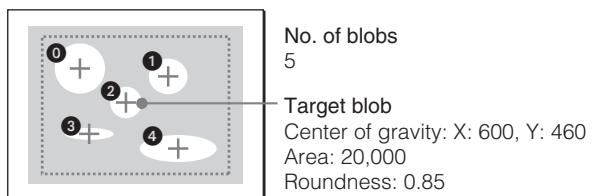
Blob

Axes Ratio []	Outputs the ratio of the major and minor axes in pixels when [Major / Minor Axis] in [Target Data] is enabled. The axes ratio is a value of the "Major axis/Minor axis," and a larger value represents a thinner shape. [Tolerance inspection target] [Label specification target]		Minimum Bounding Rectangle (Upper left, lower left, upper right, lower right) []	Outputs the minimum bounding rectangle angle, which makes the smallest area, the positions of apexes of bounding rectangle, position of the center, and the lengths of the long side/short side in the number of pixels for the detected blob. [Label specification target]	
Axes Ratio (max, min)	Outputs the maximum and minimum ratio of the major and minor axes in pixels when [Major / Minor Axis] in [Target Data] is enabled. The aspect ratio is a value of the "Major axis/Minor axis," and a larger value represents a thinner shape. [Tolerance inspection target]		Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.	
Distributed Oval Major Axis []	Outputs the major axis' of an equivalent distributed oval in pixels when [Distributed Oval] in [Target Data] is enabled. [Tolerance inspection target] [Label specification target]		 Point	<ul style="list-style-type: none"> The target used for tolerance judgment is specified by the [Primary target] (default setting: 0) except for the target count. If the primary target is set to [All], the tolerance for each item becomes the maximum and minimum for that item. When target classification is ON, the results are also output for each classification type number (in the format "!U[****].RSLT.CLS[*1].****"; *1 is the classification type number). For more details, see "List of Setting Parameters / Result Data" in the XG-X2000 Series Communications Control Manual. 	
Distributed Oval Major axis (max, min)	Outputs the maximum and minimum major axis of an equivalent distributed oval in pixels when [Distributed Oval] in [Target Data] is enabled. [Tolerance inspection target]		 Reference	For the lists of available measurement output values and setting parameters, see "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.	
Distributed Oval Minor Axis []	Outputs the minor axis' of an equivalent distributed oval in pixels when [Distributed Oval] in [Target Data] is enabled. [Tolerance inspection target] [Label specification target]				
Distributed Oval Minor Axis (max, min)	Outputs the maximum and minimum minor axis of an equivalent distributed oval in pixels when [Distributed Oval] in [Target Data] is enabled. [Tolerance inspection target]				
Distributed Oval Aspect Ratio []	Outputs the ratio of the major and minor axes of an equivalent distributed oval in pixels when [Distributed Oval] in [Target Data] is enabled. A larger value represents a thinner shape. [Tolerance inspection target] [Label specification target]				
	The equivalent oval of a blob is an approximate oval obtained from the shape of the blob and is useful for stable measurement of shapes that have spikes or strands that skew major/minor axis measurements.				
Distributed Oval Aspect Ratio (max, min)	Outputs the maximum and minimum ratio of the major and minor axes of an equivalent distributed oval in pixels when [Distributed Oval] in [Target Data] is enabled. A larger value represents a thinner shape. [Tolerance inspection target]				
Blob Axes Position (Upper left, lower left, upper right, lower right) []	Outputs coordinates for the circumscribed rectangle of all detected blobs. [Label specification target]				
Distributed Oval Position X,Y XY (Upper left, lower left, upper right, lower right) []	Outputs the coordinates for the major and minor axis points for the equivalent distributed oval for all detected blobs. The position relationship (up/down/right/left) is based on the angle of the major axis. [Label specification target]				

Measurement sample

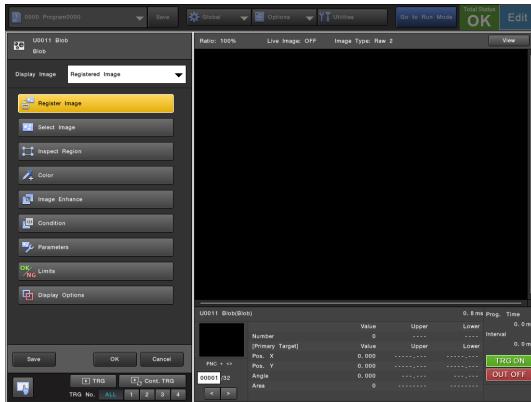
Example showing the results of a measurement performed under the following conditions:

- Detection Order: Y > X: Ascend
- Primary Target: 2



Top Menu

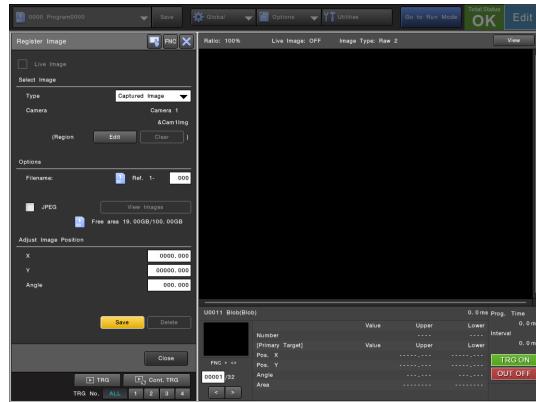
The top menu of the Blob tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-145)	Register an image to be used as a template for settings.
Select Image (Page 2-145)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-145)	Define the region to be used for unit processing.
Color (Page 2-146)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-146)	Specify the filter processing to apply to the image.
Condition (Page 2-146)	Specify the conditions to detect blobs during measurement.
Parameters (Page 2-149)	Specify other conditions for the Blob tool as required.
Limits (Page 2-150)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-151)	Specify the display methods for things such as the inspection region and mask region.
Save (Page 2-152)	Save the current state to the program file.

Register Image

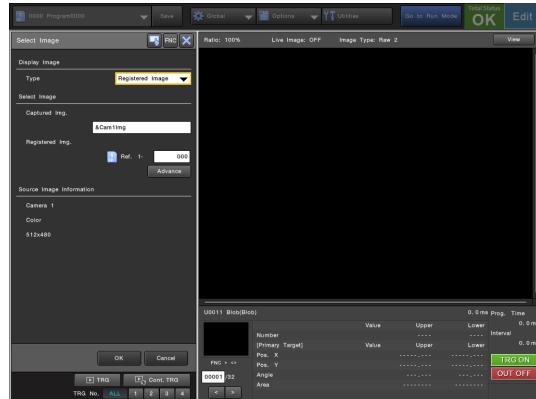
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

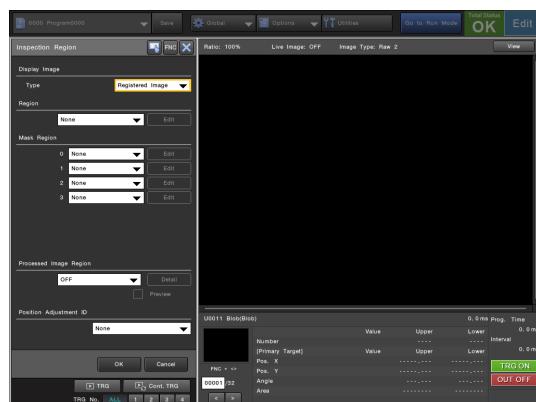
Specify the captured image and registered image to use for measurement.



For more details, see "Select Image" (Page 2-471).

Inspect Region

Define the region to be used for unit processing.

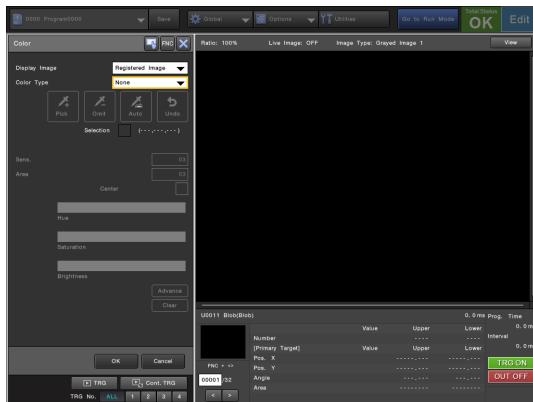


For more details, see "Region Settings" (Page 2-473).

Blob

Color

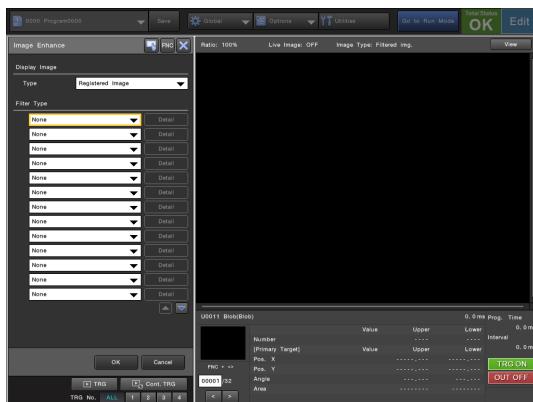
When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.



For more details, see "Color Extraction" (Page 2-483).

Image Enhance

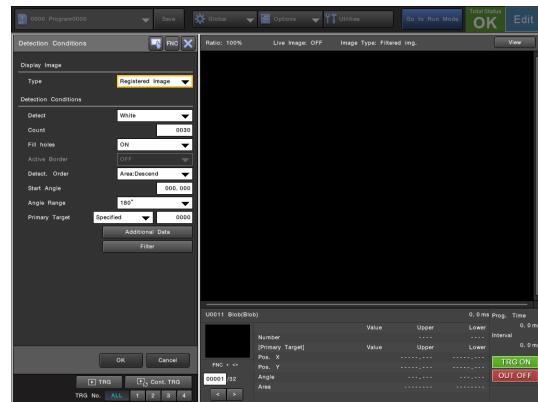
Specify the filter processing to apply to the image.



For more details, see "Image Enhance" (Page 2-489).

Condition

Specify the conditions to detect blobs during measurement.



Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Detection Conditions

Detect

Specify the color of pixels (black/white) to be detected in the binary (monochrome) image.

- White:** Set white blobs to be the target of measurement.
- Black:** Set black blobs to be the target of measurement.

Count

Specify the maximum number of blobs (1 to 9999) to be detected. For example, when [3] is set, up to 3 blobs are detected (default: 30).

Fill holes

Specify whether to fill the inside of blobs with the color specified in [Detect].

If the inside of a blob contains an area with a different color than the [Detect] color, the area, center of gravity, major axis angle, and roundness measurements could be affected. In order to prevent this, the inside of blobs can be filled using the [Detect] color as follows.



Fill holes: OFF



Fill holes: ON

- OFF:** Do not fill the inside of blobs.

- ON:** Fill the inside of blobs.



The result of fill holes is not reflected on the processing screen.

Active border

Specify whether to detect blobs located on the border of the inspection region.

- **OFF:** Blobs that are on top of the border lines of the measurement area are also detected.
- **ON:** Exclude blobs located on the border of the inspection region from detection.

 **Point** The active border ON/OFF setting can only be specified if the inspection region is a rectangle and no mask or image regions have been set. If any other inspection region is selected, the active border will be processed as if set to OFF.

Detection order

Select the blob numbering order.

The following 12 sorting methods are available for assigning numbers to blobs (default setting: Area: Descend):

- **Y>X: Ascend:** Sort blobs in ascending Y order. When Y values are the same, reorders in ascending X order.
- **X>Y: Ascend:** Sort blobs in ascending X order. When X values are the same, reorders in ascending Y order.
- **X: Ascend:** Sort blobs in ascending X order.
- **X: Descend:** Sort blobs in descending X order.
- **Y: Ascend:** Sort blobs in ascending Y order.
- **Y: Descend:** Sort blobs in descending Y order.
- **Area: Ascend:** Sorts blobs from smallest area to largest.
- **Area: Descend** (default setting): Sorts blobs from largest area to smallest.
- **Roundness: Ascend** : Sort blobs from the lowest roundness value (0.000 to 1.000, where 1.000 is a perfect circle) to the highest.
- **Roundness: Descend** : Sort blobs from the highest roundness value (0.000 to 1.000, where 1.000 is a perfect circle) to the lowest.
- **Clockwise:** Sort blobs based on angle, clockwise from the start angle.
- **Counterclockwise:** Sort blobs based on angle, counterclockwise from the start angle.

Start Angle

Specify a starting angle for order identification when [Detection Order] is [Clockwise] or [Counterclockwise].

 **Point** This setting is ignored when [Detection Order] is not [Clockwise] or [Counterclockwise].

Angle Range

Specify the angle range of the major axis.

- **OFF:** Angle is not processed (major axis angle value is defaulted to 0°).
- **180°:** Process angles in the range -89.999° to 90.000°.
- **360°:** Process angles in the range -179.999° to 180.000°.

 **Point**

- Processing may become unstable with symmetrical shapes detected as blobs when [360°] has been set for the angle range.
- This setting also applies to the angle range of the minimum bounding rectangle. When [Angle Range] is set to [OFF], the minimum bounding rectangle angle is output in a range between - 89.999° and 90.000°.

Primary Target

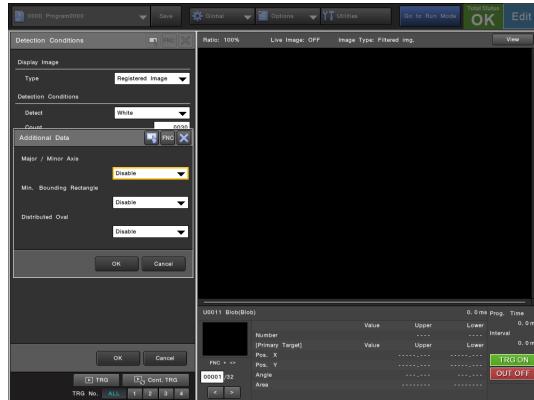
Select the blob to be used for OK / NG judgment.

- **All:** Use the maximum and minimum values measured from all blobs for the OK/NG judgment.
- **Specified:** Select [Specified] for [Primary Target] and then specify the No. of the blob used in judgment (0 to 9998) (default setting: 0). Only the blob that is specified here becomes the target of judgment.

Blob

Additional Data

Specify additional items to be inspected.



- Major / Minor Axis:**

- **Enable:** Enables the [Major Axis], [Minor Axis], and [Major / Minor Axes Ratio] parameters for the blob measurement, OK / NG judgment, and filter settings (this and the minimum bounding rectangle are mutually exclusive).
- **Disable** (default setting): Disables the [Major Axis], [Minor Axis] and [Major / Minor Axes Ratio] measurement, OK/NG judgment and filtering for targets. As a result any data is defaulted to zero.

- Min. Bounding Rectangle:**

- **Enable:** Enables the blob measurement (this and the Major/Minor Axis are mutually exclusive).
- **Disable** (default setting): Disables the blob measurement (the blob measurement is always output as zero).

- Distributed Oval:**

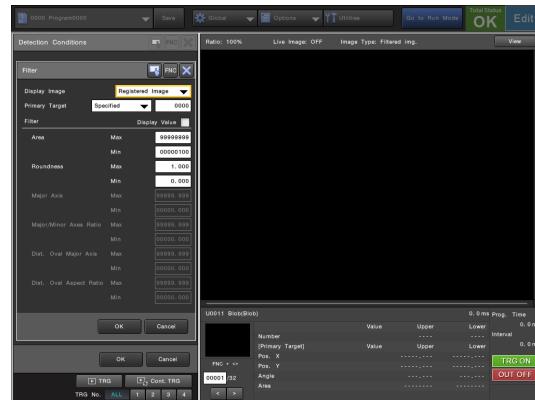
- **Enable:** Enables the [Dist. Oval Major Axis], [Dist. Oval Minor Axis] and [Dist. Oval Aspect Ratio] measurement, OK/NG judgment and filtering for targets.
- **Disable** (default setting): Disables the [Dist. Oval Major Axis], [Dist. Oval Minor Axis] and [Dist. Oval Aspect Ratio] measurement, OK/NG judgment and filtering for targets. As a result any data is defaulted as zero.



When [Major / Minor Axis], [Min. Bounding Rectangle], or [Distributed Oval] is enabled, resource memory consumption increases and the processing speed becomes slower.

Filter

Specify the maximum and minimum range for each filter parameter used to identify a blob.



- Display Image:** Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).

- **Registered image:** Displays the registered image specified under [Select Image].

- Primary Target:** Specify the group data (0 to 9998) to be used for judgment, set to [0] for normal operation.

- Display value:** Use this function to display the values of each parameter for the displayed image in blue.

- Filter:** Choose to enable / disable each filter and set the maximum and minimum range.

- **Area:** Blobs that are larger than the specified maximum value or smaller than the specified minimum value are not detected as blobs (Area Filter).

- **Roundness:** Blobs that have their roundness values higher than the specified maximum value or blobs that have roundness values lower than the specified minimum value are not detected as blobs (Roundness Filter).

- **Major Axis:** Blobs that have their major axis values higher than the specified maximum value or blobs that have major axis values lower than the specified minimum value are not detected as blobs (Major Axis Filter).

- **Major / Minor Axes Ratio:** Blobs that have their axes ratios (major axis/minor axis) higher than the specified maximum value (elongated blobs) or blobs that have axes ratios lower than the specified minimum value are not detected as blobs (Axes Ratio Filter).

- **Dist. Oval Major Axis:** Blobs that have their distributed oval major axis value higher than the specified maximum value or blobs that have their distributed oval major axis value lower than the specified minimum value are not detected as blobs (Distributed Oval Major Axis Filter).

- **Dist. Oval Aspect Ratio:** Blobs that have their aspect ratio (distributed oval major axis/minor axis) higher than the specified maximum value (elongated blobs) or blobs that have their aspect ratio lower than the specified minimum value are not detected as blobs (Distributed Oval Aspect Ratio Filter).

Point

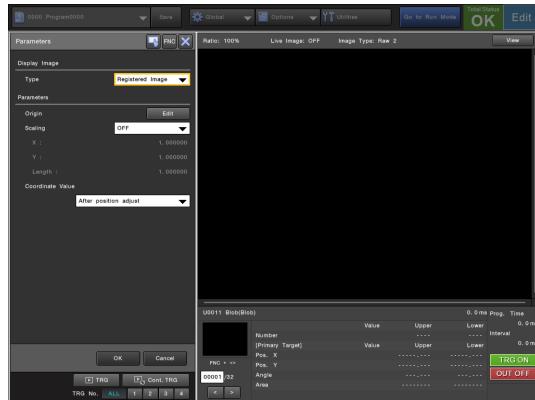
- When [Major / Minor Axis] is disabled in [Additional Data], [Major Axis] and [Major/Minor Axes Ratio] cannot be set.
- When [Distributed Oval] is disabled, [Dist. Oval Major Axis] and [Dist. Oval Aspect Ratio] cannot be set.

Reference

When the primary target is changed, it is possible to also change the value of the blob shown in the current value display to the value of any blob.

Parameters

Specify other conditions for the Blob tool as required.



Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

Reference The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels internally. However, you can convert the result data and setting parameters used for on-screen display, judgment, and calculation to the desired units, such as actual dimension values. (This process is called "scaling".)

- OFF** (default setting): Do not use scaling.
- ON**: Use scaling.

Reference

- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, see "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Blob

Coordinate Value

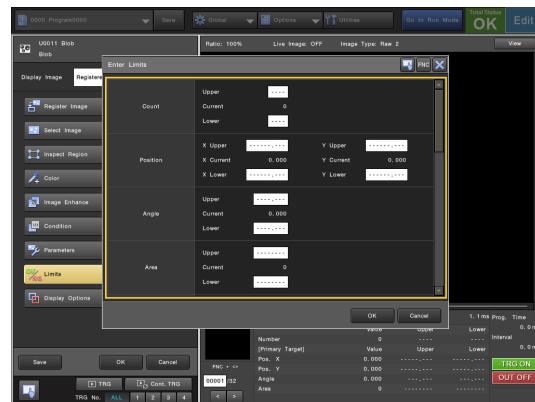
Select the coordinate value to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- After position adjust:** The inspection uses the adjusted coordinate axes determined after position adjustment.
- Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.

Reference

- [-----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Count

Specify the tolerance for the number of blobs detected. The unit of measurement is the "number of blobs" detected.

Position

Specify the tolerance for the position of the blob. The unit of measurement is the "number of pixels" indicating the center of gravity coordinates.

Angle

Specify the tolerance for the angle of the blob. The unit of measurement is the "angle" of the major axis.

Area

Specify the tolerance for the area of the blob. The unit of measurement is the [Number of Pixels] of the measurement area (0 to 99999999).

Feret

Specify the tolerance for the feret diameter of the blob. The unit of measurement is the "number of pixels" indicating the feret diameter.

Perimeter

Specify the tolerance for the perimeter of the blob. The unit of measurement is the "number of pixels" indicating the perimeter.

Roundness

Specify the tolerance for the roundness of the blob.
The unit of measurement is the "roundness correlation" indicating the roundness (0.000 to 1.000, where 1.000 is a perfect circle).

Major Axis

Specify the tolerance for the major axis of the blob.
The unit of measurement is the "number of pixels" indicating the major axis length.

Minor Axis

Specify the tolerance for the minor axis of the blob.
The unit of measurement is the "number of pixels" indicating the minor axis length.

Major / Minor Axes Ratio

Specify the tolerance for the axes ratio (Major axis / Minor axis) of the blob.
The unit of measurement is the "ratio" indicating the axes ratio (0.000 to 99999.999).

Distributed Oval Major Axis

Specify the tolerance for the distributed oval major axis of the blob.
The unit of measurement is the "number of pixels" indicating the distributed oval major axis length.

Distributed Oval Minor Axis

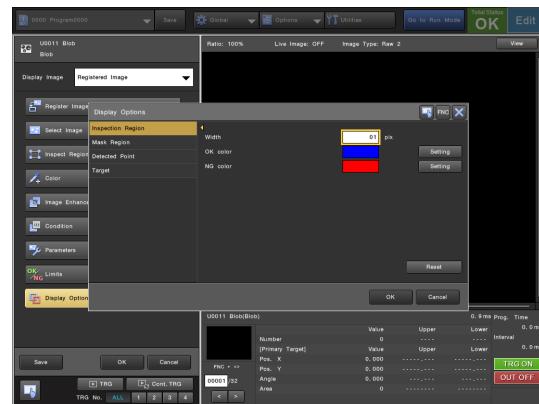
Specify the tolerance for the distributed oval minor axis of the blob.
The unit of measurement is the "number of pixels" indicating the distributed oval minor axis length.

Distributed Oval Aspect Ratio

Specify the tolerance for the distributed oval aspect ratio (Major Axis / Minor Axis) of the blob.
The unit of measurement is the "ratio" indicating the aspect ratio (0.000 to 99999.999).

Display Options

Specify the display methods for things such as the inspection and mask regions.
You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection region

Specify the line width and display color of the inspection region.

Mask region

Specify the line width and display color of the mask region.

Detected Point

Primary target

Specify the width and display color for the center of gravity position of the blob.

Other target

Specify the width and display color of the center of gravity positions for the blobs other than the one specified as the primary target (Page 2-147).

Target

Specify the blob(s) for which the center of gravity position is displayed.

- **All:** Display the detection position for all blobs.
- **Primary Target:** Display the detection position only for the blob specified as the primary target.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

-  **Point**
- If the controller is turned off before any settings are saved, all of those changes will be deleted.
 - Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
 - Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

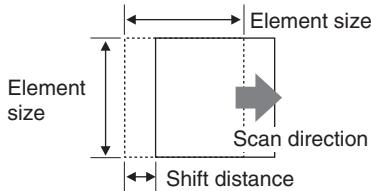
Grayscale Blob

Grayscale Blob Tool

The grayscale blob tool identifies a continuous group of pixels that exceed a threshold level from a base grayscale intensity as a target. The tool characterizes the detected targets defining properties such as area, volume, center of gravity, angle and length of major / minor axis, feret diameter, perimeter, and roundness.

Measurement Overview

The grayscale blob tool indexes the element by the shift distance in the specified scan direction within the inspection region measuring the average intensity of each element.



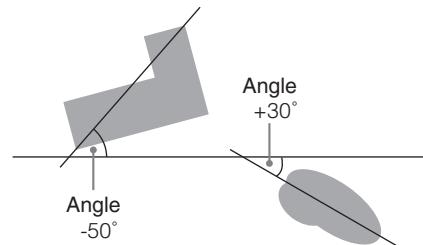
The difference between the intensity of each element and the base intensity is called the "intensity level", and a collection of elements with intensity levels that exceed the threshold value are detected as a target.

Point If a group of elements that exceed the threshold value are in contact with other bright and dark elements that exceed the threshold, all the elements will be grouped together as a single target. To separate the targets, either specify [Bright] or [Dark] for the detection method and perform detection individually, or set a higher threshold value to prevent mis-detection.

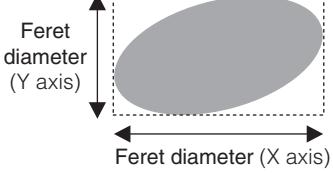
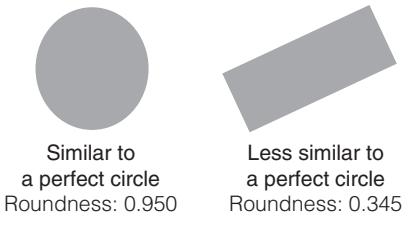
Main measurement results

The standard results and data returned by Grayscale Blob tool are as follows:

Point	Processing results may vary depending on the shape of the inspection region. The result for an item which is not processed is always 0.
Intensity level	Outputs the intensity level value.
Base intensity	Outputs the base intensity level.
Total area	Outputs the total surface area of the detected targets in pixels. <small>Tolerance inspection target</small>
Number of targets	Outputs the number of detected targets after filtering. <small>Tolerance inspection target</small>
Position (X, Y) []	Outputs the center of gravity position coordinates for all detected targets after filtering. <small>Tolerance inspection target Label specification target</small>
Position (X, Y) (max, min)	Outputs the maximum and minimum center of gravity position coordinates in pixels from the range of detected targets after filtering. <small>Tolerance inspection target</small>
Angle (T) []	Outputs the major axis angle (with reference to the horizontal X axis) for all detected targets (only available when [Angle Range] is set to [180°] or [360°]). <small>Tolerance inspection target Label specification target</small>
Angle (T) (max, min)	Outputs the maximum and minimum major axis angle from the range of detected targets (only available when [Angle Range] is set to [180°] or [360°]). <small>Tolerance inspection target</small>
Area []	Outputs the areas for all detected targets after filtering in pixels. <small>Tolerance inspection target Label specification target</small>
Area (max, min)	Outputs the maximum and minimum area from the range of detected targets after filtering in pixels. <small>Tolerance inspection target</small>
Volume[]	Outputs the volume of the target (integral sum of the intensity levels) for all detected targets (only available when the [Target Data] option [Volume] is enabled). <small>Tolerance inspection target Label specification target</small>
Volume (max, min)	Outputs the maximum and minimum volume (integral sum of the intensity levels) from the range of detected targets (only available when the [Target Data] option [Volume] is enabled). <small>Tolerance inspection target</small>



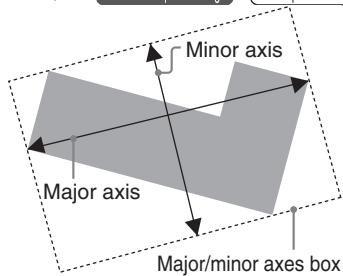
Grayscale Blob

Bright & Dark[]	Outputs whether the detected target is bright (1) or dark (-1). Tolerance inspection target Label specification target
Average Intensity Level []	Outputs the average value for all intensity level for all detected targets. Tolerance inspection target Label specification target
Average Intensity Level (max, min)	Outputs the maximum and minimum average intensity levels from the range of detected targets. Tolerance inspection target
Maximum Intensity Level []	Outputs the maximum value of the intensity level for all detected targets. Tolerance inspection target Label specification target
Maximum Intensity Level (max, min)	Outputs the maximum and minimum maximum intensity levels from the range of detected targets. Tolerance inspection target
Feret diameter (X, Y) []	Outputs the feret diameter (length and width calculated from the circumscribed rectangle created with parallel horizontal (X axis) and vertical (Y axis) boundaries) for all detected targets after filtering in pixels. Tolerance inspection target Label specification target
	
Feret diameter (X, Y) (max, min)	Outputs the maximum and minimum feret diameters in pixels from the range of detected targets after filtering. Tolerance inspection target
Perimeter []	Outputs the perimeters for all detected targets after filtering in pixels. Tolerance inspection target Label specification target
Perimeter (max, min)	Outputs the maximum and minimum perimeters in pixels from the range of detected targets after filtering. Tolerance inspection target
Roundness	Outputs the degree of similarity (1.000 to 0.000) to a perfect circle for all targets after filtering. A perfect circle is considered as a value of 1.000. and the value will reduce to 0.000 as the similarity decreases. Tolerance inspection target Label specification target
	
Roundness (max, min)	Outputs the maximum and minimum roundness values from the range of detected targets after filtering. Tolerance inspection target
Major Axis []	Outputs the major axis' for all detected targets (when [Major / Minor Axis] in [Target Data] is enabled). Tolerance inspection target Label specification target
Major Axis (max, min)	Outputs the maximum and minimum major axis from the range of detected targets (when [Major / Minor Axis] in [Target Data] is enabled). Tolerance inspection target

Minor Axis [] Outputs the minor axis' for all detected targets (when [Major / Minor Axis] in [Target Data] is enabled). Tolerance inspection target Label specification target

Minor Axis (max, min) Outputs minor axis from the range of detected targets (when [Major / Minor Axis] in [Target Data] is enabled). Tolerance inspection target

Axes Ratio [] Outputs the major minor axis ratio for all detected targets (when [Major / Minor Axis] in [Target Data] is enabled). The axes ratio is a value of the "Major axis/Minor axis," and a larger value represents a thinner shape. Tolerance inspection target Label specification target



Axes ratio (max, min) Outputs the maximum and minimum axes ratio from the range of detected targets (when [Major / Minor Axis] in [Target Data] is enabled). The axes ratio is a value of the "Major axis/Minor axis," and a larger value represents a thinner shape.

Tolerance inspection target

Distributed Oval Major Axis [] Outputs the major axis' of an equivalent distributed oval for all detected targets (when [Distributed Oval] in [Target Data] is enabled).

Tolerance inspection target Label specification target

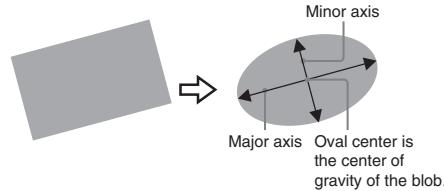
Distributed Oval Major axis (max, min) Outputs the maximum and minimum major axis' of an equivalent distributed oval from the range of detected targets (when [Distributed Oval] in [Target Data] is enabled). Tolerance inspection target

Distributed Oval Minor Axis [] Outputs the minor axis' of an equivalent distributed oval for all detected targets (when [Distributed Oval] in [Target Data] is enabled).

Tolerance inspection target Label specification target

Distributed Oval Minor axis (max, min) Outputs the maximum and minimum minor axis' of an equivalent distributed oval from the range of detected targets (when [Distributed Oval] in [Target Data] is enabled). Tolerance inspection target

Aspect Ratio [] Outputs the ratio of the major and minor axes of an equivalent distributed oval for all detected targets (when [Distributed Oval] in [Target Data] is enabled). A larger value represents a thinner shape. Tolerance inspection target Label specification target



The equivalent distributed oval is an approximate oval obtained from the shape of the blob and is useful for stable measurement of shapes that have spikes or strands that skew major/minor axis measurements.

Aspect Ratio (max, min) Outputs the maximum and minimum ratio of the major and minor axes of an equivalent distributed oval from the range of detected targets (when [Distributed Oval] in [Target Data] is enabled). Tolerance inspection target

Target axes box position (Upper left, lower left, upper right, lower right) [] Outputs maximum and minimum ratio of the major and minor axes of an equivalent distributed oval from the range of detected targets (when [Distributed Oval] in [Target Data] is enabled). Label specification target

Distributed Oval Position X,Y XY [] Outputs the coordinates for the major and minor axis points for the equivalent distributed oval for all detected targets. Label specification target

Unit judgment value [] Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.



- The target used for tolerance judgment is specified by the [Primary target] (Default: 0) except for the target count. If the primary target is set to [All], the tolerance for each item becomes the maximum and minimum for that item.
- When target classification is ON, the results are also output for each classification type No. (in the format !U[****].RSLT.CLS[*1].****, *1 is the type No.) For more details, see "List of Setting Parameters / Result Data" in the XG-X2000 Series Communications Control Manual.

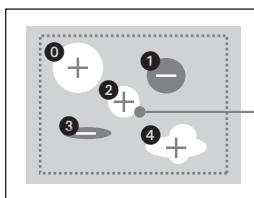


For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

Example showing the results of a grayscale blob inspection performed under the following conditions:

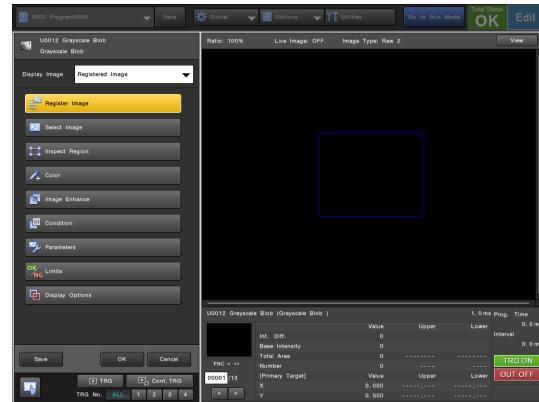
- Detection Order: Y > X: Ascend
- Primary Target: 2



Bright target: 0, 2, 4
Dark target: 1, 3
No. of target: 5
Primary target
Center of gravity: X: 600, Y: 460
Area: 20,000
Roundness: 0.85,

Top Menu

The top menu of the Grayscale Blob tool consists of the following options. Configure settings under each option as required for the inspection.

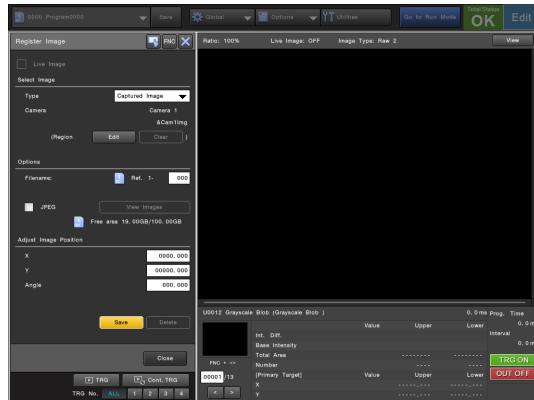


Register Image (Page 2-156)	Register an image to be used as a template for settings.
Select Image (Page 2-156)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-156)	Define the region to be used for unit processing.
Color (Page 2-156)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-157)	Specify the filter processing to apply to the image.
Condition (Page 2-157)	Specify the conditions to detect blobs during measurement.
Parameters (Page 2-162)	Specify other conditions for the Grayscale Blob tool as required.
Limits (Page 2-163)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-164)	Specify the display methods for things such as the inspection region and mask region.
Save (Page 2-165)	Save the current state to the program file.

Grayscale Blob

Register Image

Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

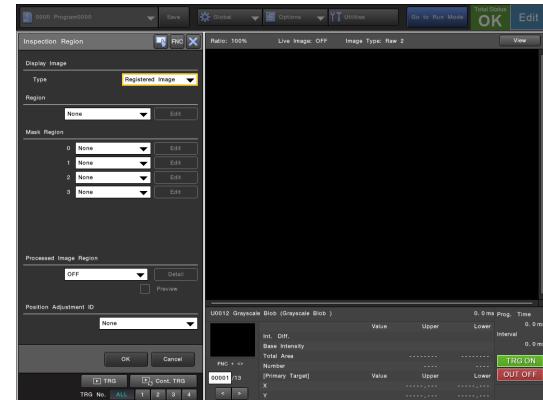
Inspect Region

Define the region to be used for unit processing.



Point

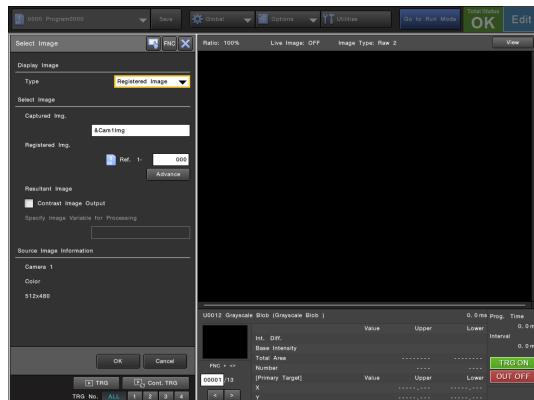
Changing the shape of the region will reset some settings on the [Condition] screen.



For more details, see "Region Settings" (Page 2-473).

Select Image

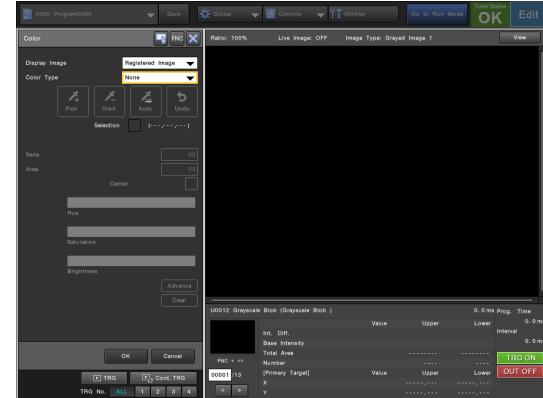
Specify the captured image and registered image to use for measurement.



For more details, see "Select Image" (Page 2-471).

Color

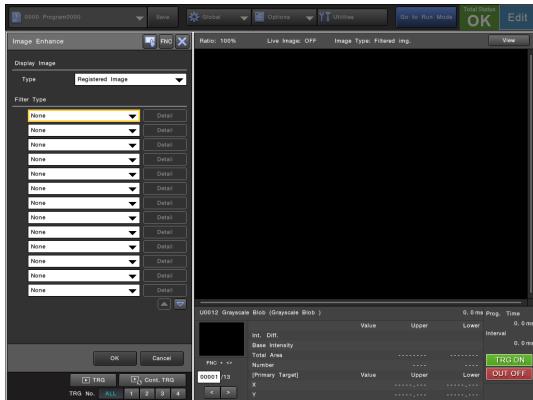
When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.



For more details, see "Color Extraction" (Page 2-483).

Image Enhance

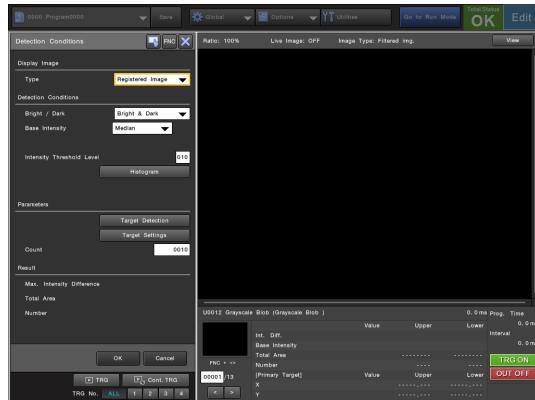
Specify the filter processing to apply to the image.



For more details, see "Image Enhance" (Page 2-489).

Condition

Specify the conditions to detect blobs during measurement.



Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Detection Conditions

Bright / Dark

Choose the method for detecting targets.

- **Bright:** Extract only features that are brighter than the base intensity.
- **Dark:** Extract only features that are darker than the base intensity.
- **Bright & Dark** (default): Extract both light and dark features.
- **Individual:** Specify individual extraction levels for bright and dark features.

Base Intensity

Specify the method for determining the base intensity.

- **Average:** Use the average grayscale value across the region as the base intensity.
- **Median** (default): Use the median grayscale value across the region as the base intensity.
- **Mode:** Use the mode (most common) grayscale value across the region as the base intensity.
- **Specified:** Specify a grayscale value (0-255) for the base intensity.



The base intensity when calculated is derived from the segmented image.

Base Intensity Level

Displays the base intensity value.

When [Specified] is selected for the base intensity, enter the intensity value 0 to 255 (default setting: 128).

Grayscale Blob

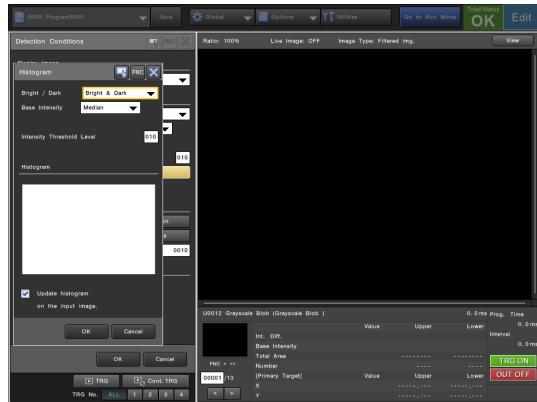
Intensity Threshold Level

Set the lower intensity threshold level for detecting targets within the range of 0 to 254 (default setting: 10). A group of elements at an intensity level above this value will be detected as a target.

Histogram

Displays the intensity distribution within the region. The base intensity is indicated as [BASE], the bright threshold value as [UP], and the dark threshold value as [LO].

- Point** As the displayed intensity distribution is based on the element size and shift setting, it may not exactly match the intensity distribution of the filtered image.

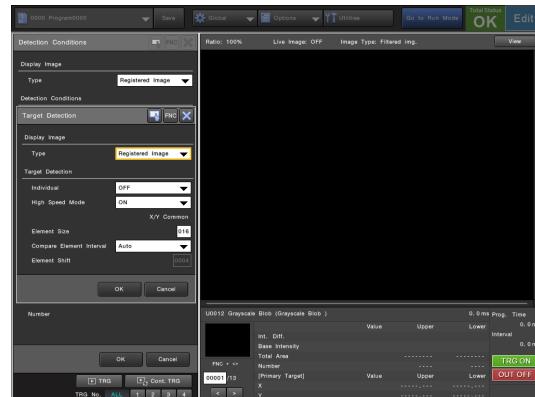


- Bright / Dark:** Uses the same setting as the [Bright / Dark] setting on the [Condition] screen. If the settings under the [Histogram] menu are changed, the same changes will be applied to the [Bright / Dark] setting in the [Condition] screen.
- Base Intensity:** Uses the same setting as the [Base Intensity] setting on the [Condition] screen. If the settings under the [Histogram] menu are changed, the same changes will be applied to the [Base Intensity] setting on the [Condition] screen.
- Base Intensity Level:** Uses the same setting as the [Base Intensity] setting on the [Condition] screen. If the settings under the [Histogram] menu are changed, the same changes will be applied to the [Base Intensity] setting on the [Condition] screen.
- Intensity Threshold Level:** Uses the same setting as the [Intensity Threshold Level] setting on the [Condition] screen. If the settings under the [Histogram] menu are changed, the same changes will be applied to the [Intensity Threshold Level] setting on the [Condition] screen.
- Update histogram on the input image:** Use this option to update the histogram display to match the captured image.

Parameters

Target Detection

Specify the detection direction and element size for finding targets.



- Individual:** Use [ON] to set element parameters individually for the XY directions.
 - **OFF** (default setting): Do not set elements individually for the XY directions.
 - **ON:** Set element parameters individually for the XY directions.
 Using this option makes possible to set a different element size, shift, and other settings for X and Y.
- High Speed Mode:** Use High speed mode to decrease unit processing time or enable fine detection.
 - **ON** (default setting): High speed processing.
 - **OFF:** Fine detection.
 When the high speed mode is set to [ON], the segment size and shift can be set in multiples of 4 only. (If a variable is referenced the value is rounded off to the nearest integer and then rounded up to the nearest multiple of 4.)
- Element Size:** Specify the element (pixel group) size (1 to 256 pixels) which moves inside the inspection region in the X (horizontal) and Y (vertical) directions respectively (default setting: 16).



To specify different sizes in the direction of X/Y individually, set [Individual] to [ON].

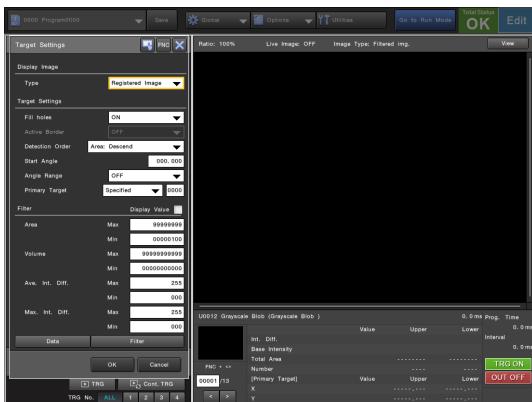
- Compare Element Interval:** Select [Manual] and increase the shift in order to reduce processing time and perform a coarser search. Increasing the compare element interval will result in a decrease in detection accuracy.
- Element Shift:** Specify the number of pixels within the range 1 to 2432 as the distance to shift the element for calculating the next average intensity value. When [Auto] is selected, this is automatically set to 1/4 of the element size. If high speed mode is [ON], this value must be a multiple of 4.



If the value of [Element Shift] is larger than [Element Size], some parts of the inspection region will not be reflected in the intensity average. To detect defects smaller than the element size, use [Auto] or specify an element shift smaller than the element size.

Target Settings

Specify the conditions for processing targets.



- **Fill holes:** Specify whether to fill the inside of blobs with the color specified in [Detect].

If the inside of a blob contains an area with a different color than the [Detect] color, the area, center of gravity, major axis angle, and roundness measurements could be affected. In order to prevent this, the inside of blobs can be filled using the [Detect] color as follows.



Fill holes: OFF



Fill holes: ON

- **OFF:** Do not fill the inside of blobs.
- **ON:** Fill the inside of blobs.



- The result of fill holes is not reflected on the processing screen.
- When fill holes is used, the area includes the holes, however the volume, average intensity level, and maximum intensity level are calculated only from the parts which exceeded the threshold value in the filled target.

- **Active Border:** Specify whether to detect blobs located on the border of the inspection region.

- **OFF:** Blobs that are on top of the border lines of the measurement area are also detected.
- **ON:** Exclude blobs located on the border of the inspection region from detection.



The active border ON/OFF setting can only be specified if the inspection region is a rectangle and no mask or image regions have been set. If any other inspection region is selected, the active border will be processed as if set to OFF.

- **Detection Order:** Select the identification order of the detected blobs. The following 18 sorting methods are available for assigning numbers to blobs (default setting: Area: Descend):

- **Y>X: Ascend:** Sort blobs in ascending Y order. When Y values are the same, reorders in ascending X order.
- **X>Y: Ascend:** Sort blobs in ascending X order. When X values are the same, reorders in ascending Y order.
- **X: Ascend:** Sort blobs in ascending X order.
- **X: Descend:** Sort blobs in descending X order.
- **Y: Ascend:** Sort blobs in ascending Y order.
- **Y: Descend:** Sort blobs in descending Y order.
- **Area: Ascend:** Sort blobs from smallest area to largest.
- **Area: Descend:** Sort blobs from largest area to smallest.
- **Roundness: Ascend:** Sort blobs from the lowest roundness value (0.000 to 1.000, where 1.000 is a perfect circle) to the highest.
- **Roundness: Descend:** Sort blobs from the highest roundness value (0.000 to 1.000, where 1.000 is a perfect circle) to the lowest.
- **Clockwise:** Sort blobs based on angle, clockwise from the start angle.
- **Counterclockwise:** Sort blobs based on angle, counterclockwise from the start angle.
- **Volume: Ascend:** Sort blobs from smallest volume to largest.
- **Volume: Descend:** Sort blobs from largest volume to smallest.
- **Ave Int.Dif: Ascend:** Sort average intensity level from smallest to biggest.
- **Ave Int.Dif: Descend:** Sort average intensity level from biggest to smallest.
- **Max. Int. Diff: Ascend:** Sort maximum intensity level from smallest to biggest.
- **Max. Int. Diff: Descend:** Sort maximum intensity level from biggest to smallest.
- **Start Angle:** Specify a starting angle for order identification when [Detection Order] is [Clockwise] or [Counterclockwise]



This setting is ignored when [Detection Order] is not [Clockwise] or [Counterclockwise].

Grayscale Blob

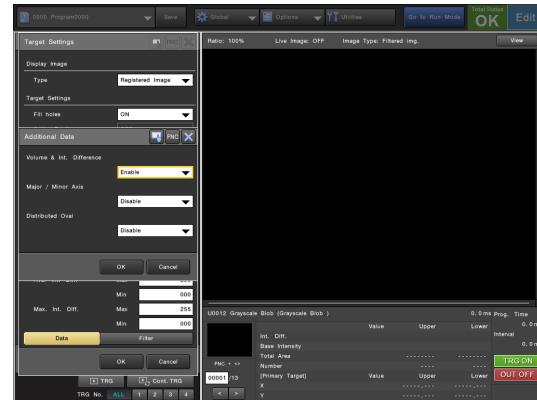
- Angle Range:** Specify the angle range of the major axis.
 - **OFF** (default setting) (2): Angle is not processed (major axis angle value is defaulted to 0°).
 - **180°** (0): Process angles in the range -89.999° to 90.000°.
 - **360°** (1): Process angles in the range -179.999° to 180.000°.

Point Processing may become unstable with symmetrical shapes detected as blobs when [360°] has been set for the angle range.

- Primary Target:** Select the blob to be used for OK / NG judgment.
 - **All:** Use the maximum and minimum values measured from all blobs for the OK/NG judgment.
 - **Specified:** Select [Specified] for [Primary Target] and then specify the number of the blob used in judgment (0 to 9998). Only the blob that is specified here becomes the target of judgment.
- Filter:** Specify the maximum and minimum range for each filter parameter used to identify a blob.
 - **Display Value:** If this is ticked, the value of each parameter with regards to the currently displayed image is displayed in blue respectively.
 - **Area:** Blobs that have a larger area than the specified maximum or smaller than the specified minimum are not detected as blobs (Area filter).
 - **Volume:** Blobs that have a larger volume than the specified maximum or smaller than the specified minimum are not detected as blobs (Volume filter).
 - **Ave. Intensity Difference:** Blobs that have a larger average intensity differential than the specified maximum or smaller than the specified minimum are not detected as blobs (Average intensity difference filter).
 - **Max. Intensity Difference:** Blobs that have a larger maximum intensity differential than the specified maximum or smaller than the specified minimum are not detected as blobs (Maximum intensity difference filter).

Reference When the primary target is changed, it is possible to also change the value shown in the current value display to the value of any target.

Data



Volume & Intensity Difference:

Enable (default setting): Enable the measurement data and OK/NG judgment for [Volume], [Ave. Intensity Difference], [Max. Intensity Difference], and [Bright & Dark] definition.

Disable: Disable the measurement data and OK/NG judgment for [Volume], [Average Intensity Difference], [Maximum Intensity Difference], and [Bright & Dark] definition. As a result any data is defaulted to zero.

Major / Minor Axis:

Enable: Enable the [Major Axis], [Minor Axis] and [Major / Minor Axes Ratio] measurement, OK/NG judgment and filtering for targets.

Disable (default setting): Disable the [Major Axis], [Minor Axis] and [Major / Minor Axes Ratio] measurement, OK/NG judgment and filtering for targets. As a result any data is defaulted to zero.

Distributed Oval:

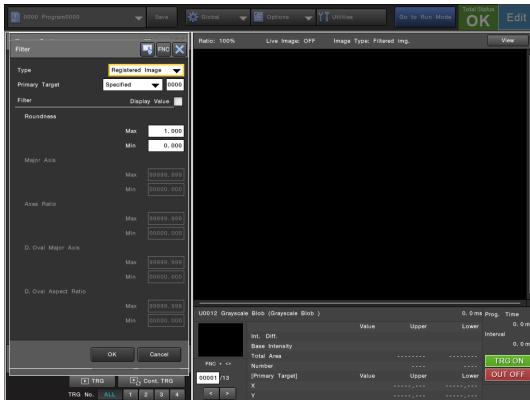
Enable: Enable the [Dist. Oval Major Axis], [Dist. Oval Minor Axis] and [Dist. Oval Aspect Ratio] measurement, OK/NG judgment and filtering for targets.

Disable (default setting): Disable the [Dist. Oval Major Axis], [Dist. Oval Minor Axis] and [Dist. Oval Aspect Ratio] measurement, OK/NG judgment and filtering for targets. As a result any data is defaulted as zero.

Point

- Enabling [Major / Minor Axis], [Distributed Oval], and [Volume & Intensity Difference] increases the consumption of program memory, slowing down the processing time.
- If Volume & Intensity Difference is disabled when Volume: Ascend, Volume: Descend, Average Intensity Difference: Ascend, Average Intensity Difference: Descend, Maximum Intensity Difference: Ascend, or Maximum Intensity Difference: Descend is selected as the detection order, the detection order is initialized to Area: Descend.

• Filter



- **Type:** Switch the image displayed on the screen.
- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].
- **Primary Target:** Select the blob to be used for OK / NG judgment.
- All:** Use the maximum and minimum values measured from all blobs for the OK/NG judgment.
- Specified:** Select [Specified] for [Primary Target] and then specify the number of the blob used in judgment (0 to 9998) (default setting: 0). Only the blob that is specified here becomes the target of judgment.
- **Display Value:** If this is ticked, the value of each parameter with regards to the currently displayed image is displayed in blue respectively.
- **Roundness:** Blobs that have their roundness values higher than the specified maximum or blobs that have roundness values lower than the specified minimum are not detected as blobs (Roundness filter).
- **Major Axis:** Blobs that have their major axis values higher than the specified maximum or blobs that have major axis values lower than the specified minimum are not detected as blobs (Major axis filter).
- **Axes Ratio:** Blobs that have their axes ratios (major axis/minor axis) higher than the specified maximum value (elongated blobs) or blobs that have axes ratios lower than the specified minimum value are not detected as blobs (Axes ratio filter).
- **Dist. Oval Major Axis:** Blobs that have their distributed oval major axis value higher than the specified maximum value or blobs that have their distributed oval major axis value lower than the specified minimum value are not detected as blobs (Distributed oval major axis filter).
- **Dist. Oval Aspect Ratio:** Blobs that have their aspect ratio (distributed oval major axis/minor axis) higher than the specified maximum value (elongated distributed oval) or blobs that have their aspect ratio lower than the specified minimum value are not detected as blobs (Distributed oval aspect ratio filter).

Point

- When [Major/Minor Axis] is disabled in [Additional Data], [Major Axis] and [Axes Ratio] cannot be set.
- When [Distributed Oval] is disabled, [Dist. Oval Major Axis] and [Dist. Oval Aspect Ratio] cannot be set.
- If [Volume & Intensity Difference] is disabled, [Volume], [Ave. Intensity Difference], and [Max. Intensity Difference] cannot be set.

Reference

When the primary target is changed, it is possible to also change the value shown in the current value display to the value of any target.

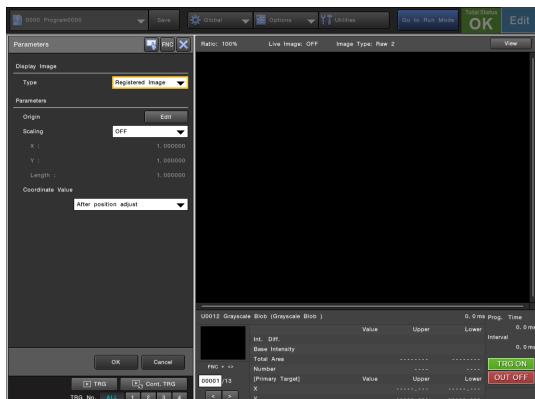
Count

Specify the maximum number of blobs (1 to 9999) to be detected. For example, when [3] is set, up to 3 blobs are detected.

Grayscale Blob

Parameters

Specify other conditions for the Grayscale Blob tool as required.



Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

Reference The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels internally. However, you can convert the result data and setting parameters used for on-screen display, judgment, and calculation to the desired units, such as actual dimension values. (This process is called "scaling".)

- OFF** (default setting): Do not use scaling.
- ON:** Use scaling.

Reference

- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, see "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate Value

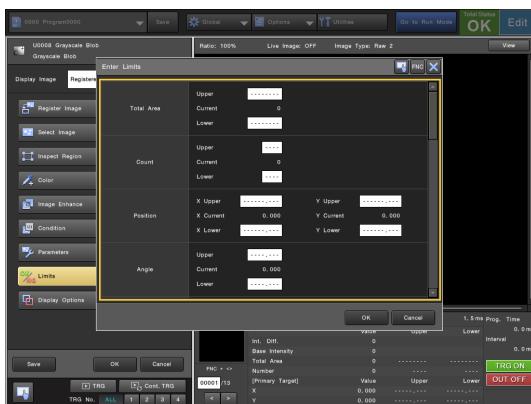
Select the coordinate value to be used after position adjustment. If position adjustment (Page 2-306) is not used, this setting will have no effect on the measurement.

- After position adjust:** The inspection uses the adjusted coordinate axes determined after position adjustment.
- Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.



- [----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Total Area

Specify the tolerance for the total area for the detected targets. The unit of measurement is the [Number of Pixels] of the measurement area (0 to 99999999).

Count

Specify the tolerance for the number of blobs detected. The unit of measurement is the "number of blobs" detected.

Position

Specify the tolerance for the position of the blob. The unit of measurement is the "number of pixels" indicating the center of gravity coordinates.

Angle

Specify the tolerance for the angle of the blob. The unit of measurement is the "angle" of the major axis.

Area

Specify the tolerance for the area of the blob.

The unit of measurement is the [Number of Pixels] of the measurement area (0 to 99999999).

Ave. Int. Diff

Specify the tolerance for the average intensity difference of the target compared to the base intensity.

The unit of measurement is the [Grayscale Level] indicating the average intensity (0 to 255).

Max. Int. Diff.

Specify the tolerance for the maximum intensity difference of the target compared to the base intensity.

The unit of measurement is the [Grayscale Level] indicating the maximum intensity (0 to 255).

Volume

Specify the tolerance for the volume of the target.

The unit of measurement is the "integral sum of the intensity difference" indicating the measured volume (0 to 9999999999).

Feret

Specify the tolerance for the feret diameter of the blob.

The unit of measurement is the "number of pixels" indicating the feret diameter.

Perimeter

Specify the tolerance for the perimeter of the blob.

The unit of measurement is the "number of pixels" indicating the perimeter.

Roundness

Specify the tolerance for the roundness of the blob.

The unit of measurement is the "roundness correlation" indicating the roundness (0.000 to 1.000, where 1.000 is a perfect circle).

Major Axis

Specify the tolerance for the major axis of the blob.

The unit of measurement is the "number of pixels" indicating the major axis length.

Minor Axis

Specify the tolerance for the minor axis of the blob.

The unit of measurement is the "number of pixels" indicating the minor axis length.

Grayscale Blob

Major / Minor Axes Ratio

Specify the tolerance for the axes ratio (Major axis / Minor axis) of the blob.

The unit of measurement is the "ratio" indicating the axes ratio (0.000 to 99999.999).

Dist. Oval Major Axis

Specify the tolerance for the distributed oval major axis of the blob.

The unit of measurement is the "number of pixels" indicating the distributed oval major axis length.

Dist. Oval Minor Axis

Specify the tolerance for the distributed oval minor axis of the blob.

The unit of measurement is the "number of pixels" indicating the distributed oval minor axis length.

Dist. Oval Aspect Ratio

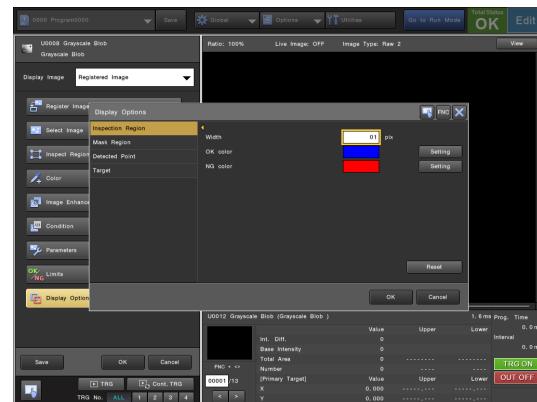
Specify the tolerance for the distributed oval aspect ratio (Major Axis / Minor Axis) of the blob.

The unit of measurement is the "ratio" indicating the aspect ratio (0.000 to 99999.999).

Display Options

Specify the display methods for things such as the inspection region and mask region.

You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection region

Specify the line width and display color of the inspection region.

Mask region

Specify the line width and display color of the mask region.

Detected point

Primary Target

Specify the width and display color for the center of gravity position of the blob.

Other target

Specify the width and display color of the center of gravity positions for the blobs other than the one specified as the primary target (Page 2-160).

Target

Select the blob whose detected position is to be displayed.

- **All:** Display the detected position for all blobs.
- **Primary target:** Show the detected position only for the primary target.

Reset

Restores the display options to their default settings.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

Profile Position

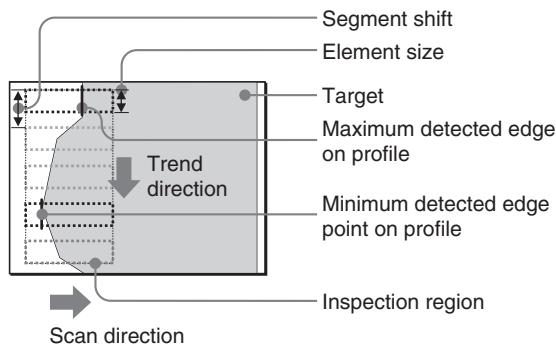
Profile Position Tool

The Profile Position tool takes a segment of a specified size and indexes it through the inspection region along the trend direction. With each shift of the segment the tool scans in the opposing direction detecting contrast changes to identify an edge point. By identifying all the edge points along the profile the maximum, minimum and average edge position of the target profile can be measured.

Measurement Overview

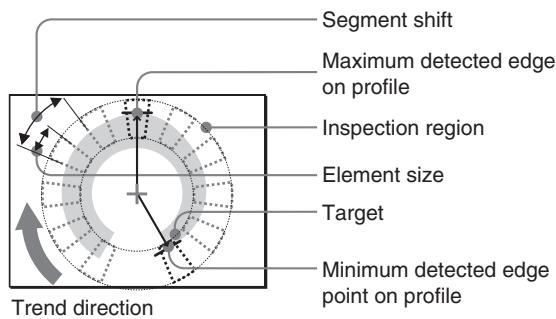
When the inspection region is a rectangle or a rotated rectangle

In the instance the scan direction is [→] and trend direction is [↓]



When the inspection region is a ring or an arc

When the trend direction is [Clockwise]



Main measurement results

The standard results and data returned by the Profile Position tool are as follows:



Point

Processing results may vary depending on the shape of the inspection region. The result for an item which is not processed is always 0.

When the inspection region is a rectangle or a rotated rectangle

Number of segments	Outputs the number of set segments.
Number of detected segments	Outputs the number of segments where contrast changes were detected and edges identified. <small>[Tolerance inspection target]</small>
Number of edges	Outputs the number edges in all segments. <small>[Label specification target]</small>
Number (max)	Outputs the number of edges in the segment with the maximum edge position.
Number (min)	Outputs the number of edges in the segment with the minimum edge position.
Position X []	Outputs the X position coordinate of all the edge positions in pixels. <small>[Tolerance inspection target]</small> (only when the inspection region is a rectangle and the trend direction is ↓) <small>[Label specification target]</small>
Position X (Max)	Outputs the X position coordinate of the maximum edge position in pixels. <small>[Tolerance inspection target]</small> (only when the inspection region is a rectangle and the trend direction is ↓)
Position X (Min)	Outputs the X position coordinate of the minimum edge position in pixels. <small>[Tolerance inspection target]</small> (only when the inspection region is a rectangle and the trend direction is ↓)
Position X (Ave)	Outputs the average X position coordinate from all the edge positions in pixels.
Position Y []	Outputs the Y position coordinate of all the edge positions in pixels. <small>[Tolerance inspection target]</small> (only when the inspection region is a rectangle and the trend direction is →) <small>[Label specification target]</small>
Position Y (Max)	Outputs the Y position coordinate of the maximum edge position in pixels. <small>[Tolerance inspection target]</small> (only when the inspection region is a rectangle and the trend direction is →)
Position Y (Min)	Outputs the Y position coordinate of the minimum edge position in pixels. <small>[Tolerance inspection target]</small> (only when the inspection region is a rectangle and the trend direction is →)
Position Y (Ave)	Outputs the average Y position coordinate from all the edge positions in pixels.
Angle []	Outputs the angle of rotation of the inspection region when the region is a rotated rectangle (always 0 when the inspection region is a rectangle). <small>[Label specification target]</small>

Angle (Max)	Outputs the maximum angle of rotation of the inspection region when the region is a rotated rectangle (always 0 when the inspection region is a rectangle).	Line Y1	Outputs the Y position coordinate of the intersection between the best fit line and the top side of the inspection region (or left side when the trend direction is →). (when [Best Fit Circle/Line] is [Line])
Angle (Min)	Outputs the minimum angle of rotation of the inspection region when the region is a rotated rectangle (always 0 when the inspection region is a rectangle).	Line XY1	Outputs the position coordinates of the intersection between the best fit line and the top side of the inspection region (or left side when the trend direction is →). (when [Best Fit Circle/Line] is [Line])
Position XY []	Outputs the position coordinates of all the edge positions in pixels. (Label specification target)	Line X2	Outputs the X position coordinate of the intersection between the best fit line and the bottom side of the inspection region (or right side when the trend direction is →). (when [Best Fit Circle/Line] is [Line])
Position XY (Max)	Outputs the position coordinates of the maximum edge position in pixels.	Line Y2	Outputs the Y position coordinate of the intersection between the best fit line and the bottom side of the inspection region (or right side when the trend direction is →). (when [Best Fit Circle/Line] is [Line])
Position XY (Min)	Outputs the position coordinates of the minimum edge position in pixels.	Line XY2	Outputs the position coordinates of the intersection between the best fit line and the bottom side of the inspection region (or right side when the trend direction is →). (when [Best Fit Circle/Line] is [Line])
Position XY (Ave)	Outputs the average position coordinates from all the edge positions in pixels.	Line center X	Outputs the X position coordinate of the midpoint between the Line XY1 and Line XY2 positions. (when [Best Fit Circle/Line] is [Line])
Distance []	Outputs the distances from the start of each segment of the inspection region to the position coordinate of the edge position in the segment in pixels. (Tolerance inspection target) (only when the inspection region is a rotated rectangle) (Label specification target)	Line center Y	Outputs the Y position coordinate of the midpoint between the Line XY1 and Line XY2 positions. (when [Best Fit Circle/Line] is [Line])
Distance (Max)	Outputs the distance from the start of the segment with the maximum edge position to the position coordinate of the maximum edge position in pixels. (Tolerance inspection target) (only when the inspection region is a rotated rectangle)	Line center XY	Outputs the position coordinates of the midpoint between the Line XY1 and Line XY2 positions. (when [Best Fit Circle/Line] is [Line])
Distance (Min)	Outputs the distance from the start of the segment with the minimum edge position to the position coordinate of the minimum edge position in pixels. (Tolerance inspection target) (only when the inspection region is a rotated rectangle)	Line angle	Outputs the angle of Line XY2 in reference to Line XY1. (0° to 359.999°) (when [Best Fit Circle/Line] is [Line])
Distance (Ave)	Outputs the average distance from the start of the segments to the coordinate of the edge positions in pixels.	Line p θ	Outputs the p and θ of the detected line (when [Best Fit Circle/Line] is [Line]).
Intensity []	Outputs the intensity differential of the edge at all the edge positions. (Label specification target)	Line p	Outputs the p of the detected line (when [Best Fit Circle/Line] is [Line]).
Intensity (Max)	Outputs the intensity differential of the edge at the maximum edge position.	Line θ	Outputs the θ of the detected line (when [Best Fit Circle/Line] is [Line]).
Intensity (Min)	Outputs the intensity differential of the edge at the minimum edge position.	Maximum segment No.	Outputs the segment No. of the segment with the maximum edge position.
Circle radius	Outputs the radius of the best fit circle in pixels. (when [Best Fit Circle/Line] is [Circle])	Minimum segment No.	Outputs the segment No. of the segment with the minimum edge position.
Circle center X	Outputs the X position coordinate at the center of the best fit circle in pixels. (when [Best Fit Circle/Line] is [Circle])	Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.
Circle center Y	Outputs the Y position coordinate at the center of the best fit circle in pixels. (when [Best Fit Circle/Line] is [Circle])		
Circle center XY	Outputs the position coordinates at the center of the best fit circle in pixels. (when [Circle Best Fit Circle/Line] is [Circle])		
Circle center XY radius	Outputs the position coordinates at the center of the best fit circle and the radius in pixels. (when [Circle Best Fit Circle/Line] is [Circle]).		
Line X1	Outputs the X position coordinate of the intersection between the best fit line and the top side of the inspection region (or left side when the trend direction is →). (when [Best Fit Circle/Line] is [Line])		

Profile Position

When the measurement area is a ring or an arc

Number of segments	Outputs the number of set segments.
Number of detected segments	Outputs the number of segments where contrast changes were detected and edges identified. <small>Tolerance inspection target</small>
Number	Outputs the number edges in all segments. <small>Label specification target</small>
Number (max)	Outputs the number of edges in the segment with the maximum radius.
Number (min)	Outputs the number of edges in the segment with the minimum radius.
Position X []	Outputs the X position coordinate of all the edge positions in pixels. <small>Label specification target</small>
Position X (Max)	Outputs the X position coordinate of the maximum radius.
Position X (Min)	Outputs the X position coordinate of the minimum radius.
Position X (Ave)	Outputs the average X position coordinate from all the edge positions in pixels.
Position Y[]	Outputs the Y position coordinate of all the edge positions in pixels. <small>Label specification target</small>
Position Y (Max)	Outputs the Y position coordinate of the maximum radius.
Position Y (Min)	Outputs the Y position coordinate of the minimum radius.
Position Y (Ave)	Outputs the average Y position coordinate from all the edge positions in pixels.
Angle []	Outputs the angle of a measured segment. <small>Label specification target</small>
Angle (Max)	Outputs the angle of the segment with the maximum radius.
Angle (Min)	Outputs the angle of the segment with the minimum radius.
Position XY []	Outputs the position coordinates of all the edge positions in pixels. <small>Label specification target</small>
Position XY (Max)	Outputs the position coordinates of the maximum radius.
Position XY (Min)	Outputs the position coordinates of the minimum radius.
Position XY (Ave)	Outputs the average position coordinates from all the edge positions in pixels.
Distance []	Outputs the distances from the start of each segment of the inspection region to the position coordinate of the edge position in the segment in pixels. <small>Label specification target</small>
Distance (Max)	Outputs the distance from the start of the segment with the maximum radius to the position coordinate of the maximum radius in pixels.
Distance (Min)	Outputs the distance from the start of the segment with the minimum radius to the position coordinate of the minimum radius in pixels.
Distance (Ave)	Outputs the average distance from the start of the segments to the coordinate of the edge positions in pixels.
Radius []	Outputs the radius of all edge positions in pixels. <small>Tolerance inspection target Label specification target</small>

Radius (Max)	Outputs the radius of the edge position with the maximum radius. <small>Tolerance inspection target</small>
Radius (Min)	Outputs the radius of the edge position with the minimum radius. <small>Tolerance inspection target</small>
Radius (Ave)	Outputs the average radius of all edge positions in pixels.
Intensity []	Outputs the intensity differential of the edge at all the edge positions. <small>Label specification target</small>
Intensity (Max)	Outputs the intensity differential of the edge at the maximum radius.
Intensity (Min)	Outputs the intensity differential of the edge at the minimum radius.
Circle radius	Outputs the radius of the best fit circle in pixels. (when [Best Fit Circle/Line] is [Circle])
Circle center X	Outputs the X position coordinate at the center of the best fit circle in pixels. (when [Best Fit Circle/Line] is [Circle])
Circle center Y	Outputs the Y position coordinate at the center of the best fit circle in pixels. (when [Best Fit Circle/Line] is [Circle])
Circle center XY	Outputs the position coordinates at the center of the best fit circle in pixels. (when [Best Fit Circle/Line] is [Circle])
Maximum segment No.	Outputs the segment No. of the segment with the maximum edge position.
Minimum segment No.	Outputs the segment No. of the segment with the minimum edge position.
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

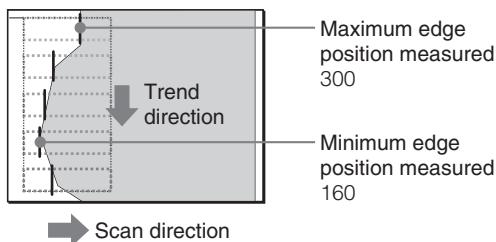
Reference For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

When the inspection region is a rectangle or a rotated rectangle

Example showing the results of a Profile Position inspection performed under the following conditions:

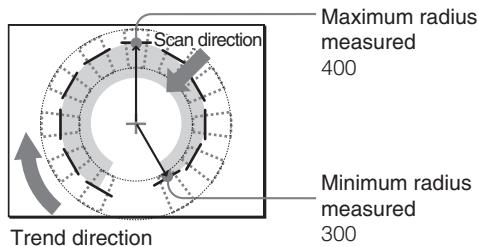
- Trend direction: ↓
- Scan Direction: →
- Edge Direction: Both



When the inspection region is a ring or an arc

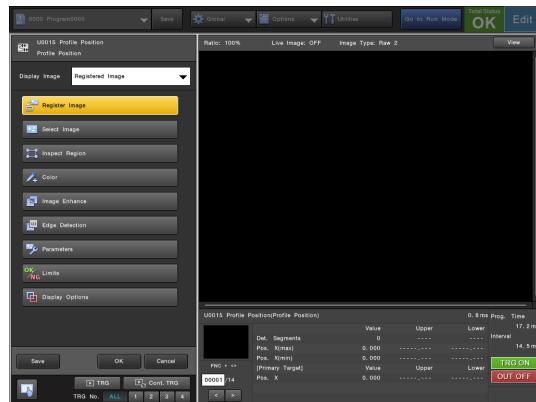
Example showing the results of a Profile Position inspection performed under the following conditions:

- Trend direction: Clockwise
- Scan Direction: Out → Center
- Edge Direction: Both



Top Menu

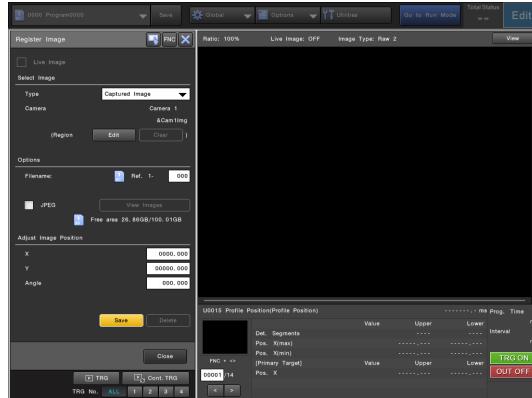
The top menu of the Profile Position tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-170)	Register an image to be used as a template for settings.
Select Image (Page 2-170)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-170)	Define the region to be used for unit processing.
Color (Page 2-170)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-171)	Specify the filter processing to apply to the image.
Edge Detection (Page 2-171)	Specify the scan direction and edge direction for detecting edges, as well as other detailed conditions for edge detection.
Parameters (Page 2-174)	Specify other conditions for the Profile Position tool as required.
Limits (Page 2-175)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-176)	Specify the display methods for things such as the inspection region and mask region.
Save (Page 2-177)	Save the current state to the program file.

Profile Position**Register Image**

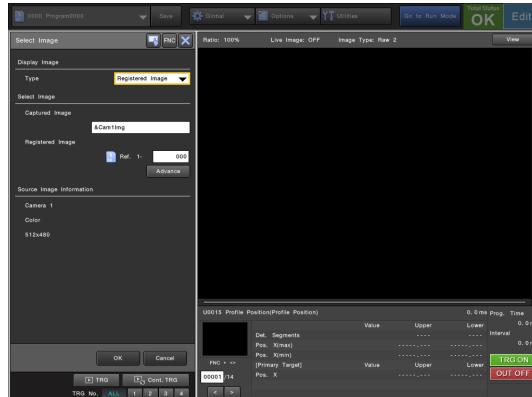
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

Specify the captured image and registered image to use for measurement.



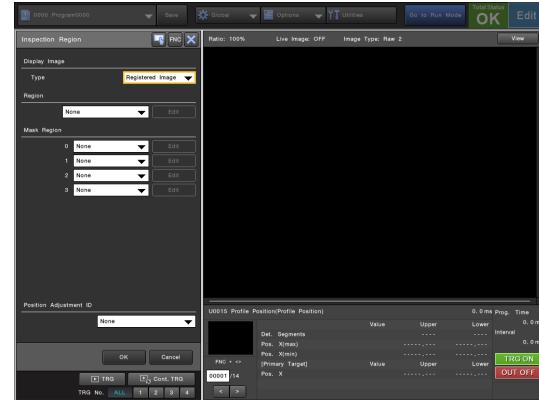
For more details, see "Select Image" (Page 2-471).

Inspect Region

Define the region to be used for unit processing.



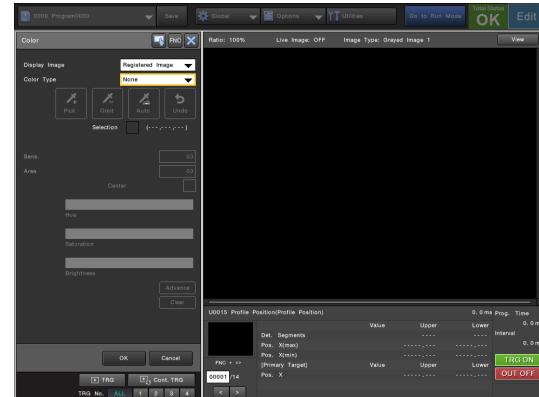
Changing the shape of the region will reset some settings on the [Edge Detection] and [Limits] screen.



For more details, see "Region Settings" (Page 2-473).

Color

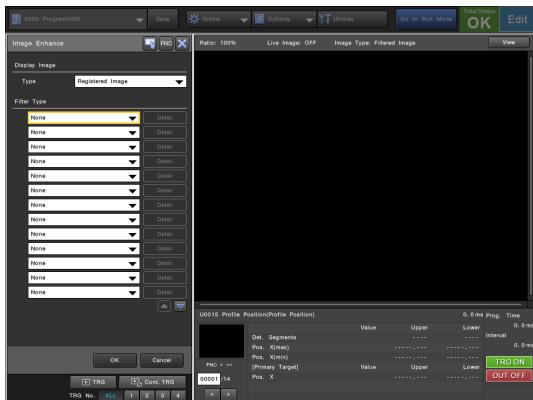
When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.



For more details, see "Color Extraction" (Page 2-483).

Image Enhance

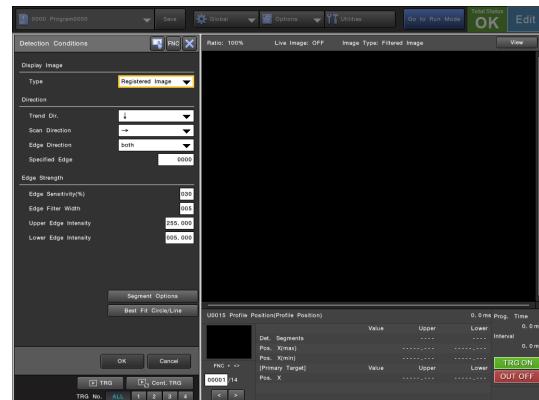
Specify the filter processing to apply to the image.



For more details, see "Image Enhance" (Page 2-489).

Edge Detection

Specify the scan direction and edge direction for detecting edges, as well as other detailed conditions for edge detection.



Reference Refer to "What is an Edge?" (Page 2-95) for the technical description of edge detection.

Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Direction

Trend Direction

Select the edge segment movement direction.

- **When the inspection region is a rectangle:** → or ↓
- **If the inspection region is a rotated rectangle:** ↓ (top to bottom) only.
- **When the inspection region is a ring or an arc:** only clockwise is available.



If variable referencing is used for the scan direction, the reference setting may be canceled if there is a change in the trend direction.

Scan direction

Select the scan direction to detect an edge.

- **When the inspection region is a rectangle:** ↓ or ↑ (when the trend direction is →), → or ← (when the trend direction is ↓)
- **When the inspection region is a rotated rectangle:** Forward (from left to right), Reverse (from right to left)
- **When the inspection region is a ring or an arc:** Center → Out, Out → Center

Profile Position

Edge Direction

Select the change in contrast for detecting an edge.

- **both**: Detect edges in a transition that can change either from a bright area to a dark area or from a dark area to a bright area.
- **Light to Dark**: Detect edges in a transition that changes from a bright area to a dark area.
- **Dark to Light**: Detect edges in a transition that changes from a dark area to a bright area.

Specified Edge

Specify the edge No. (-3600 to 3599) used for the measurement within the segment.

If a value of 0 or higher is specified, the edge No. is counted in the order of detection in the scan direction. If a negative value is specified, the edge No. is counted in the order opposite to that of the scan direction.

If the specified edge number is not found, the result of that segment is 0.

Edge Strength

Edge Sensitivity (%)

Set the percentage threshold (0% to 100%) for detecting edges.

Edge Filter Width

Set the width (0 to 100 pixels) of the smoothing filter applied to the differential graph for detecting edges.

Upper Edge Intensity

Specify the upper limit (0.000 to 255.000) of edge intensity for detecting edges.

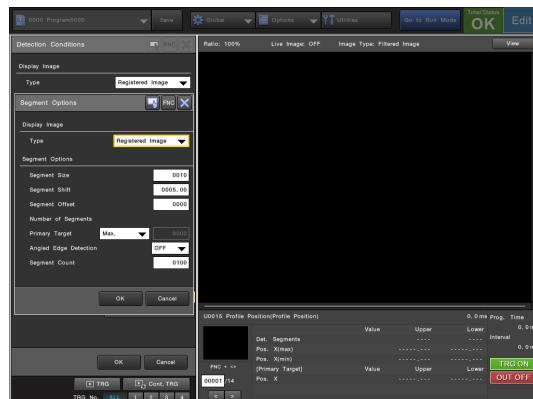
Lower Edge Intensity

Specify the lower limit (0.000 to 255.000) of edge intensity for detecting edges.

Reference

It may be possible to exclude noisy edges in the segment by adjusting the upper and lower edge intensity values based on the highest edge intensity in the segment, shown on the left of the edge graph. See "What is an Edge?" (Page 2-95) for more details.

Segment Options



Display Image

Type

Switch the image displayed on the screen.

- **Captured image**: Displays the latest image from the specified camera (image variable).
- **Registered image**: Displays the registered image specified under [Select Image].

Segment Options

Segment Size

Specify the size of the segment in the inspection region.

- When the inspection region is a rectangle or a rotated rectangle: Specify a value between 1 and 9999 pixels. If the segment size is larger than the size of the inspection region, a measurement error will occur.
- When the inspection region is a ring or an arc: Specify a value between 0.01 and 359.99°. If the segment size is larger than the inspection region, a measurement error will occur.

Segment Shift

Specify the shifting distance of the segment along the trend.

- When the inspection region is a rectangle or a rotated rectangle: Specify a value between 0.01 and 9999.99 pixels.
- When the inspection region is a ring or an arc: Specify a value between 0.01 and 359.99°.

Segment Offset (Start Angle)

Specify the offset (distance or angle) of the first segment in the inspection region. If an error occurs due to no edge points near the beginning of the inspection region, offset the segment to a better location.

- When the inspection region is a rectangle or a rotated rectangle: Specify a value between 0 and 9999 pixels.
- When the inspection region is a ring or an arc: Specify a value between 0.00 and 359.99°.

Primary target

Select the segment from [Max.], [Min.] or [Specified] to be used for the OK / NG judgment. When selecting [Specified], specify the segment No. (0 to 4999) of the segment.

Point The number of segments set in the current inspection region is updated automatically according to the change in the segment size and shift. The maximum number of segments is 5000, but the actual number of segments that can be set may be lower depending on other settings.

Reference During operation, the screen displays the position, edge graph, edge intensity value, and measurement results of the segment specified as the primary target. Changing the primary target is useful for checking the detection status of specific segments.

Angled Edge Detection

Set to [ON] to stabilize the detection of slanted edges in the inspection region. Using this option may affect the edge X, Y position accuracy.

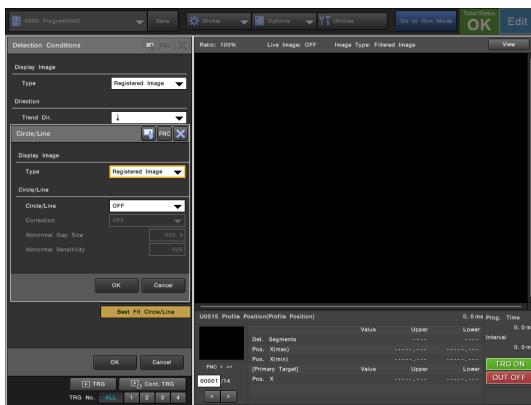
Segment Count

Specify the maximum number of segments which can be detected in the unit currently being set.

Point

- The maximum number of segments available for detection can vary based on other settings.
- Based on specific settings, the Segment Count is fixed and cannot be changed.

Best Fit Circle / Line



Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Circle / line

Select whether to project a best fit circle or line based on the detected edge information.

- OFF:** No best fit line
- Circle:** Calculate a best fit circle using the least square method on the range of edge points detected.
- Line:** Calculate a best fit a line using the least square method on the range of edge points detected (only available when the inspection region is a rectangle or a rotated rectangle).

Point

- Detection is not possible if there are fewer than 3 segments inside the inspection region for a circle or less than 2 for a line.
- The best fit circle is not possible when the calculation result exceeds either the center coordinates by ± 16000 pixels or its radius exceeds 16000 pixels.
- If a best fit [Circle] or [Line] is used the data used for position adjustment will be changed to the information from the best fit circle or line.
- If variables are used for [Correction], [Abnormal Gap Size], or [Abnormal Sensitivity], the reference setting may be reset depending on the change in the [Best Fit Circle/Line] setting.

Correction

Correct any false detection for the best fit [Circle / Line] caused by noise.

When [Circle/Line] is selected, noise in the edge information may greatly affect the result. Turn correction [ON] to remove incomplete edges from the best fit calculation and thus reduce the effects of noise.

Point If too few edge points are detected, turning the correction [ON] in [Circle/Line] may increase the occurrence of errors in circle or line detection.

Abnormal Gap Size

When [Best Fit Circle/Line] and [Correction] are selected, specify the allowable range of deviation (distance) between adjacent segments to remove abnormal detected edge points.

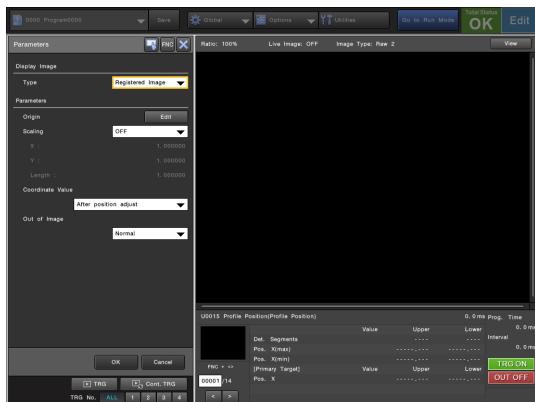
Abnormal Sensitivity

When [Best Fit Circle/Line] and [Correction] are selected, specify the upper edge sensitivity limit (%) for the abnormal detected points, in the segments.

Profile Position

Parameters

Specify other conditions for the Profile Position tool as required.



Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

Reference The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels. The result data and setting parameters used for display, judgment and calculations can be converted and scaled to real life values and dimensions by using the pre-set scaling factor option.

- OFF:** Do not use scaling.
- ON:** Use scaling.

Reference

- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate Value

Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- After position adjust:** The inspection uses the adjusted coordinate axes determined after position adjustment.
- Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Out of Image

Specify whether to incorporate data that falls outside of the inspection region. This maybe required when position adjustment is used.

- Normal** (default): Edge detection outside of the region is disabled as the image data outside of the region is masked. Since masking requires time to process, the inspection time may vary depending on the quantity image data outside the region. Processing will take longer when the inspection region is a ring or an arc.
- Fast:** The image data outside of the region is not masked, allowing for faster processing. As the image data outside the region has not been masked so there is an increased chance of detecting an edge outside the region. Select [Normal] to avoid incorrect edge detection.

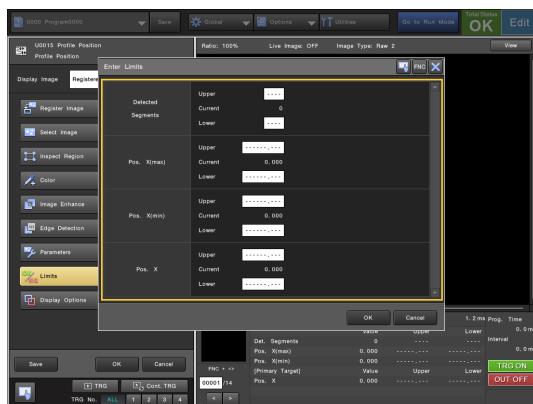


Image data which is already located outside of the region during the inspection region setting will always be masked regardless of the [Out of Image] setting.

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.

Reference

- [----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Detected Segments

Specify the tolerance for the segment detection count.

The unit of measurement is the "number of segments" detected.

Pos. X (Max)

Specify the tolerance for the maximum value of the detected X position (when the inspection region is a [Rectangle] and the trend direction is ↓).

The unit of measurement is the "number of pixels" indicating the X coordinate of the edge position.

Pos. X (Min)

Specify the tolerance for the minimum value of the detected X position (when the inspection region is a [Rectangle] and the trend direction is ↓).

The unit of measurement is the "number of pixels" indicating the X coordinate of the edge position.

Pos. X

Specify the tolerance for the X edge position (when the inspection region is a [Rectangle] and the trend direction is ↓). The unit of measurement is the "number of pixels" indicating the X coordinate of the edge position.

Pos. Y (max)

Specify the tolerance for the maximum value of the detected Y position (when the inspection region is a [Rectangle] and the trend direction is →).

The unit of measurement is the "number of pixels" indicating the Y coordinate of the edge position.

Pos. Y (min)

Specify the tolerance for the minimum value of the detected Y position (when the inspection region is a [Rectangle] and the trend direction is →).

The unit of measurement is the "number of pixels" indicating the Y coordinate of the edge position.

Pos. Y

Specify the tolerance for the Y position edge (when the inspection region is a [Rectangle] and the trend direction is →). The unit of measurement is the "number of pixels" indicating the Y coordinate of the edge position.

Dist. (max)

Specify the tolerance for the maximum detected distance (when the inspection region is a [Rotated Rectangle]).

The unit of measurement is the "number of pixels" indicating the distance.

Dist. (min)

Specify the tolerance for the minimum detected distance (when the inspection region is a [Rotated Rectangle]).

The unit of measurement is the "number of pixels" indicating the distance.

Dist.

Specify the tolerance for the detected distance (when the inspection region is a [Rotated Rectangle]).

The unit of measurement is the "number of pixels" indicating the distance.

Rad. (max)

Specify the tolerance for the maximum detected radius (when the inspection region is a [Ring/Arc]).

The unit of measurement is the "number of pixels" indicating the radius.

Rad. (min)

Specify the tolerance for the minimum detected radius (when the inspection region is a [Ring/Arc]).

The unit of measurement is the "number of pixels" indicating the radius.

Rad.

Specify the tolerance for the detected radius (when the inspection region is a [Ring/Arc]).

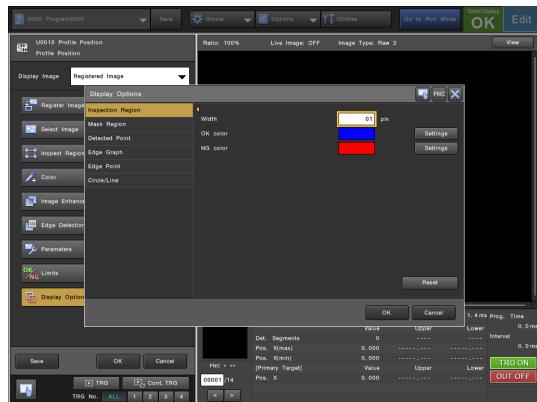
The unit of measurement is the "number of pixels" indicating the radius.

Profile Position

Display Options

Specify the display methods for things such as the inspection region and mask region, and detected edges and edge graph.

You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection region

Specify the line width and display color of the inspection region.

Mask region

Specify the line width and display color of the mask region.

Detected Point

Target

Specify how to display the detected points.

- **OFF:** Hide the detected points.
- **Primary target** (default): Show the detected point for the primary target.
- **Primary target, Max/Min:** Show the detected point for the primary target, maximum and minimum measured values.

Primary target

Specify the width and display color of the line indicating the detected edge.

Other target

Specify the width and display color of the line indicating the detected edge other than the one specified as the primary target (Page 2-173).

Edge Graph

Edge graph

Select whether to display the edge graph.

- **OFF** (default): Hide the edge graph.
- **Primary Target:** Display a graph of the primary target segment.
- **Maximum:** Display a graph of the largest segment.
- **Minimum:** Display a graph of the smallest segment.

Wave

Specify the width and display color of the edge graph waveform.

Frame

Specify the width and display color of the edge graph frame.

Sensitivity

Specify the width and display color of the line representing the edge sensitivity threshold.

Point

Setting [Edge graph] to [ON] consumes additional program memory. Check the amount of remaining program memory before enabling.

Edge Point

Profile

Chose if the line connecting the detection point in the segment and the edge detection point should be displayed or not.

Point

This setting is not applied to the display when [Display Type] is set to [Raw 2].

Segments

Chose if the line of the segments should be displayed or not.

Point

- This setting is not applied to the display when [Display Type] is set to [Raw 2].
- If the segment size is larger than the segment shift, the segments will not be displayed.

Circle/Line

Specify the width and display color of the best fit line or circle determined from the detected points.

Reset

Returns the display options to their defaults.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

Profile Width

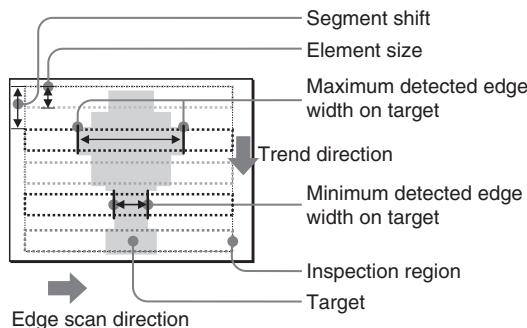
Profile Width Tool

The Profile Width tool takes a segment of a specified size and indexes it through the inspection region along the trend direction. With each shift of the segment the tool scans in the opposing direction detecting contrast changes to identify edge points. By identifying all the edge points along the two sides of a target the maximum, minimum and average edge width of the target profile can be measured.

Measurement Overview

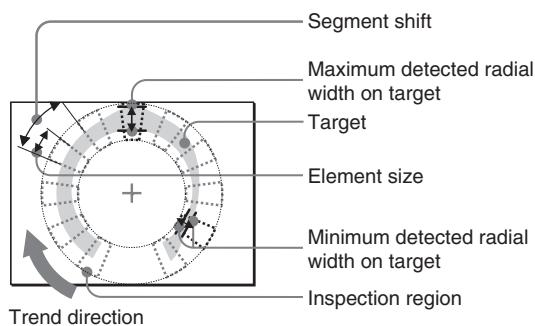
When the inspection region is a rectangle or a rotated rectangle

- In the instance the scan direction is [→] and trend direction is [↓]

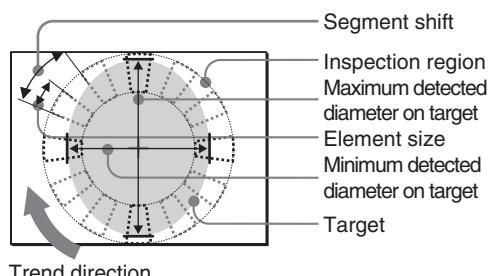


When the inspection region is a ring or an arc

- In the instance the trend direction is [Clockwise] and [Measure] is [Outer Gap]



- In the instance the trend direction is [Clockwise] and [Measure] is [Outer Diameter]



Main measurement results

The standard results and data returned by the Profile Width tool are as follows:



Point

Processing results may vary depending on the shape of the inspection region. The result for an item which is not processed is always 0.

When the inspection region is a rectangle or a rotated rectangle

Number of segments	Outputs the number of set segments.
Number of detected segments	Outputs the number of segments where contrast changes were detected and edges identified. <small>(Tolerance inspection target)</small>
Number []	Outputs (1) if a pair is detected and (0) if a pair is not detected for all segments. <small>(Label specification target)</small>
Number (max)	Outputs (1) if a pair is detected and (0) if a pair is not detected for the segment with the maximum edge width.
Number (min)	Outputs (1) if a pair is detected and (0) if a pair is not detected for the segment with the minimum edge width.
Width []	Outputs the width (diameter/radial width) of all the edge width pairs in pixels. <small>(Tolerance inspection target) (Label specification target)</small>
Width (Max)	Outputs the maximum edge width (diameter / radial width) from all the edge width pairs in pixels. <small>(Label specification target)</small>
Width (Min)	Outputs the minimum edge width (diameter / radial width) from all the edge width pairs in pixels. <small>(Label specification target)</small>
Width (Ave)	Outputs the average edge width from all the edge width pairs in pixels.
Position 1 (X/Y/XY) []	Outputs position coordinates for the first identified edge (typically the one nearest the start of the segment) of all edge width pairs in pixel. <small>(Label specification target)</small>
Position 1 (X/Y/XY) (max)	Outputs position coordinates for the first identified edge (typically the one nearest the start of the segment) of the maximum edge width pair in pixels.
Position 1 (X/Y/XY) (min)	Outputs position coordinates for the first identified edge (typically the one nearest the start of the segment) of the minimum edge width pair in pixels.
Angle 1 []	Outputs the angle of rotation of the inspection region when the region is a rotated rectangle (always 0 when the inspection region is a rectangle). <small>(Label specification target)</small>
Angle 1(max)	Outputs the maximum angle of rotation of the inspection region when the region is a rotated rectangle (always 0 when the inspection region is a rectangle).
Angle 1(min)	Outputs the minimum angle of rotation of the inspection region when the region is a rotated rectangle (always 0 when the inspection region is a rectangle).
Distance 1 []	Outputs the distance from the start of each segment of the inspection region to the position coordinate of the first identified edge (typically the one nearest the start of the segment) of the edge width pair in pixels. <small>(Label specification target)</small>
Distance 1 (max)	Outputs the distance from the start of the segment with the maximum edge width pair to the position coordinate of the first identified edge (typically the one nearest the start of the segment) of the maximum edge width pair in pixels.

Distance 1 (min)	Outputs the distance from the start of the segment with the minimum edge width pair to the position coordinate of the first identified edge (typically the one nearest the start of the segment) of the minimum edge width pair in pixels.
Intensity 1 []	Outputs the intensity differential of the first identified edge (typically the one nearest the start of the segment) of all the edge width pairs. <small>(Label specification target)</small>
Intensity 1 (max)	Outputs the intensity differential of the first identified edge (typically the one nearest the start of the segment) of the maximum edge width pair.
Intensity 1 (min)	Outputs the intensity differential of the first identified edge (typically the one nearest the start of the segment) of the minimum edge width pair.
Position 2 (X/Y/XY) []	Outputs position coordinates for the second identified edge (typically the one nearest the end of the segment) of all edge width pairs in pixels. <small>(Label specification target)</small>
Position 2 (X/Y/XY) (max)	Outputs position coordinates for the second identified edge (typically the one nearest the end of the segment) of the maximum edge width pair in pixels.
Position 2 (X/Y/XY) (min)	Outputs position coordinates for the second identified edge (typically the one nearest the end of the segment) of the minimum edge width pair in pixels.
Angle 2 []	Outputs the angle of rotation of the inspection region when the region is a rotated rectangle (always 0 when the inspection region is a rectangle). <small>(Label specification target)</small>
Angle 2 (Max)	Outputs the maximum angle of rotation of the inspection region when the region is a rotated rectangle (always 0 when the inspection region is a rectangle).
Angle 2 (Min)	Outputs the minimum angle of rotation of the inspection region when the region is a rotated rectangle (always 0 when the inspection region is a rectangle).
Distance 2 []	Outputs the distance from the start of each segment of the inspection region to the position coordinate of the second identified edge (typically the one nearest the end of the segment) of the edge width pair in pixels. <small>(Label specification target)</small>
Distance 2 (Max)	Outputs the distance from the start of the segment with the maximum edge width pair to the position coordinate of the second identified edge (typically the one nearest the end of the segment) of the maximum edge width pair in pixels.
Distance 2 (Min)	Outputs the distance from the start of the segment with the minimum edge width pair to the position coordinate of the second identified edge (typically the one nearest the end of the segment) of the minimum edge width pair in pixels.
Intensity 2 []	Outputs the intensity differential of the second identified edge (typically the one nearest the end of the segment) of all the edge width pairs. <small>(Label specification target)</small>
Intensity 2 (Max)	Outputs the intensity differential of the second identified edge (typically the one nearest the end of the segment) of the maximum edge width pair.
Intensity 2 (Min)	Outputs the intensity differential of the second identified edge (typically the one nearest the end of the segment) of the minimum edge width pair.
Maximum segment No.	Outputs the segment No. of the segment with the maximum edge position.
Minimum segment No.	Outputs the segment No. of the segment with the minimum edge position.
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

When the inspection region is a ring or an arc

Number of segments	Outputs the number of set segments.
Number of detected segments	Outputs the number of segments where contrast changes were detected and edges identified. <small>Tolerance inspection target</small>
Number []	Outputs (1) if a pair is detected and (0) if a pair is not detected for all segments. <small>(Label specification target)</small>
Number (Max)	Outputs (1) if a pair is detected and (0) if a pair is not detected for the segment with the maximum edge width.
Number (Min)	Outputs (1) if a pair is detected and (0) if a pair is not detected for the segment with the minimum edge width.
Width []	Outputs the width (diameter/radial width) of all the edge width pairs in pixels. <small>Tolerance inspection target (Label specification target)</small>
Width (Max)	Outputs the maximum edge width (diameter / radial width) from all the edge width pairs in pixels. <small>Tolerance inspection target</small>
Width (Min)	Outputs the minimum edge width (diameter / radial width) from all the edge width pairs in pixels. <small>Tolerance inspection target</small>
Width (Ave)	Outputs the average edge width (diameter / radial width) from all the edge width pairs in pixels.
Position 1 (X/Y/XY) []	Outputs position coordinates for the first identified edge (typically the one nearest the start of the segment) of all edge width pairs in pixel. <small>(Label specification target)</small>
Position 1 (X/Y/XY) (max)	Outputs position coordinates for the first identified edge (typically the one nearest the start of the segment) of the maximum edge width pair in pixels.
Position 1 (X/Y/XY) (min)	Outputs position coordinates for the first identified edge (typically the one nearest the start of the segment) of the minimum edge width pair in pixels.
Angle 1 []	Outputs angle for the second identified edge (typically the one nearest the end of the segment) of all edge width pairs. <small>(Label specification target)</small>
Angle 1(max)	Outputs the angle for the second identified edge (typically the one nearest the end of the segment) of the maximum edge width pair.
Angle 1(min)	Outputs the angle for the second identified edge (typically the one nearest the end of the segment) of the minimum edge width pair.
Distance 1 []	Outputs the distance from the start of each segment of the inspection region to the position coordinate of the first identified edge (typically the one nearest the start of the segment) of the edge width pair in pixels. <small>(Label specification target)</small>
Distance 1(max)	Outputs the distance from the start of the segment with the maximum edge width pair to the position coordinate of the first identified edge (typically the one nearest the start of the segment) of the maximum edge width pair in pixels.
Distance 1(min)	Outputs the distance from the start of the segment with the minimum edge width pair to the position coordinate of the first identified edge (typically the one nearest the start of the segment) of the minimum edge width pair in pixels.
Intensity 1 []	Outputs the intensity differential of the first identified edge (typically the one nearest the start of the segment) of all the edge width pairs. <small>(Label specification target)</small>
Intensity 1(max)	Outputs the intensity differential of the first identified edge (typically the one nearest the start of the segment) of the maximum edge width pair.
Intensity 1(min)	Outputs the intensity differential of the first identified edge (typically the one nearest the start of the segment) of the minimum edge width pair.

Profile Width

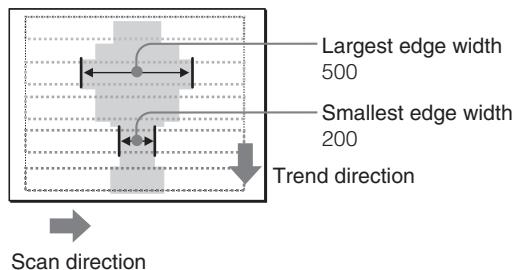
Position 2 (X/Y/XY) []	Outputs position coordinates for the second identified edge (typically the one nearest the end of the segment) of all edge width pairs in pixels. <small>(Label specification target)</small>
Position 2 (X/Y/XY) (max)	Outputs position coordinates for the second identified edge (typically the one nearest the end of the segment) of the maximum edge width pair in pixels.
Position 2 (X/Y/XY) (min)	Outputs position coordinates for the second identified edge (typically the one nearest the end of the segment) of the minimum edge width pair in pixels.
Angle 2 []	Outputs angle for the second identified edge (typically the one nearest the end of the segment) of all edge width pairs. (For outer gap and inner gap, the value is the same as for Angle 1. For outer diameter and inner diameter, the value is Angle 1 + 180°.) <small>(Label specification target)</small>
Angle 2 (Max)	Outputs the angle for the second identified edge (typically the one nearest the end of the segment) of the maximum edge width pair. (For outer gap and inner gap, the value is the same as for Angle 1. For outer diameter and inner diameter, the value is Angle 1 + 180°.)
Angle 2 (Min)	Outputs the angle for the second identified edge (typically the one nearest the end of the segment) of the minimum edge width pair. (For outer gap and inner gap, the value is the same as for Angle 1. For outer diameter and inner diameter, the value is Angle 1 + 180°.)
Distance 2 []	Outputs the distance from the start of each segment of the inspection region to the position coordinate of the second identified edge (typically the one nearest the end of the segment) of the edge width pair in pixels. <small>(Label specification target)</small>
Distance 2 (Max)	Outputs the distance from the start of the segment with the maximum edge width pair to the position coordinate of the second identified edge (typically the one nearest the end of the segment) of the maximum edge width pair in pixels.
Distance 2 (Min)	Outputs the distance from the start of the segment with the minimum edge width pair to the position coordinate of the second identified edge (typically the one nearest the end of the segment) of the minimum edge width pair in pixels.
Intensity 2 []	Outputs the intensity differential of the second identified edge (typically the one nearest the end of the segment) of all the edge width pairs. <small>(Label specification target)</small>
Intensity 2 (Max)	Outputs the intensity differential of the second identified edge (typically the one nearest the end of the segment) of the maximum edge width pair.
Intensity 2 (Min)	Outputs the intensity differential of the second identified edge (typically the one nearest the end of the segment) of the minimum edge width pair.
Maximum segment No.	Outputs the segment No. of the segment with the maximum edge position.
Minimum segment No.	Outputs the segment No. of the segment with the minimum edge position.
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

Reference For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample**When the inspection region is a rectangle or a rotated rectangle**

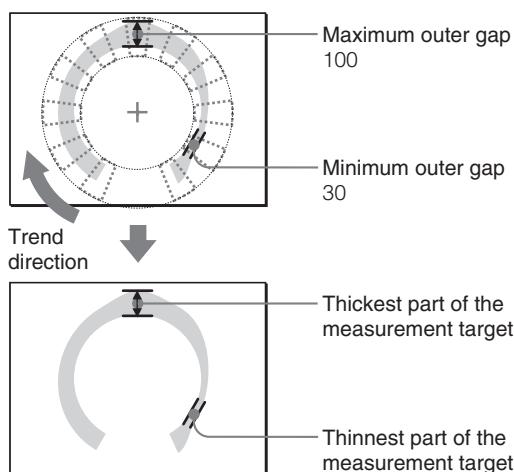
Example showing the results of a Profile Width inspection performed under the following conditions:

- Measure: Outer Gap
- Trend direction: ↓
- Scan Direction: →
- Edge Direction: Both

**When the inspection region is a ring or an arc (1)**

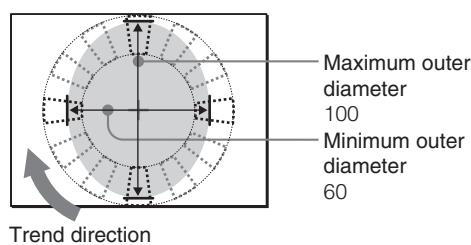
Example showing the results of a Profile Width inspection performed under the following conditions:

- Measure: Outer Gap
- Trend direction: Clockwise
- Scan Direction: Center → Out
- Edge Direction: Both

**When the inspection region is a ring or an arc (2)**

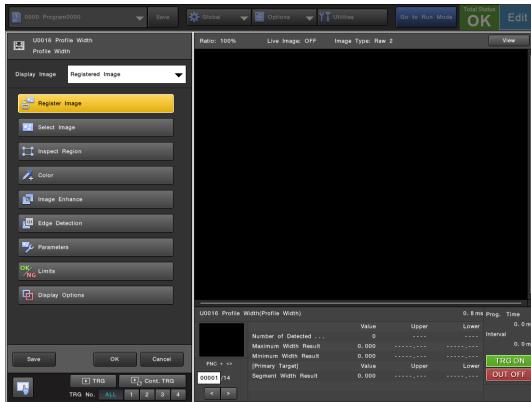
Example showing the results of a Profile Width inspection performed under the following conditions:

- Measure: Outer Diameter
- Trend direction: Clockwise
- Scan Direction: Center → Out
- Edge Direction: Both



Top Menu

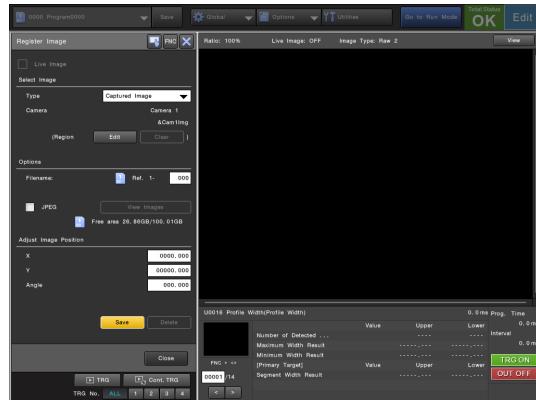
The top menu of the Profile Width tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-181)	Register an image to be used as a template for settings.
Select Image (Page 2-181)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-182)	Define the region to be used for unit processing.
Color (Page 2-182)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-182)	Specify the filter processing to apply to the image.
Edge Detection (Page 2-183)	Specify the scan direction and edge direction for detecting edges, as well as other detailed conditions for edge detection.
Parameters (Page 2-185)	Specify other conditions for the Profile Width tool as required.
Limits (Page 2-186)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-187)	Specify the display methods for things such as the inspection region and mask region.
Save (Page 2-188)	Save the current state to the program file.

Register Image

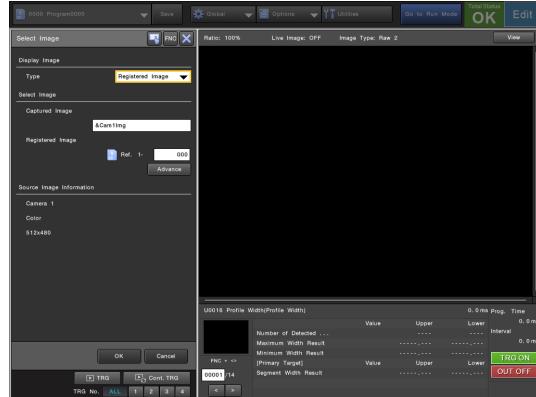
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

Specify the captured image and registered image to use for measurement.



For more details, see "Select Image" (Page 2-471).

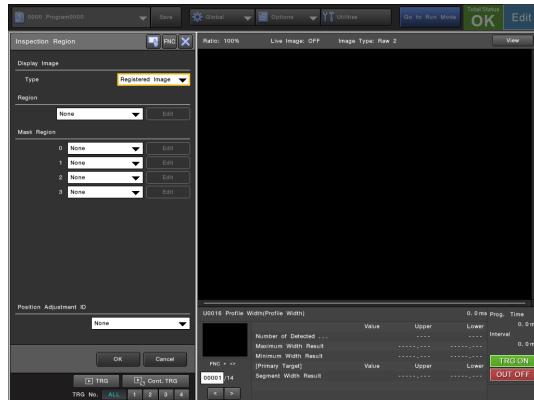
Profile Width

Inspect Region

Define the region to be used for unit processing.



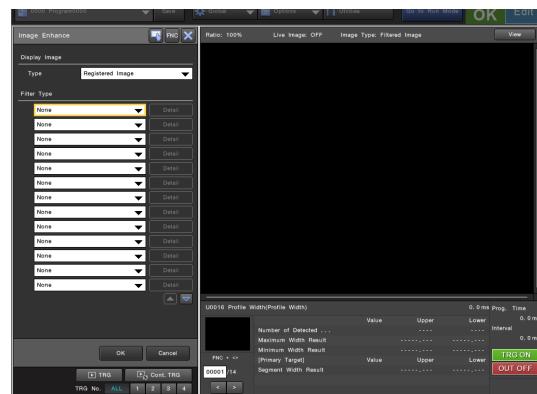
Changing the shape of the region will reset some settings on the [Edge Detection] and [Limits] screens.



For more details, see "Region Settings" (Page 2-473).

Image Enhance

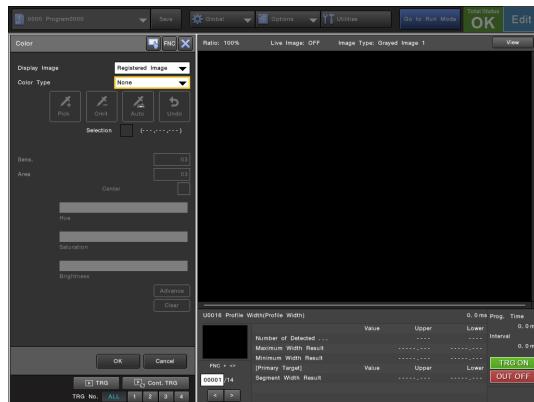
Specify the filter processing to apply to the image.



For more details, see "Image Enhance" (Page 2-489).

Color

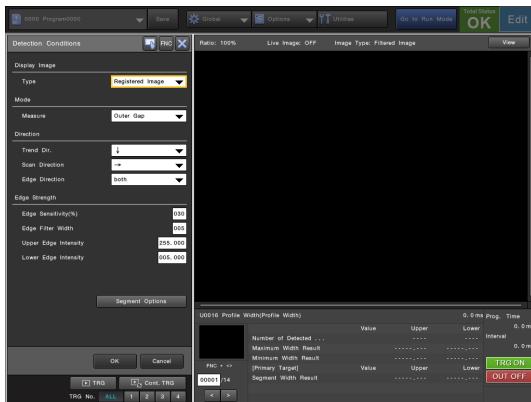
When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.



For more details, see "Color Extraction" (Page 2-483).

Edge Detection

Specify the scan direction and edge direction for detecting edges, as well as other detailed conditions for edge detection.



Reference Refer to "What is an Edge?" (Page 2-95) for the technical description of edge detection.

Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

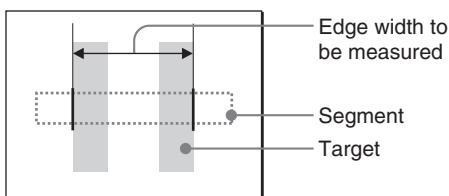
Mode

Measure

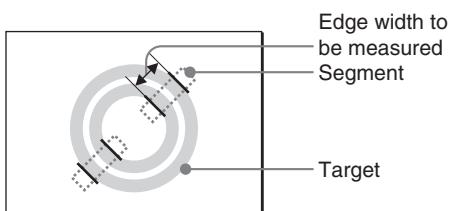
Select the type of Edge Width measurement.

- Outer Gap:** Measure the distance between the two outermost edges in the inspection region.

When the inspection region is a rectangle or a rotated rectangle:

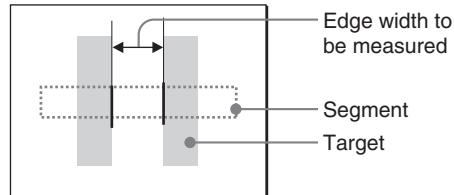


When the inspection region is a ring or an arc:

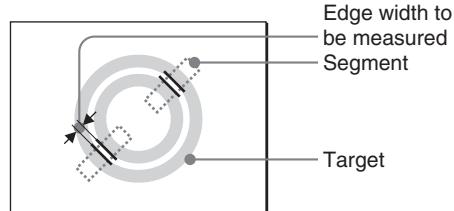


- Inner Gap:** Measure the distance between the two innermost edges in the inspection region.

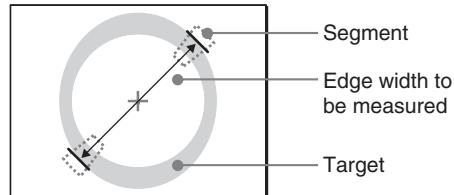
When the inspection region is a rectangle or a rotated rectangle:



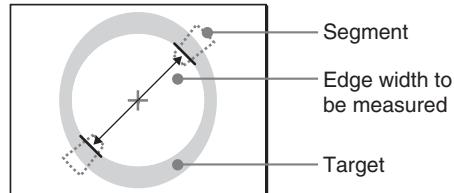
When the inspection region is a ring or an arc:



- Outer Diameter** (Ring only): Measure the outer diameter of the edges detected by two opposing segments in a ring inspection region.



- Inner Diameter** (Ring only): Measure the inner diameter of the edges detected by two opposing segments in a ring inspection region.



If variable referencing is used for the scan direction, the reference setting may be canceled if there is a change in the trend direction.

Profile Width

Direction

Trend Dir.

Select the edge segment movement direction.

- **When the inspection region is a rectangle:** → or ↓
- **If the inspection region is a rotated rectangle:** ↓ (top to bottom) only.
- **When the inspection region is a ring or an arc:** only clockwise is available.

Scan Direction

Select the scan direction to detect an edge.

- **When the inspection region is a rectangle:** ↓ or ↑ (when the trend direction is →), → or ← (when the trend direction is ↓)
- **When the inspection region is a rotated rectangle:** Forward (from left to right), Reverse (from right to left)
- **When the inspection region is a ring or an arc:** Center → Out, Out → Center

Edge Direction

Select the change in contrast for detecting an edge.

- **both** (default): Detect edges in a transition that can change either from a bright area to a dark area or from a dark area to a bright area.
- **Light to Dark:** Detect edges in a transition that changes from a bright area to a dark area.
- **Dark to Light:** Detect edges in a transition that changes from a dark area to a bright area.

Edge Strength

Edge Sensitivity (%)

Set the percentage threshold (0% to 100%) for detecting edges.

Edge Filter Width

Set the width (0 to 100 pixels) of the smoothing filter applied to the differential graph for detecting edges.

Upper Edge Intensity

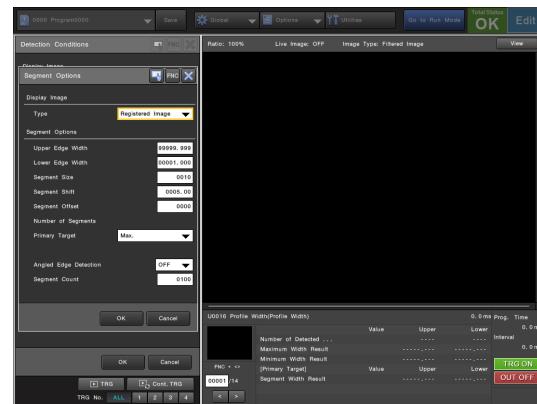
Specify the upper limit (0.000 to 255.000) of edge intensity for detecting edges.

Lower Edge Intensity

Specify the lower limit (0.000 to 255.000) of edge intensity for detecting edges.

Reference It may be possible to exclude noisy edges in the segment by adjusting the upper and lower edge intensity values based on the highest edge intensity in the segment, shown on the left of the edge graph. See "What is an Edge?" (Page 2-95) for more details.

Segment Options



Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Segment Options

- **Upper Edge Width:** Specify the upper limit of the detected edge width (0 - 99999.999 pixels).
- **Lower Edge Width:** Specify the lower limit of the detected edge width (0 - 99999.999 pixels).



The maximum and minimum distances specified in the [Edge Width] will apply to the results before the scaling operation, even if [Scaling] (Page 2-185) is set to [ON].

Segment Size

Specify the size of the segment in the inspection region.

- When the inspection region is a rectangle or a rotated rectangle: Specify a value between 1 and 9999 pixels. If the segment size is larger than the size of the inspection region, a measurement error will occur.
- When the inspection region is a ring or an arc: Specify a value between 0.01 and 359.99°. If the segment size is larger than the inspection region, a measurement error will occur.

Segment Shift

Specify the shifting distance of the segment along the trend.

- When the inspection region is a rectangle or a rotated rectangle: Specify a value between 0.01 and 9999.99 pixels.
- When the inspection region is a ring or an arc: Specify a value between 0.01 and 359.99°.

Segment Offset (Start Angle)

Specify the offset (distance or angle) of the first segment in the inspection region. If an error occurs due to no edge points near the beginning of the inspection region, offset the segment to a better location.

- When the inspection region is a rectangle or a rotated rectangle: Specify a value between 0 and 9999 pixels.
- When the inspection region is a ring or an arc: Specify a value between 0.00 and 359.99°.

Primary Target

Select the segment from [Max.], [Min.] or [Specified] (0 to 4999) to be used as the target for OK / NG judgment.

Point The number of segments set in the current inspection region is updated automatically according to the change in the segment size and shift. The maximum number of segments is 5000, but the actual number of segments that can be set may be lower depending on other settings.

Reference During operation, the screen displays the position, edge graph, edge intensity value, and measurement results of the segment specified as the primary target. Changing the primary target is useful for checking the detection status of specific segments.

Angled Edge Detection

Set to [ON] to stabilize the detection of slanted edges in the inspection region. Using this option may affect the edge X, Y position accuracy.

Segment Count

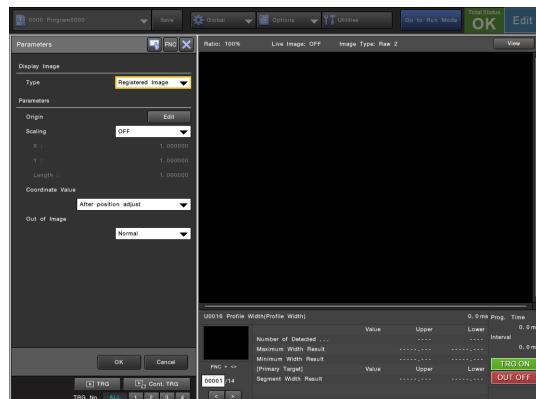
Specify the maximum number of segments which can be detected in the unit currently being set (1 to 5000, 100(default)).

Point

- The maximum number of segments available for detection can vary based on other settings.
- Based on specific settings, the Segment Count is fixed and cannot be changed.

Parameters

Specify other conditions for the Profile Width tool as required.



Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

Reference The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels. The result data and setting parameters used for display, judgment and calculations can be converted and scaled to real life values and dimensions by using the pre-set scaling factor option.

- OFF:** Do not use scaling.
- ON:** Use scaling.

Reference

- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Profile Width

Coordinate Value

Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- After position adjust:** The inspection uses the adjusted coordinate axes determined after position adjustment.
- Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Out of Image

Specify whether to incorporate data that falls outside of the inspection region. This maybe required when position adjustment is used.

- Normal** (default): Edge detection outside of the region is disabled as the image data outside of the region is masked. Since masking requires time to process, the inspection time may vary depending on the quantity image data outside the region. Processing will take longer when the inspection region is a ring or an arc.
- Fast:** The image data outside of the region is not masked, allowing for faster processing. As the image data outside the region has not been masked so there is an increased chance of detecting an edge outside the region. Select [Normal] to avoid incorrect edge detection.

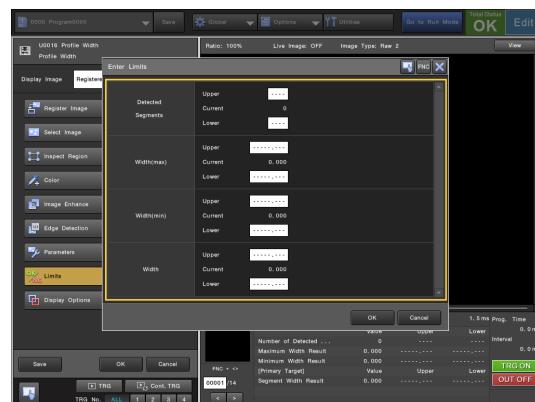


Image data which is already located outside of the region during the inspection region setting will always be masked regardless of the [Out of Image] setting.

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.



- [----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Detected Segments

Specify the tolerance for the segment detection count.

The unit of measurement is the "number of segments" detected.

Width (max)

Specify the tolerance for the maximum value of the detected width.

The unit of measurement is the "number of pixels" indicating the edge width.

Width (min)

Specify the tolerance for the minimum value of the detected width.

The unit of measurement is the "number of pixels" indicating the edge width.

Width

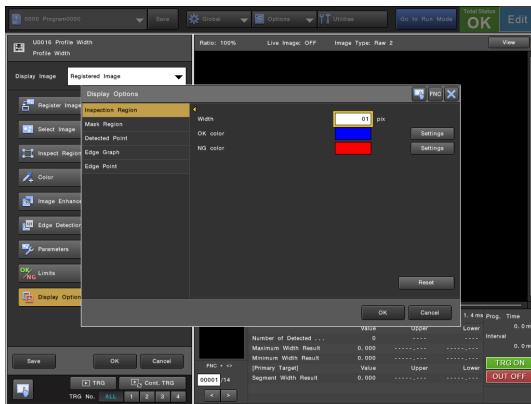
Specify the tolerance for the detected width in the judgment target segment.

The unit of measurement is the "number of pixels" indicating the edge width.

Display Options

Specify the display methods for things such as the inspection region and mask region, and detected edges and edge graph.

You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection region

Specify the line width and display color of the inspection region.

Mask region

Specify the line width and display color of the mask region.

Detected Point

Target

Specify how to display the detected points.

- **OFF:** Hide the detected points.
- **Primary target** (default): Show the detected points for the primary target.
- **Primary target, Max/Min:** Show the detected points for the primary target, maximum and minimum measured values.

Primary Target

Specify the width and display color of the line indicating the detected edge.

Other Target

Specify the width and display color of the line indicating the detected edge other than the one specified as the primary target (Page 2-185).

Edge Graph

Edge graph

Select whether to display the edge graph.

- **OFF** (default): Hide the edge graph.
- **Primary Target:** Display a graph of the primary target segment.
- **Maximum:** Display a graph of the largest segment.
- **Minimum:** Display a graph of the smallest segment.

Wave

Specify the width and display color of the edge graph waveform.

Frame

Specify the width and display color of the edge graph frame.

Sensitivity

Specify the width and display color of the line representing the edge sensitivity threshold.



Setting [Edge graph] to [ON] consumes additional program memory. Check the amount of remaining program memory before enabling.

Edge Point

Profile

Specify the thickness and display color of the line connecting the detection point in the segment and the edge detection point.



This setting is not applied to the display when [Display Type] is set to [Raw2].

Segments

Specify the line thickness and display color of the segments.



- This setting is not applied to the display when [Display Type] is set to [Raw2].
- If the segment size is larger than the segment shift, the segments will not be displayed.

Reset

Returns the display options to their defaults.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

-  **Point**
- If the controller is turned off before any settings are saved, all of those changes will be deleted.
 - Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
 - Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

Profile Defect

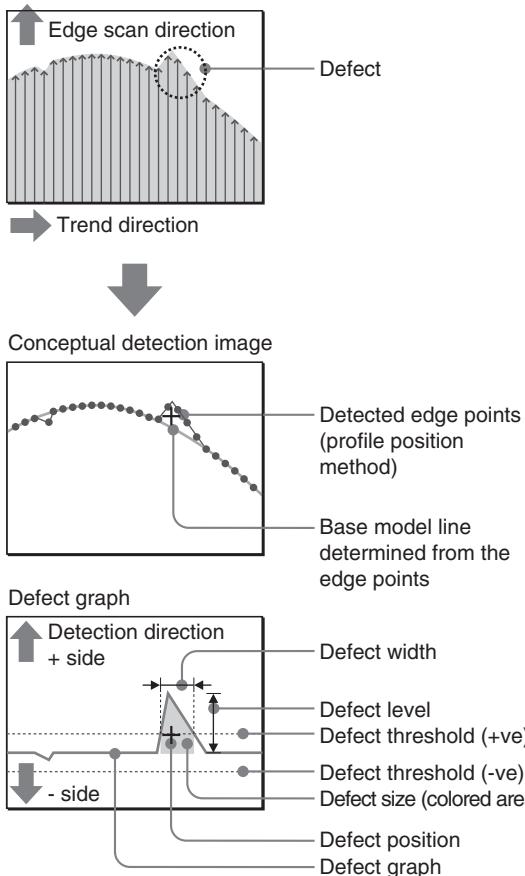
Profile Defect Tool

The Profile Defect tool takes a target's edge points (similar to Profile Position (Page 2-166)) and compares them to a smoothed base model line (straight line, circle, oval or free curve) to determine if there are any individual or small groups of edge points that are outside of the normal target profile.

Detected deviations from the norm which are greater than the threshold value are determined as defects and their position, level (height or depth), width and size (area) can all be measured.

Measurement Overview

Example of an inspection region with a curved base model line



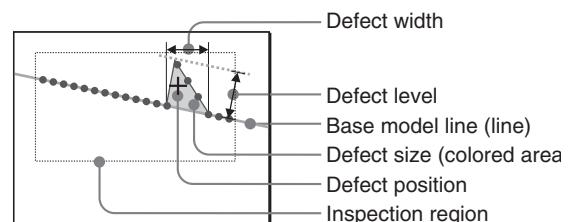
- Detection direction:** The defect detection direction is based on the edge scan direction. If the edge direction is from inside outwards then positive defects are considered protrusions, whereas negative defects are depressions.

- Defect level:** The maximum difference in distance between the base model line and the detected edge points which make up the defect by exceeding the detection threshold.
- Defect width:** The number of continuous edge points (segments) that exceed the detection threshold and thus make up the defect.
- Defect size:** The sum of the differences between the base model line and all edge points of the defect (defect levels) or the differences between the detection threshold value and all edge points of the defect. (The selection is available in [Defect Size Calculation Method] in the [Parameters] menu.)
- Defect position:** The center of gravity of the defect. Defined by the base model line and the defect edge points.

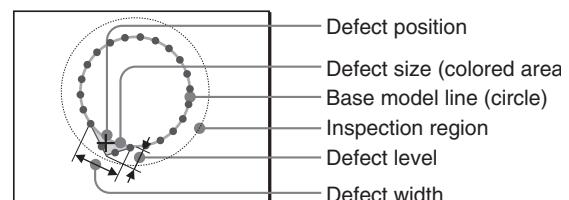


The measured results may differ depending on the segment size and shift specified in the [Edge Detection] menu. For example, even if the physical size is the same, increasing the segment size or shift may affect the defect segment count and measured defect size. If the inspection region is a ring or an arc, such changes may affect defect detection close to the border of the region.

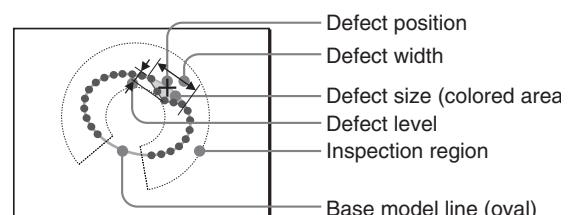
Example with a rectangle or rotated rectangle inspection region and a straight base model line



Example of a ring inspection region and a circle base model line



Example of an arc inspection region and an oval base model line



Profile Defect**Main measurement results**

The standard results and data returned by the Profile Defect tool are as follows:

Number of segments	Outputs the number of set segments.
Number of detected segments	Outputs the number of segments where contrast changes were detected and edges identified. [Tolerance inspection target]
Defect count	Outputs the number of defects detected in the inspection region. [Tolerance inspection target]
Total defect size	Outputs the total size of all defects detected in the inspection region. [Tolerance inspection target]
Defect Size []	Outputs the defect sizes (areas) of all individual defects detected in the inspection region. [Tolerance inspection target] [Label specification target]
Defect size (Max)	Outputs the maximum defect size (area) detected in the inspection region. [Tolerance inspection target]
Defect size (Min)	Outputs the minimum defect(area) size detected in the inspection region. [Tolerance inspection target]
Defect Position X []	Outputs the X position coordinate of all defects in pixels. [Tolerance inspection target] [Label specification target]
Defect position X (Max)	Outputs the maximum X position coordinate from the range of detected defects in the inspection region in pixels. [Tolerance inspection target]
Defect position X (Min)	Outputs the minimum X position coordinate from the range of detected defects in the inspection region in pixels. [Tolerance inspection target]
Defect Position Y []	Outputs the Y position coordinate of all defects in pixels. [Tolerance inspection target] [Label specification target]
Defect position Y (Max)	Outputs the maximum Y position coordinate from the range of detected defects in the inspection region in pixels. [Tolerance inspection target]
Defect position Y (Min)	Outputs the minimum Y position coordinate from the range of detected defects in the inspection region in pixels. [Tolerance inspection target]
Defect Position XY []	Outputs the XY position coordinates of all defects in pixels. [Label specification target]
Defect Angle []	Outputs the angles of all defects in reference to the following position coordinates (Circle and oval base model lines: Angle from the center of the base circle or oval. Other base model lines: Angle from the center of the inspection region when the inspection region is a ring or an arc, or the angle of a rotated rectangle when the inspection region is a rectangle or a rotated rectangle). [Label specification target]
Defect Level []	Outputs the defect levels (height / depth) of all individual defects detected in the inspection region. [Label specification target]
Defect level (Max)	Outputs the maximum defect level (height / depth) detected in the inspection region.
Defect level (Min)	Outputs the minimum defect level (height / depth) detected in the inspection region.
Total defect level	Outputs the sum of the maximum positive and negative (protrusions and depressions) defect level detected in the inspection region.
Total defect width	Outputs the total number of edge points of all detected defects in the inspection region.
Defect Width []	Outputs the number of edge points for all individual defects detected in the inspection region defect. [Label specification target]

Defect width (Max)	Outputs the number of edge points for the maximum defect width detected in the inspection region
Defect width (Min)	Outputs the number of edge points for the minimum defect width detected in the inspection region.
Defect Top Position X []	Outputs the X position coordinate of the top of the defect (the edge point with the maximum defect level in the defect) for all defects in pixels. [Label specification target]
Defect Top Position Y []	Outputs the Y position coordinate of the top of the defect (the edge point with the maximum defect level in the defect) for all defects in pixels. [Label specification target]
Defect Top Position XY []	Outputs the XY position coordinates of the top of the defect (the edge point with the maximum defect level in the defect) for all defects in pixels. [Label specification target]
Defect Edge Position X1 []	Outputs the X position coordinate of the edge point located immediately before a defect begins (if the inspection region is a ring or an arc, the position before a defect in the clockwise direction) for all detected defects in the inspection region in pixels. [Label specification target]
Defect Edge Position Y1 []	Outputs the Y position coordinate of the edge point located immediately before a defect begins (if the inspection region is a ring or an arc, the position before a defect in the clockwise direction) for all detected defects in the inspection region in pixels. [Label specification target]
Defect Edge Position XY1 []	Outputs the XY position coordinates of the edge point located immediately before a defect begins (if the inspection region is a ring or an arc, the position before a defect in the clockwise direction) for all detected defects in the inspection region in pixels. [Label specification target]
Defect Edge Position X2 []	Outputs the X position coordinate of the edge point located immediately after a defect ends (if the inspection region is a ring or an arc, the position after a defect in the clockwise direction) for all detected defects in the inspection region in pixels. [Label specification target]
Defect Edge Position Y2 []	Outputs the X position coordinate of the edge point located immediately after a defect ends (if the inspection region is a ring or an arc, the position after a defect in the clockwise direction) for all detected defects in the inspection region in pixels. [Label specification target]
Defect Edge Position XY2 []	Outputs the XY position coordinates of the edge point located immediately after a defect ends (if the inspection region is a ring or an arc, the position after a defect in the clockwise direction) for all detected defects in the inspection region in pixels. [Label specification target]
Base line	Outputs (1) if the creation of the base model line is successful (0) if not
Base line X1	Outputs the X position coordinate of the intersection between the base model line and the top side (or left side when the trend direction is →) of the inspection region in pixels (when the base model line is [Line]).
Base line Y1	Outputs the Y position coordinate of the intersection between the base model line and the top side (or left side when the trend direction is →) of the inspection region in pixels (when the base model line is [Line]).

Base line XY1	Outputs the XY position coordinates of the intersection between the base model line and the top side (or left side when the trend direction is →) of the inspection region in pixels (when the base model line is [Line]).
Base line X2	Outputs the X position coordinate of the intersection between the base model line and the bottom side (or right side when the trend direction is →) of the inspection region in pixels (when the base model line is [Line]).
Base line Y2	Outputs the Y position coordinate of the intersection between the base model line and the bottom side (or right side when the trend direction is →) of the inspection region in pixels (when the base model line is [Line]).
Base line XY2	Outputs the XY position coordinates of the intersection between the base model line and the bottom side (or right side when the trend direction is →) of the inspection region in pixels (when the base model line is [Line]).
Base line center X	Outputs the X position coordinate of the center of the line between the base model line XY1 and XY2 positions in pixels (when the base model line is [Line]).
Base line center Y	Outputs the Y position coordinate of the center of the line between the base model line XY1 and XY2 positions in pixels (when the base model line is [Line]).
Base line center XY	Outputs the XY position coordinates of the center of the line between the base model line XY1 and XY2 positions in pixels (when the base model line is [Line]).
Base line angle	Outputs the angle (0° to 359.999°) of Base Line XY2 in reference to Base Line XY1 (base model line and inspection region) (when the base model line is [Line]).
Base circle radius	Outputs the radius of the circle from the base model line (when the base model line is [Circle]).
Base circle center X	Outputs the X position coordinate at the center of the circle from the base model line in pixels (when the base model line is [Circle]).
Base circle center Y	Outputs the Y position coordinate at the center of the circle from the base model line in pixels (when the base model line is [Circle]).
Base circle center XY	Outputs the XY position coordinates at the center of the circle from the base model line in pixels (when the base model line is [Circle]).
Base circle center XY radius	Outputs the XY position coordinates at the center of the circle from the base model line and the radius in pixels (when the base model line is [Circle]).
Base oval radius 1	Outputs the horizontal radius of the oval from the base model line in pixels (when the base model line is [Oval]).
Base oval radius 2	Outputs the vertical radius of the oval from the base model line in pixels (when the base model line is [Oval]).
Base oval center X	Outputs the X position coordinate at the center of the oval from the base model line in pixels (when the base model line is [Oval]).
Base oval center Y	Outputs the Y position coordinate at the center of the oval from the base model line in pixels (when the base model line is [Oval]).
Base oval center XY	Outputs the XY position coordinates at the center of the oval from the base model line in pixels (when the base model line is [Oval]).
Base oval angle	Outputs the major axis angle (0° to 359.999°) of the detected oval (when the base model line is [Oval]).
Defect Start Segment	Outputs the defect segment No. of all detected defects in the inspection region. Label specification target
Defect Top Segment	Outputs the segment No. of the segment showing the top of the defect (the edge point with the maximum defect level in the defect) for all detected defects in the inspection region. Label specification target
Defect End Segment	Outputs the end segment No. of all detected defects in the inspection region. Label specification target
Base Free Curve X []	Outputs the X position coordinate of all edge points that make up the detected free curve in the inspection region in pixels (when the base model line is [Free Curve]). Label specification target
Base Free Curve Y []	Outputs the Y position coordinate of all edge points that make up the detected free curve in the inspection region in pixels (when the base model line is [Free Curve]). Label specification target
Base Free Curve XY []	Outputs the XY position coordinates of all edge points that make up the detected free curve in the inspection region in pixels (when the base model line is [Free Curve]). Label specification target
Edge to Model Difference []	Outputs the difference between the base model line and the edge point in all the segments in pixels. Label specification target
Edge Count[]	Outputs the number edges in all segments. Label specification target
Edge Position X []	Outputs the X position coordinate of all the edge positions in pixels. Label specification target
Edge Position Y []	Outputs the Y position coordinate of all the edge positions in pixels. Label specification target
Edge Position XY []	Outputs the XY position coordinates of all the edge positions in pixels. Label specification target
Edge Angle []	Outputs the angles of all edge points (or the angle of the rotated rectangle when the inspection region is a rectangle or a rotated rectangle). Label specification target
Base line p θ	Outputs the p and θ of the detected line (when the base model line is [Line]).
Base line p	Outputs the p of the detected line (when the base model line is [Line]).
Base line θ	Outputs the θ of the detected line (when the base model line is [Line]).
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

Reference

For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

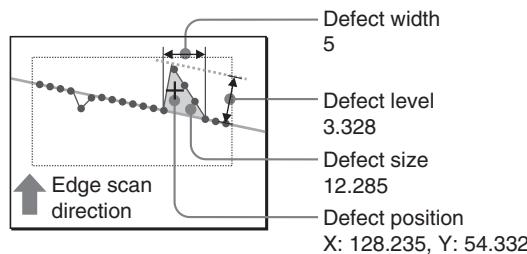
Profile Defect

Measurement sample

Example of a rectangle or rotated rectangle inspection region and a straight base model line

Example showing the results of a Profile Defect inspection performed under the following conditions:

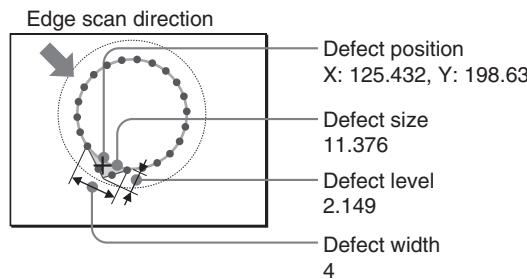
- Base model: Line
- Edge scan direction: ↑
- Defect detection direction: +



Example of a ring inspection region and a circle base model line

Example showing the results of a Profile Defect inspection performed under the following conditions:

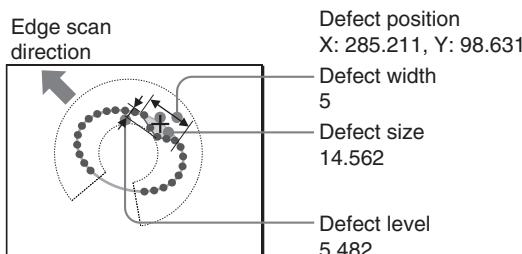
- Base model: Circle
- Edge scan direction: Out to Center
- Defect detection direction: ±



Example of an arc inspection region and an oval base model line

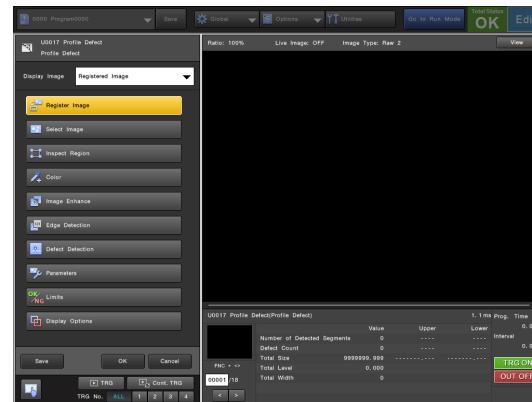
Example showing the results of a Profile Defect inspection performed under the following conditions:

- Base model: Oval
- Edge scan direction: Center to Out
- Defect detection direction: -



Top Menu

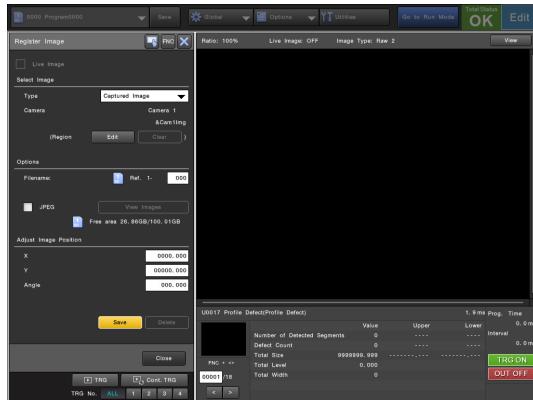
The top menu of the Profile Defect tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-193)	Register an image to be used as a template for settings.
Select Image (Page 2-193)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-193)	Define the region to be used for unit processing.
Color (Page 2-193)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-194)	Specify the filter processing to apply to the image.
Edge Detection (Page 2-194)	Specify the scan direction and edge direction for detecting edges, as well as other detailed conditions for edge detection.
Defect Detection (Page 2-196)	Specify the base model line and defect detection direction for detecting defects, as well as other detailed conditions for defect detection.
Parameters (Page 2-198)	Specify other conditions for the Profile Defect tool as required.
Limits (Page 2-199)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-200)	Specify the display methods for things such as the inspection region and mask regions, detected defects and defect graph.
Save (Page 2-201)	Save the current state to the program file.

Register Image

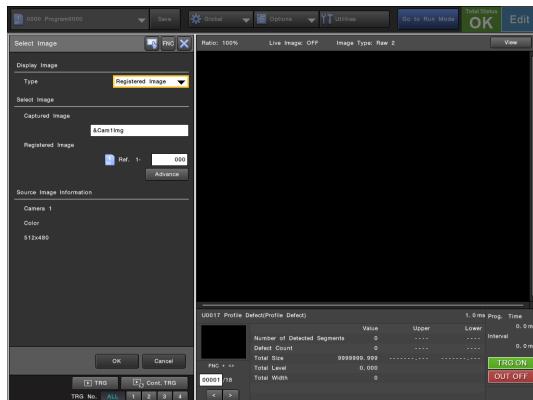
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

Specify the captured image and registered image to use for measurement.



For more details, see "Select Image" (Page 2-471).

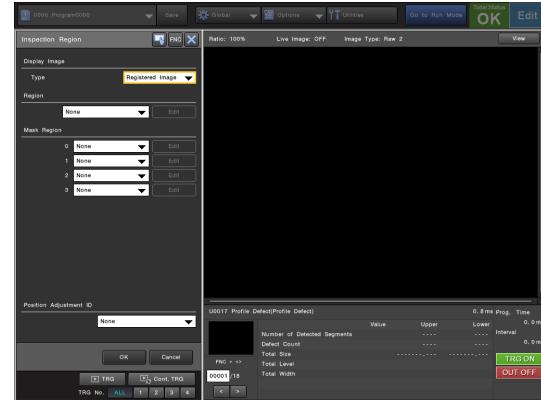
Inspect Region

Define the region to be used for unit processing.



Point

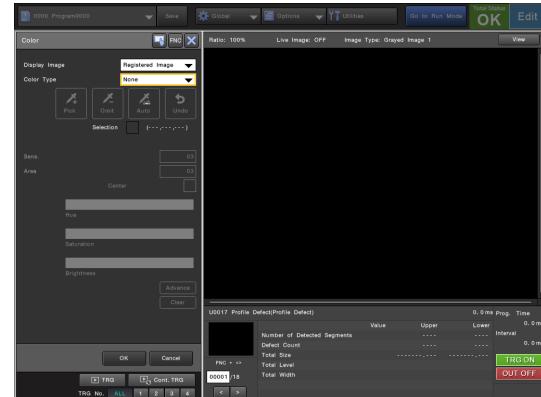
Changing the shape of the region will reset some settings on the [Edge Detection] and [Condition] screens.



For more details, see "Region Settings" (Page 2-473).

Color

When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.

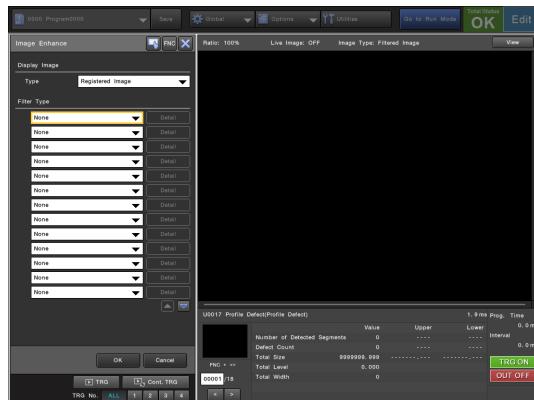


For more details, see "Color Extraction" (Page 2-483).

Profile Defect

Image Enhance

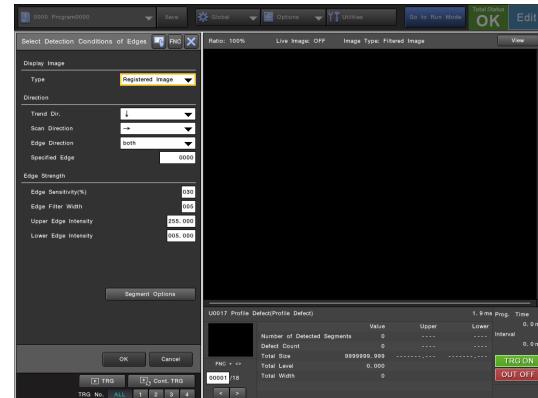
Specify the filter processing to apply to the image.



For more details, see "Image Enhance" (Page 2-489).

Edge Detection

Specify the scan direction and edge direction for detecting edges, as well as other detailed conditions for edge detection.



Refer to "What is an Edge?" (Page 2-95) for the technical description of edge detection.

Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Direction

Trend Dir.

Select the edge segment movement direction.

- When the inspection region is a rectangle:** → or ↓
- If the inspection region is a rotated rectangle:** ↓ (top to bottom) only.
- When the inspection region is a ring or an arc:** only clockwise is available.



If variable referencing is used for the scan direction, the reference setting may be canceled if there is a change in the trend direction.

Scan Direction

Select the scan direction to detect an edge.

- When the inspection region is a rectangle:** ↓ or ↑ (when the trend direction is →), → or ← (when the trend direction is ↓)
- When the inspection region is a rotated rectangle:** Forward (from left to right), Reverse (from right to left)
- When the inspection region is a ring or an arc:** Center → Out, Out → Center

Edge Direction

Select the change in contrast for detecting an edge.

- **both** (default): Detect edges in a transition that can change either from a bright area to a dark area or from a dark area to a bright area.
- **Light to Dark**: Detect edges in a transition that changes from a bright area to a dark area.
- **Dark to Light**: Detect edges in a transition that changes from a dark area to a bright area.

Specified Edge

Specify the edge No. (-3600 to 3599) to be used within the segments.

- If a negative value is specified, the edge No. is counted in the order opposite to that of the scan direction.
- If the specified edge number is not found, the result of that segment is 0. However, note that when [Undetected Point] in the [Parameters] menu is set to an option other than [Ignore], the result will be output according to that setting.

Edge Strength

Edge Sensitivity (%)

Set the percentage threshold (0% to 100%) for detecting edges.

Edge Filter Width

Set the width (0 to 100 pixels) of the smoothing filter applied to the differential graph for detecting edges.

Upper Edge Intensity

Specify the upper limit (0.000 to 255.000) of edge intensity for detecting edges.

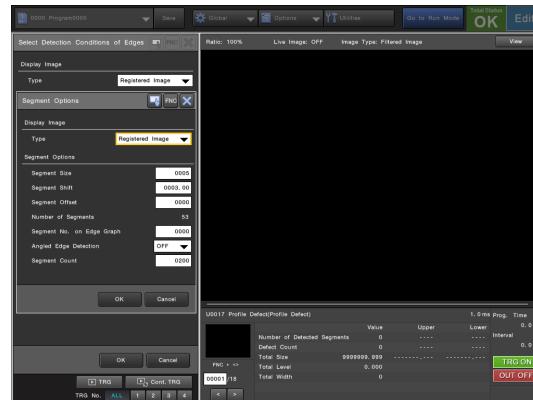
Lower Edge Intensity

Specify the lower limit (0.000 to 255.000) of edge intensity for detecting edges.

Reference

It may be possible to exclude noisy edges in the segment by adjusting the upper and lower edge intensity values based on the highest edge intensity in the segment, shown on the left of the edge graph. See "What is an Edge?" (Page 2-95) for more details.

Segment Options



Type

Switch the image displayed on the screen.

- **Captured image**: Displays the latest image from the specified camera (image variable).
- **Registered image**: Displays the registered image specified under [Select Image].

Segment Options

Segment Size

Specify the size of the segment in the inspection region.

- When the inspection region is a rectangle or a rotated rectangle: Specify a value between 1 and 9999 pixels. If the segment size is larger than the size of the inspection region, a measurement error will occur.
- When the inspection region is a ring or an arc: Specify a value between 0.01 and 359.99°. If the segment size is larger than the inspection region, a measurement error will occur.

Segment Shift

Specify the shifting distance of the segment along the trend.

- When the inspection region is a rectangle or a rotated rectangle: Specify a value between 0.01 and 9999.99 pixels.
- When the inspection region is a ring or an arc: Specify a value between 0.01 and 359.99°.

Segment Offset (Start Angle)

Specify the offset (distance or angle) of the first segment in the inspection region. If an error occurs due to no edge points near the beginning of the inspection region, offset the segment to a better location.

- When the inspection region is a rectangle or a rotated rectangle: Specify a value between 0 and 9999 pixels.
- When the inspection region is a ring or an arc: Specify a value between 0.00 and 359.99°.

Profile Defect

Segment No. on Edge Graph

- Specify the segment whose position, edge graph, edge intensity value and measurement result are to be displayed on the screen. The setting range is from 0 to 4999.

Point The number of segments set in the current inspection region is updated automatically according to the change in the segment size and shift. The maximum number of segments is 5000, but the actual number of segments that can be set may be lower depending on other settings.

Reference During operation, the screen displays the position, edge graph, edge intensity value, and measurement results of the segment specified for Segment No. on Edge Graph. Changing the segment no. is useful for checking the detection status of specific segments.

Angled Edge Detection

Set to [ON] to stabilize the detection of slanted edges in the inspection region. Using this option may affect the edge X, Y position accuracy.

Segment Count

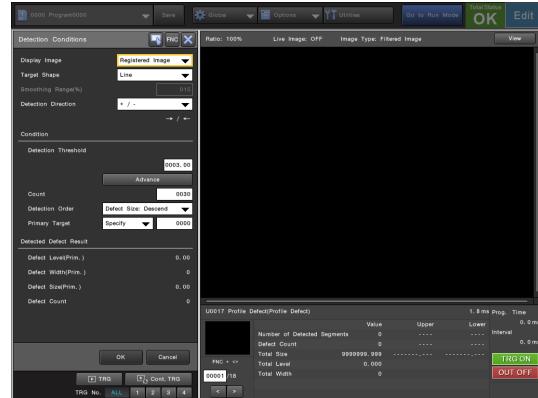
Specify the maximum number of segments which can be detected in the unit currently being set.

Point

- The maximum number of segments available for detection can vary based on other settings.
- Based on specific settings, the Segment Count is fixed and cannot be changed.

Defect Detection

Specify the base model line and defect detection direction for detecting defects, as well as other detailed conditions for defect detection.



Display Image

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Target Shape

Select the model line similar to that of the target shape to be used as a reference for the profile.

- Line:** Use a straight line as the reference model line (when the inspection region is a rectangle or a rotated rectangle).
- Circle:** Use a circle as the reference model line.
- Oval:** Use an oval as the reference model line (when the inspection region is a ring or an arc).

Free Curve

Use a free curve as the reference model line.

Smoothing Range (%)

When [Free Curve] is selected as the [Target Shape], specify the percentage (with respect to all segments) of smoothing for the curve. Increase the smoothing range to make the reference model line smoother, or reduce it for a finer sharp change.

Detection Dir.

Select the direction to search for a defect.

- +**: Detect changes in the + direction only.
- : Detect changes in the - direction only.
- +/-**: Detect changes in both the + and - directions.
- +/- (Individual)**: Detect changes in both the + and - directions. This option enables the detection thresholds for defects in the + and - directions to be set individually.

Point

A reference is shown on screen to indicate the scan direction based on the shape of the inspection region. The + sign indicates the direction is the same as the scan direction while the - sign indicates the direction is opposite to the scan direction.

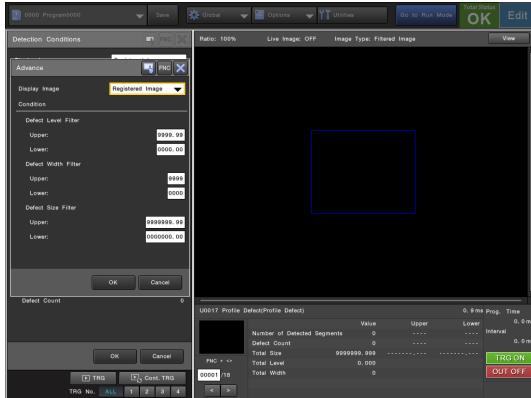
Defect Detection

Detection Threshold

Set the threshold value for the defect level (0 to 9999.99) as the threshold level (defect level) for identifying defects.

Advance

Use this option to specify the detection conditions in detail. Using the [Advance] menu options can help filter out falsely detected defects.



- **Display Image:** Switch the image displayed on the screen.
 - **Captured image:** Displays the latest image from the specified camera (image variable).
 - **Registered image:** Displays the registered image specified under [Select Image].
- **Defect Level Filter:**
 - **Upper:** Specify the upper limit of the defect level to detect defects (0.00 to 9999.99).
 - **Lower:** Specify the lower limit of the defect level to detect defects (0.00 to 9999.99).
- **Defect Width Filter:**
 - **Upper:** Specify the upper limit of the defect width to detect defects (0 to 9999).
 - **Lower:** Specify the lower limit of the defect width to detect defects (0 to 9999).
- **Defect Size Filter:**
 - **Upper:** Specify the upper limit of the defect size to detect defects (0.00 to 9999999.99).
 - **Lower:** Specify the lower limit of the defect size to detect defects (0.00 to 9999999.99).

Count

Specify the maximum number of defects (1 to 9999) to be detected. When [3] is specified, the process searches for up to 3 defects.

Detection Order

Select the identification order of the defects. From the 12 options below.

- **Segment: Ascend:** Sort defects based on smallest segment No. to largest.
- **Segment: Descend:** Sort defects based on largest segment No. to smallest.
- **X: Ascend:** Sort groups in ascending X order.
- **X: Descend:** Sort groups in descending X order.
- **Y: Ascend:** Sort groups in ascending Y order.
- **Y: Descend:** Sort groups in descending Y order.
- **Defect Level: Ascend:** Sort defects from lowest defect level to highest.
- **Defect Level: Descend:** Sort defects from highest defect level to lowest.
- **Defect Width: Ascend:** Sort defects from lowest defect width to highest.
- **Defect Width: Descend:** Sort defects from highest defect width to lowest.
- **Defect Size: Ascend:** Sort defects from lowest defect size to highest.
- **Defect Size: Descend:** Sort defects from highest defect size to lowest.

Primary Target

Set the defect to be used for OK / NG judgment.

- **All:** Use the minimum and maximum values measured from all defects for the judgment.
- **Specify:** To judge only a particular defect, specify the No. of the defect used in judgment (0 to 4999). The measurement from the defect specified here is used for judgment.

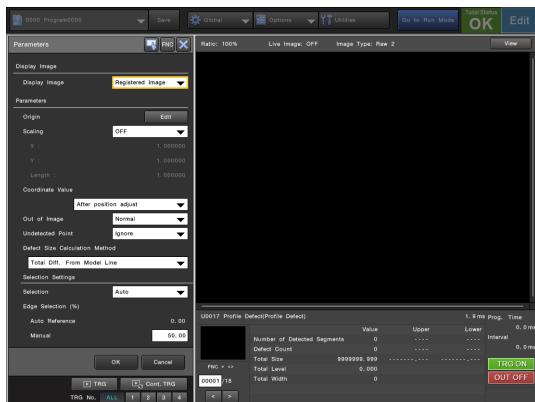
Reference

- During operation, the defect level graph, position and defect level of the defect segment specified as the primary target are displayed. Changing the defect segment is useful for checking the detection status of a specific defect.
- If [Primary Target] is set to [All], all the defect edge points will be displayed in green.

Profile Defect

Parameters

Specify other conditions for the Profile Defect tool as required.



Display Image

Display Image

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

Reference The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels. The result data and setting parameters used for display, judgment and calculations can be converted and scaled to real life values and dimensions by using the pre-set scaling factor option.

- OFF:** Do not use scaling.
- ON:** Use scaling.

Reference

- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate Value

Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- After position adjust:** The inspection uses the adjusted coordinate axes determined after position adjustment.
- Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Out of Image

Specify whether to incorporate data that falls outside of the inspection region. This maybe required when position adjustment is used.

- Normal** (default): Edge detection outside of the region is disabled as the image data outside of the region is masked. Since masking requires time to process, the inspection time may vary depending on the quantity image data outside the region. Processing will take longer when the inspection region is a ring or an arc.
- Fast:** The image data outside of the region is not masked, allowing for faster processing. As the image data outside the region has not been masked so there is an increased chance of detecting an edge outside the region. Select [Normal] to avoid incorrect edge detection.



Point

Image data which is already located outside of the region during the inspection region setting will always be masked regardless of the [Out of Image] setting.

Undetected Point

Use this setting for handling the defect level for where no edge points are detected.

- Ignore:** Undetected points are treated as having a defect level of 0.
- Maximize:** Undetected points are treated as having the maximum value in the edge scan direction.
- Minimize:** Undetected points are treated as having the minimum value in the edge scan direction.
- Fill:** The defect level of undetected points is determined from the surrounding area.



Point

Selecting [Fill] increases processing time.

Defect Size Calculation Method

Select a defect size calculation method.

- Total Diff. From Model Line:** The total difference from the base model line is used as the defect size.
- Total Diff. From Threshold:** The total difference from the [Detect Threshold] value set in the [Defect Detection] screen is used as the defect size.

Selection Settings

Selection

Select the culling rate of detection data to create a model line. To increase (for a more precise baseline) or decrease (for faster processing) the number of detection points used to create the base model line, select [Manual] and then specify the cull rate.

- **Auto:** Set the culling rate automatically.
- **Manual:** Set the desired culling rate.

Edge Selection(%)

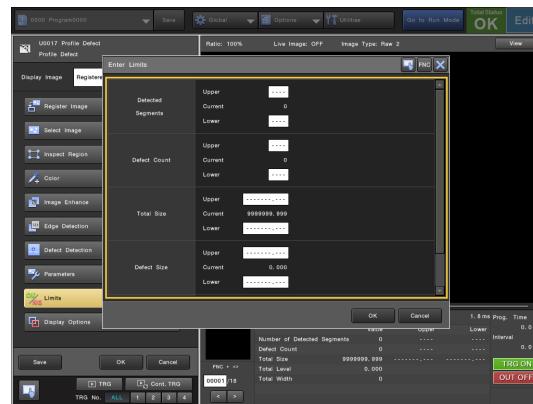
When [Manual] is selected for the [Selection], specify the culling rate between 0 and 99.99%.

Point Setting the cull rate too high will make the base model line undetectable.

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.

Reference

- [----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Detected Segments

Specify the tolerance for the segment detection count. The unit of measurement is the "number of segments" detected.

Defect Count

Specify the tolerance for the detected defect count. The unit of measurement is the "number of defects" detected.

Total Size

Specify the tolerance for the total size of all defects. The unit of measurement is the "number of pixels".

Defect Size

Specify the tolerance for the defect size of the defect specified as the primary target. The unit of measurement is the "number of pixels".

Defect Pos

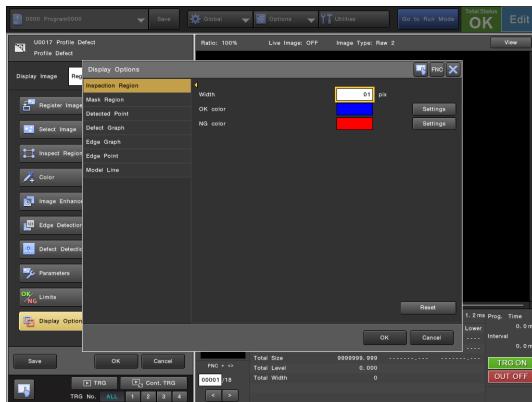
Specify the tolerance for the center of gravity of the defect. The unit of measurement is the "number of pixels" indicating the center of gravity coordinates.

Profile Defect

Display Options

Specify the display methods for things such as the inspection region and mask regions, detected defects and defect graph.

You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection region

Specify the line width and display color of the inspection region.

Mask region

Specify the line width and display color of the mask region.

Detected Point

Target

Specify how to display the detected defect points.

- **OFF:** Hide the detected points.
- **Primary target:** Show the detected defect point for the primary target.
- **All** (default): Show the detected points for all the detected defects.

Primary Target

Specify the width and display color of the line indicating the detected defect.

Other Target

Specify the width and display color of the line indicating the detected defect other than the one specified as the primary target (Page 2-197).

Defect Graph

Defect graph

Specify whether to display the defect graph or not.

- **ON:** Display the defect graph.
- **OFF** (default): Hide the defect graph.

Point Selecting [ON] will increase the processing time.

Wave

Specify the width and display color of the defect graph waveform.

Frame

Specify the width and display color of the defect graph frame.

Detect Threshold

Specify the width and display color of the line representing the detection threshold.

Filter lower limits

Specify the width and display color for the line representing the lower limit of the defect level filter.

Point Setting [Defect graph] to [ON] consumes additional program memory. Check the amount of remaining program memory before enabling.

Edge Graph

Edge graph

Select whether to display the edge graph.

- **OFF** (default): Hide the edge graph.
- **Primary Target:** Display the edge graph of the segment specified at [Primary Target].

Wave

Specify the width and display color of the edge graph waveform.

Frame

Specify the width and display color of the edge graph frame.

Sensitivity

Specify the width and display color of the line representing the edge sensitivity threshold.

Point Setting [Edge graph] to [Primary Target] consumes additional program memory. Check the amount of remaining program memory before enabling.

Edge Point

Edge Point

Specify how to display the edge point detected during operation.

- **OFF** (default): Hide the edge point.
- **Primary target:** Display the detected edge point of the segment specified at [Primary Target] which has the maximum defect level.
- **Primary target, Max/Min:** Display the detected edge points of the three segments: The segment specified at [Primary Target] and those with maximum defect levels on the + and - sides respectively.

Profile

Specify whether to display the line connecting the detection point in the segment and the edge detection point.

- **OFF:** Hide the profile.
- **ON** (default): Display the profile.

 **Point** This is not supported for the display in screen image type [Raw 2].

Segments

Select whether to display the segments.

- **OFF** (default): Hide the segments.
- **ON:** Show the segments.

 **Point**

- This is not supported for the display in screen image type [Raw 2].
- If the segment size is larger than the segment shift, the segments will not be displayed.

Model line

Specify the line width and display color of the base model line.

Reset

Returns the display options to their defaults.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

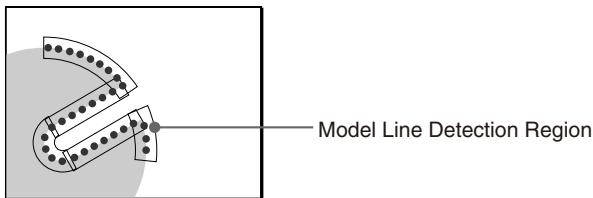
Multi-Profile Defect

Multi-Profile Defect Tool

By executing the same processing as Profile Defect (Page 2-189) on multiple inspection regions, you can inspect protrusions and dents on targets with complex shapes. You can set consecutive multiple inspection regions and automatically extract regions from contour images. Furthermore, for corners on targets, you can also extend the inspection regions based on virtual intersections of the contour lines and add corner inspection processing. This is useful when measuring corners for which inspection is difficult such as when corners are detected as protrusions or dents due to changes in the target's position or the like.

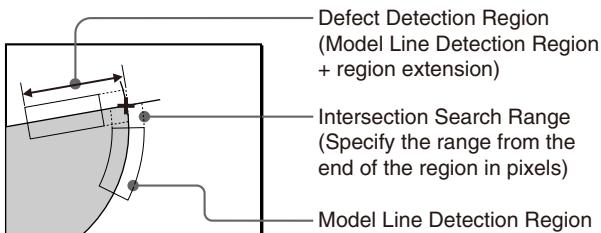
Measurement Overview

1. Contour inspection of complex shapes



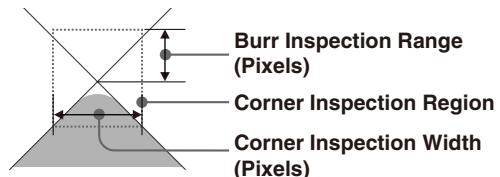
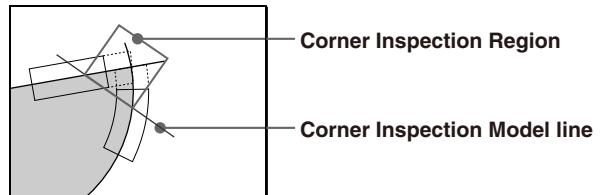
- Model Line Detection Region:** A region for detecting borders (model lines) specified in the region settings.

2. Inspection by extending the defect detection regions close to the intersection (Enable Region Extension)



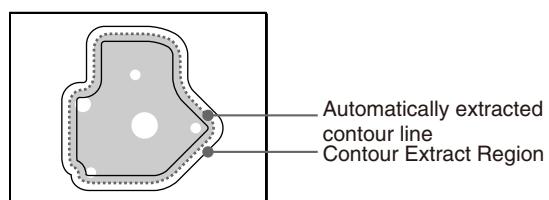
- Defect Detection Region:** A region in which defects are detected. If region extension is disabled, the region is the same as the region specified for the model line detection region. If region extension is enabled, the region is extended close to the intersection of the two model lines specified for intersection detection.
- Intersection Search Range:** Specifies the range to search for the intersection from the end of the model line inspection region in pixels.

3. Corner inspection at an intersection (Enable Corner Inspection)



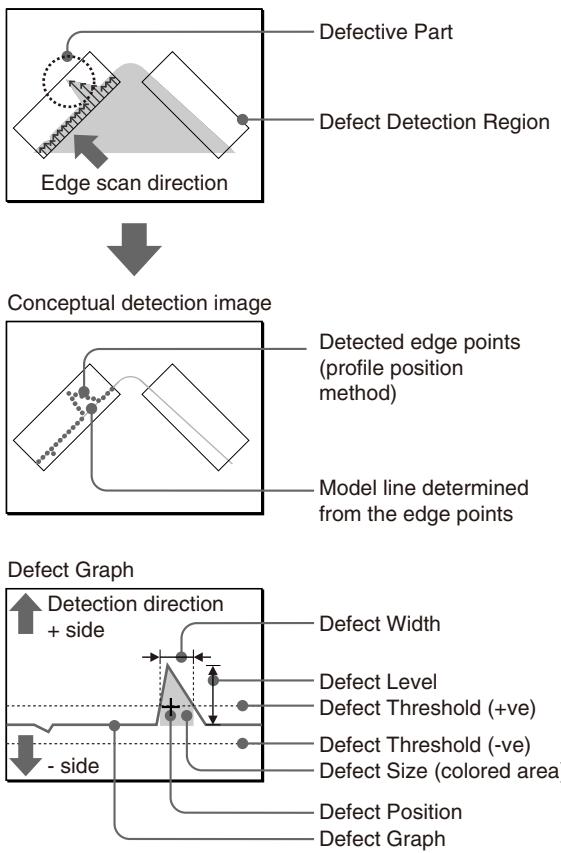
- Corner Inspection Region:** Specifies the region to inspect a corner at an intersection.
- Corner Inspection Model Line:** The reference line for corner inspection. It is the side of the corner inspection region which is interior relative to the intersection.
- Corner Inspection Width:** The width of a corner inspection region. The base of the isosceles triangle formed by the center lines of the two model line detection regions is the corner inspection width.
- Burr Inspection Range:** The range to inspect for burrs from an intersection in a corner inspection region.

4. Automatic extraction of defect regions on complex shapes (Region: Auto Extract)



The measured results may differ depending on the segment size and shift specified for the edge detection conditions. For example, even if the physical size of the defect is the same, increasing the segment size or shift may significantly affect the defect segment count, measured defect size, and corner area. In addition, if the model line region is a ring or an arc, such changes may significantly affect defect detection close to the inner side and the outer side of the model line region.

Example of defect extraction



Main measurement results

The standard results and data returned by the Multi-Profile Defect tool are as follows:

Total Detected Segments	Outputs the total number of segments where edges were detected. [Tolerance inspection target]
Detected Segments (Min.)	Outputs the minimum number of segments where edges were detected in the inspection regions. [Tolerance inspection target]
Contour Length	Outputs the total length when the detected edge point of each segment is connected by a line. This includes the distance between the start point and end point if a closed region is specified.
Total Defect Count	Outputs the total number of defects detected. [Tolerance inspection target]
Total Defect Size	Outputs the total size of all defects detected. [Tolerance inspection target]
Total Defect Level	Outputs the sum of the maximum positive and negative (protrusions and depressions) defect level detected.
Total Defect Width	Outputs the total number of segments (continuous edge point count) of all detected defects in the inspection region.
Number of Intersections	Outputs the number of set intersections.
Total Corner Defect Count	Outputs the total number of defects detected in the corner inspection.
Defect Size	Outputs the defect sizes (areas) (total difference from model line or detection threshold) of all individual defects detected in the inspection region. [Tolerance inspection target] [Label specification target]
Maximum Defect Size	Outputs the maximum defect size (area) detected.
Minimum Defect Size	Outputs the minimum defect size (area) detected.
Defect Level	Outputs the defect levels (height / depth) (maximum value of the difference from the model line) of all individual defects detected. [Label specification target]
Maximum Defect Level	Outputs the maximum defect level (height / depth) detected.
Minimum Defect Level	Outputs the minimum defect level (height / depth) detected.
Defect Width	Outputs the number of edge points for all individual defects detected. [Label specification target]
Maximum Defect Width	Outputs the number of edge points for the maximum defect width detected.
Minimum Defect Width	Outputs the number of edge points for the minimum defect width detected.
Defect XY Position	Outputs the XY position coordinates of all defects in pixels. [Label specification target]
Maximum Defect X Position	Outputs the maximum X position coordinate from the range of detected defects in pixels. [Tolerance inspection target]
Minimum Defect X Position	Outputs the minimum X position coordinate from the range of detected defects in pixels. [Tolerance inspection target]
Maximum Defect Y Position	Outputs the maximum Y position coordinate from the range of detected defects in pixels. [Tolerance inspection target]
Minimum Defect Y Position	Outputs the minimum Y position coordinate from the range of detected defects in pixels. [Tolerance inspection target]

Multi-Profile Defect

Defect Angle	Outputs the angles of all defect positions (for the parts where the model line is automatically extracted: the direction perpendicular to the model line; for the other parts: the segment angle).	Inspection Region N: Circle Model Center XY	Outputs the XY position coordinates at the center of the circle detected in inspection region N in pixels (when the model line is [Circle]).
Defect Start XY Position	Outputs the XY position coordinates of the edge point located immediately before a defect begins (if the inspection region is a ring or an arc, the position before a defect in the clockwise direction) for detected defects in the inspection region in pixels. Label specification target	Inspection Region N: Reference Circle Center XY/ Radius	Outputs the XY position coordinates at the center of the circle and the radius detected in inspection region N in pixels (when the model line is [Circle]).
Defect Top XY Position	Outputs the XY position coordinates of the top of the defect (the edge point with the maximum defect level in the defect) for defects in pixels. Label specification target	Inspection Region N: Oval Model Radius 1	Outputs the horizontal radius of the oval detected in inspection region N in pixels (when the model line is [Oval]).
Defect End XY Position	Outputs the XY position coordinates of the edge point located immediately after a defect ends (if the inspection region is a ring or an arc, the position after a defect in the clockwise direction) for detected defects in the inspection region in pixels. Label specification target	Inspection Region N: Oval Model Radius 2	Outputs the vertical radius of the oval detected in inspection region N in pixels (scaling applies the X direction value) (when the model line is [Oval]).
Defect Start Segment Number	Outputs the start segment No. of detected defects in the inspection region. Label specification target	Inspection Region N: Oval Model Center XY	Outputs the XY position coordinates at the center of the oval detected in inspection region N in pixels (when the model line is [Oval]).
Defect Top Segment Number	Outputs the segment No. of the segment showing the top of the defect (the edge point with the maximum defect level in the defect) for detected defects in the inspection region. Label specification target	Inspection Region N: Oval Model Angle	Outputs the angle of the oval detected in inspection region N (when the model line is [Oval]).
Defect End Segment Number	Outputs the end segment No. of detected defects in the inspection region. Label specification target	Inspection Region N: Segment Start Position of Model Line Calculation Region	Outputs the index number of the first segment used for model line detection of inspection region N in all the segments.
Region No.	Outputs the Region No. to which the detected defect belongs. Label specification target	Inspection Region N: Number of Segments of Model Line Calculation Region	Outputs the number of segments used for model line detection of inspection region N.
Corner Area (Max.)	Outputs the maximum corner area for each corner detection region. Tolerance inspection target	Inspection Region N: Segment Start Position of Defect Detection Region	Outputs the index number of the first segment used for defect detection of inspection region N in all the segments.
Corner Area (Min.)	Outputs the minimum corner area for each corner detection region. Tolerance inspection target	Inspection Region N: Number of Segments of Defect Detection Region	Outputs the number of segments used for defect detection of inspection region N.
Corner Distance (Max.)	Outputs the maximum corner distance for each corner detection region. Tolerance inspection target	Inspection Region N: Defect Detection Region Start Point Coordinates XY	Outputs the position of the first segment used for defect detection of inspection region N.
Corner Distance (Min.)	Outputs the minimum corner distance for each corner detection region. Tolerance inspection target	Inspection Region N: Defect Detection Region End Point Coordinates XY	Outputs the position of the last segment used for defect detection of inspection region N.
Inspection Region N: No. Points for Target Model	Outputs the number of model lines calculated in inspection region N (0: Calculation of model line failed; 1: Calculation of model line was successful).	Inspection Region N (Edge Result): Segment XY Edge Position	Outputs in pixels the XY position coordinates of the edge position in the specified segment of inspection region N. Label specification target
Inspection Region N: Line Model XY Position 1	Outputs the XY position coordinates of the intersection between the detected line and the top side (or left side when the trend direction is →) of the inspection region in pixels in inspection region N (when the model line is [Line]).	Inspection Region N (Edge Result): Segment Edge Angle	Outputs the angle of the specified segment of inspection region N (or the angle of the rotated rectangle when the inspection region is a rectangle or a rotated rectangle). Label specification target
Inspection Region N: Line Model XY Position 2	Outputs the XY position coordinates of the intersection between the detected line and the bottom side (or right side when the trend direction is →) of the inspection region in pixels in inspection region N (when the model line is [Line]).	Inspection Region N (Edge Result): Edge to Model Difference	Outputs the difference between the model line and the edge point in all the segments in pixels. Label specification target
Inspection Region N: Line Model Center	Outputs the position coordinates of the center of the model line detected in inspection region N in pixels (when the model line is [Line]).	Inspection Region N (Free Curve Result): Free Curve Model Individual XY	Outputs the XY position coordinates of all edge points that make up the detected free curve in the inspection region in pixels (when the model line is [Free Curve]). Label specification target
Inspection Region N: Line Model Angle	Outputs the angle of the model line detected in inspection region N (when the model line is [Line]).		
Inspection Region N: Rho and Theta of Reference Line	Outputs the model line information detected in inspection region N (when the model line is [Line]).		
Inspection Region N: Circle Model Radius	Outputs the radius of the circle detected in inspection region N (when the model line is [Circle]).		

Inspection Region N (Edge Result): Contour Length	Outputs the length of the connected edge position detected in each segment in pixels. This includes the distance between the start point and end point if a closed region is specified.
Intersection N: Corner Defect Count	Outputs the number of defects detected in corner detection in intersection label N.
Intersection N: Corner Area	Outputs the corner area in corner detection in intersection label N.
Intersection N: Corner Distance	Outputs the corner distance in corner detection in intersection label N.
Intersection N: Intersection No.	Outputs the intersection number for intersection label N (the intersection order can be specified in Detection Order for the intersection label).
Intersection N: Intersection Detection (Presence/Absence)	Outputs (1) if an intersection was successfully detected on intersection label N and (0) if not.
Intersection N: Intersection Coordinates XY	Outputs the coordinates of the intersection position on intersection label N.
Intersection N: Angle of One Line Forming the Intersection	Outputs the angle of one line forming the intersection on intersection label N.
Intersection N: Angle of Other Line Forming the Intersection	Outputs the angle of the other line forming the intersection on intersection label N.
Intersection N: Number of Segments	Outputs the number of segments for corner detection in intersection label N.
Intersection N: Number of Detected Segments	Outputs the number of segments where edges were actually able to be detected in corner detection on intersection label N.
Intersection N: Representative Segment No.	Outputs the number of the segment where the peak was detected in corner detection on intersection label N.
Intersection N: Line Model XY Position 1	Outputs the position coordinates of the intersection between the line detected in the corner detection and the top side (or left side when the trend direction is →) of the corner inspection region in pixels in intersection label N (when the model line is [Line]).
Intersection N: Line Model XY Position 2	Outputs the position coordinates of the intersection between the line detected in the corner detection and the bottom side (or right side when the trend direction is →) of the corner inspection region in pixels in intersection label N (when the model line is [Line]).
Intersection N: Line Model Center XY	Outputs the center position coordinates of the model line detected in the corner detection in pixels in intersection label N (when the model line is [Line]).
Intersection N: Line Model Angle	Outputs the angle of the model line detected in the corner detection in intersection label N (when the model line is [Line]).
Intersection N: Rho and Theta of Reference Line	Outputs the information of the reference line (base of the corner inspection region) for corner detection in intersection label N (when the model line is [Line]).
Intersection N (Edge Result): Segment XY Edge Position	Outputs the position coordinates of segments detected in corner detection in intersection label N in pixels. <small>(Label specification target)</small>

Intersection N (Edge Result): Segment Edge Angle	Outputs the angle of the segment detected in corner detection in intersection label N. <small>(Label specification target)</small>
Intersection N (Edge Result): Edge to Model Difference	Outputs all the differences between the model line and the detection point on each segment detected in corner inspection in intersection label N in pixels. <small>(Label specification target)</small>
Unit judgment value	When the measurement result of the tolerance judgment target is outside the specified tolerance (upper limit and lower limit), it is judged as [NG]. When the result is within the tolerance range, it is judged as [OK].

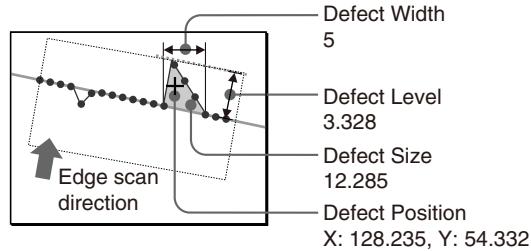
Reference

For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

Example showing the results of a Multi-Profile Defect inspection performed under the following conditions:

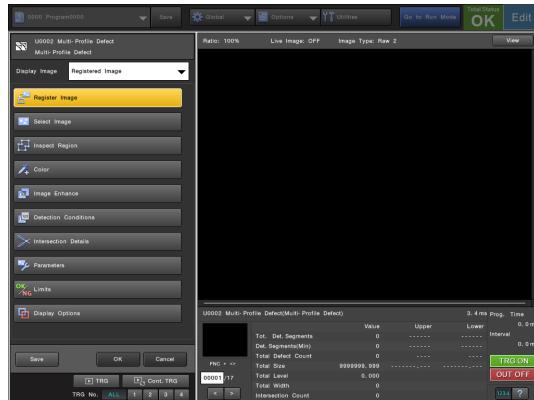
- Model Line : Line
- Detection Direction : +



Multi-Profile Defect

Top Menu

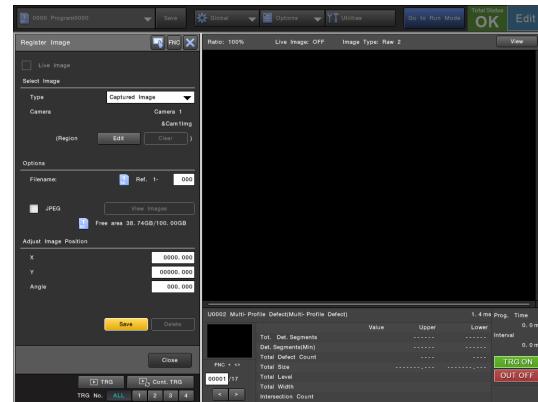
The top menu of the Multi-Profile Defect tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-206)	Register an image to be used as a template for settings.
Select Image (Page 2-206)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-207)	Define the region to be used for unit processing.
Color (Page 2-209)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-209)	Specify the filter processing to apply to the image.
Detection Conditions (Page 2-209)	Specify detailed conditions for detecting edges and defects.
Intersection Details (Page 2-213)	Set the settings for the intersection of the model lines detected from the inspection regions and set the corner inspection conditions for that intersection.
Parameters (Page 2-215)	Specify other conditions for the Multi-Profile Defect tool as required.
Limits (Page 2-217)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-218)	Specify the display methods for things such as the inspection region.
Save (Page 2-219)	Save the current state to the program file.

Register Image

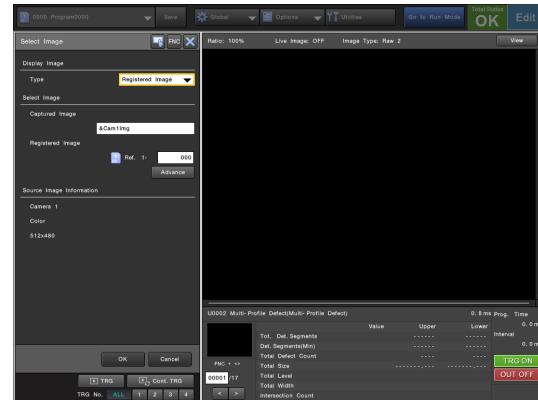
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

Specify the captured image and registered image to use for measurement.

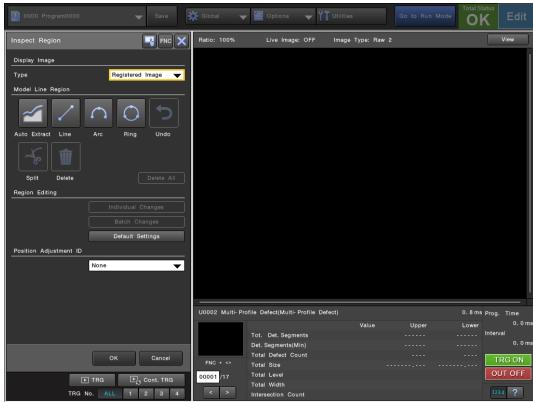


For more details, see "Select Image" (Page 2-471).

Inspect Region

Specify the region where the model line is to be detected from in the captured image. The Multi-Profile Defect Unit generates a region from the model line (detected through the model line region) with the specified width on both sides of the model line, and performs inspections using that region as the defect detection region. You can register 128 regions from No. 0 to 127.

- Point**
 - Changing the shape of the region will reset or clear some settings in [Detection Conditions].
 - Region numbers are 0 to 999. Repeatedly adding and deleting region numbers will use them up. For more details, refer to "Renumber Regions/Intersections" (Page 2-215).



Position Adjustment ID

To apply position adjustment to the captured image, select the position adjustment unit to be referenced.

Drawing a Region

- 1 Select the region shape from the [Model Line Region] field and draw a contour line.**

Auto Extract

If you select a spot near the contour line, the contour will be automatically extracted from the image selected under [Display Image]. If the contour cannot be extracted as you expected, change the Search Step Width, Edge Search Direction, Color extraction, Height Extraction, Image Enhance, and other settings.

- **Search Step Width:** Specifies the step width for when searching for the contour. When capturing a contour that has sharp changes, set [Search Step Width] to [Narrow]. When capturing a contour that only has gradual changes, by setting [Search Step Width] to [Wide], the program memory consumption can be limited and the processing time decreased.
- **Narrow:** Searches for the contour at an interval of approximately 8 pixels.
- **Standard:** Searches for the contour at an interval of approximately 16 pixels.
- **Wide:** Searches for the contour at an interval of approximately 32 pixels.
- **Edge Search Direction:** Specifies the direction where the light-dark boundary can be detected stably. Between light and dark, by searching in the direction from the one which is more uniform to the other, the light-dark boundary can be detected stably.
 - **Dark to Light:** Searches for a shift from dark to light.
 - **Light to Dark:** Searches for a shift from light to dark.

Line

If you select the start and end points in order, a line will be drawn between the two points. If you select the [Draw Continuously] check box, you can draw a line continuously to the drawn line.

If you select [Switch to Arc], you can continue drawing and draw an arc without breaking away from the line that has been drawn (you can also return to a line after switching to an arc).

Arc

If you select the start, mid, and end points in order, an arc will be drawn that passes through the three specified points. If you select the [Draw Continuously] check box, you can draw an arc continuously to the drawn arc.

If you select [Switch to Line], you can continue drawing and draw a line without breaking away from the arc that has been drawn (you can also return to an arc after switching to a line).

Ring

If you select three points, a ring will be drawn that passes through the three specified points.

- 2 If you drew lines using [Line], [Arc], and [Ring], select [Exit].**

A region where the specified region width is secured to the left and right of the drawn contour line will be drawn.

Changing Region Settings

Changing Individual Region Settings

Select [Individual Changes] from the [Region Editing] field and change the region width, scan direction, edge direction, smoothing range, and other settings. You can also edit drawn regions by selecting [Edit].

Changing All Region Settings at the Same Time

Select [Batch Changes] from the [Region Editing] field and specify the region width, scan direction, edge direction, and smoothing range.

Setting the Initial Value for the Region

Select [Default Settings] and specify the region width, scan direction, and edge direction. The values set here are applied to the region width and so on for the model lines drawn subsequently.



Point

- You can also select [Delete All] to delete all the model lines at the same time.
- When configured regions are deleted, the region number assigned to that region is left blank (the region numbers will not be automatically re-sorted). When new regions are added, they are assigned the next number after the largest number that is already assigned as a region number. Therefore, if you repeatedly add and delete regions, the region numbers may not be sequential. If this occurs, you can move up the region numbering to fill up the blank numbers (numbers that are not in use) by executing [Renumber Regions/Intersections].

Splitting a Region

You can split regions by splitting drawn model lines halfway.

1 Select [Split] from the [Model Line Region] field.

2 Select the point where you want to split.

The region is split at the point you selected.



You can also select [Specify Splitting Position by Value] and then specify the region number and the position to be split by values to split a region.

If you accidentally select the wrong split position:

Select [Undo].

Deleting a Region

You can delete regions by deleting drawn model lines.

1 Select [Delete] from the [Model Line Region] field.

2 Select the model line that you want to delete.

The selected model line and the region secured to the left and right of the model line are deleted.



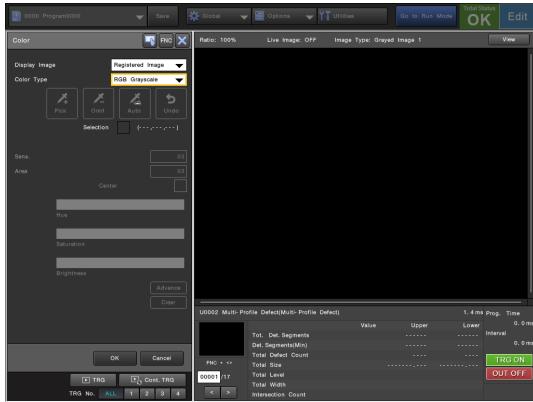
You can also select [Specify Region to Delete by No.] and then specify the number of the region to be deleted.

To cancel deletion:

Select [Undo].

Color

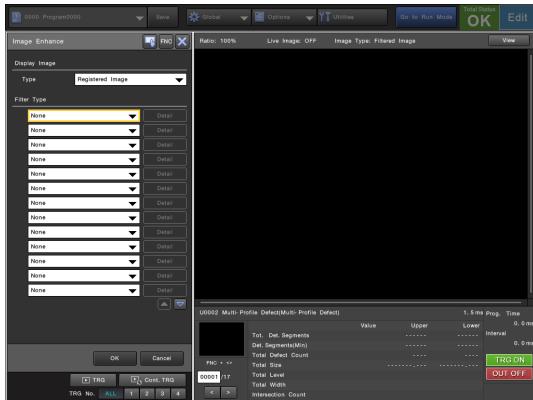
When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.



For more details, see "Color Extraction" (Page 2-483).

Image Enhance

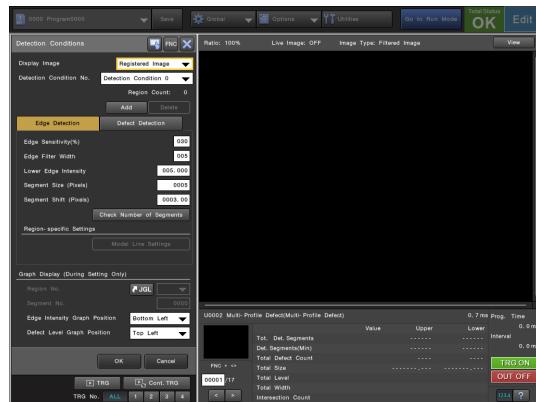
Specify the filter processing to apply to the image.



For more details, see "Image Enhance" (Page 2-489).

Detection Conditions

Specify detailed conditions for detecting edges and defects.



Display Image

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Detection Condition No.

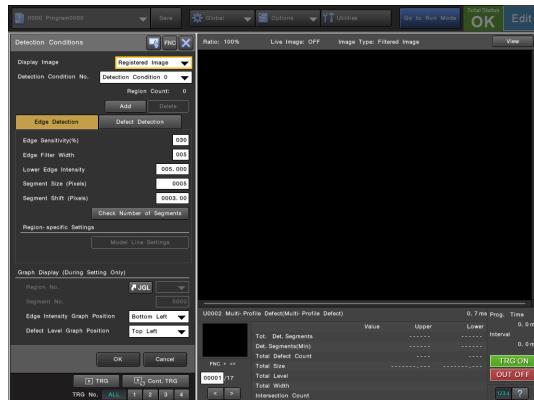
Select the detection condition number to be set. You can specify the detection condition number by inspection region.

- **Add:** Adds a detection condition number (up to 5) and switches to the settings for the added number.
- **Delete:** Deletes the settings for the selected detection condition number.

Multi-Profile Defect

Edge Detection

Specify the scan direction and edge direction for detecting edges, as well as other detailed conditions for edge detection.



Reference Refer to "What is an Edge?" (Page 2-95) for the technical description of edge detection.

Edge Sensitivity (%)

Set the percentage threshold (0% to 100%) for recognizing edges.

Edge Filter Width

Set the width (0 to 100 pixels) of the smoothing filter applied to the differential graph for detecting edges.

Lower Edge Intensity

Specify the lower limit (0.000 to 255.000) of edge intensity for detecting edges.

Reference It may be possible to exclude noise edges in the segment by adjusting the upper and lower edge intensity values based on the highest edge intensity in the segment, shown on the left of the edge graph. See "What is an Edge?" (Page 2-95) for more details.

Segment Size (Pixels)

Specify the size of the segment, from 1 to 9999 (pixels), in the inspection region. If the segment size is larger than the inspection region width in the trend direction, a measurement error will occur.

Segment Shift (Pixels)

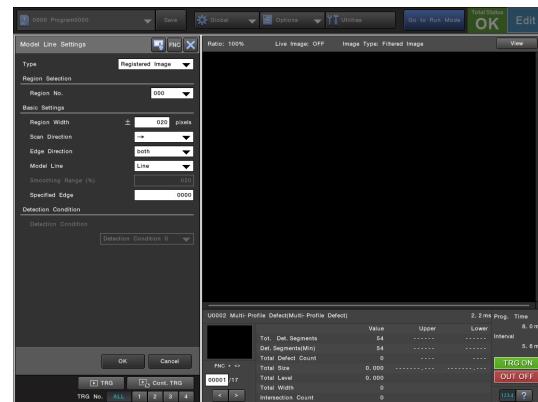
Specify the shifting distance of the segment, from 0.01 to 9999.99 (pixels), along the trend.

Check Number of Segments

You can check the number of segments assigned to each region and the number of segments in the unit. The maximum number of segments per region is 10,000 (and a maximum of 90,000 for the entire unit), but the actual number of segments that can be set may be lower depending on other settings.

Region-specific Settings

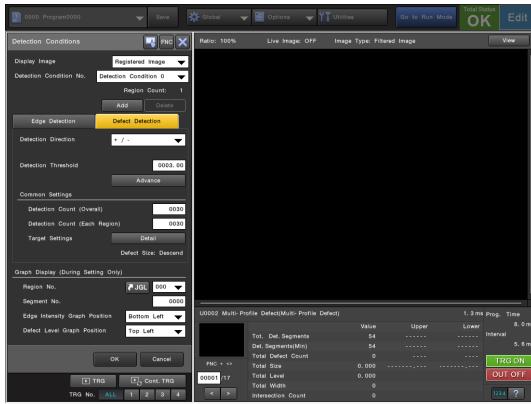
You can select [Model Line Settings] to set detection conditions to be used for model line regions by region.



- **Region Width:** Specifies the width of the model line region.
- **Scan Direction:** Specifies the direction in which to scan for edges within the model line region (segment).
- **Edge Direction:** Specifies the light-dark change direction to detect as an edge. Select from [Light to Dark], [Dark to Light], or [both].
- **Model Line:** Selects the model line fitted to the contour shape of the inspection target from [Line (Only for Line region)], [Circle], [Free Curve], or [Oval (Only for Ring/Arc regions)].
 - **Line:** Sets a line as the model line.
 - **Circle:** Sets a circle as the model line.
 - **Free Curve:** Sets a free curve line as the model line.
 - **Oval:** Sets an oval as the model line.
- **Smoothing Range (%):** Set this option when [Free Curve] is selected for the model line. Increase the value to draw the free curve smoothly on the contour of the measurement target. To make it sharper, decrease the value.
- **Specified Edge:** Specifies the number of the edge in the segment that is to be the measurement target. If a value of 0 or higher is specified, it is counted in the order of detection in the scan direction. If a negative value is specified, it is counted in the order opposite to that of the scan direction. If the specified edge number is not detected, the result of that segment is 0. However, if [Undetected Point] in [Parameters] is set to a setting other than [Ignore], the measurement result will be based on the setting.
- **Detection Condition:** Selects the Detection Condition to use for the selected model line region. When several Detection Conditions are created, the appropriate Detection Condition can be assigned to each model line region. This is useful when, for some regions, the use of a Detection Condition that is different from the rest is desired. For the creation, editing, and deletion of Detection Conditions, perform them in Detection Conditions.

Defect Detection

Specify the model line and defect detection direction for detecting defects, as well as other detailed conditions for defect detection.



Detection Direction

Select the direction to search for a defect.

- +**: Detects only the irregularities in the + direction as defects.
- : Detects only the irregularities in the - direction as defects.
- + / -**: Detects the irregularities in both the + and - directions as defects.
- + / - (Individual)**: Detects the irregularities in both the + and - directions as defects. This option is different from [+/-] in that it enables the detection thresholds for defects in the + and - directions to be set individually.



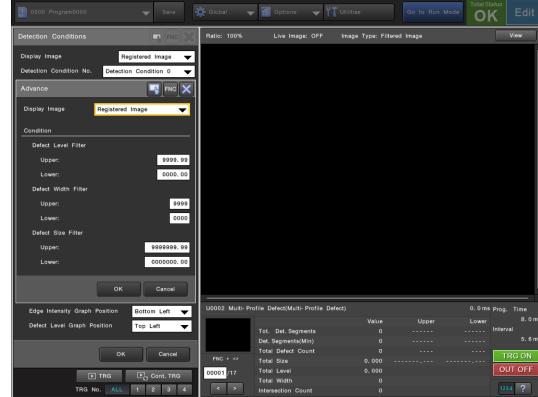
A reference is shown on screen to indicate the detection direction based on the selected detection direction and the shape of the inspection region. The + sign indicates the direction is the same as the edge scan direction while the - sign indicates the direction is opposite to the edge scan direction.

Detection Threshold

Set the threshold value for the defect level (0 to 9999.99) for identifying defects.

Advance

Use this option to specify the detection conditions in detail. Using the [Advance] menu options can help filter out falsely detected defects.



- Display Image:** Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).

- **Registered image:** Displays the registered image specified under [Select Image].

- Defect Level Filter:**

- **Upper:** Specify the upper limit of the defect level to detect as a defect (0.00 to 9999.99).

- **Lower:** Specify the lower limit of the defect level to detect as a defect (0.00 to 9999.99).

- Defect Width Filter:**

- **Upper:** Specify the upper limit of the defect width to detect as a defect (0 to 9999).

- **Lower:** Specify the lower limit of the defect width to detect as a defect (0 to 9999).

- Defect Size Filter:**

- **Upper:** Specify the upper limit of the defect size to detect as a defect (0.00 to 999999.99).

- **Lower:** Specify the lower limit of the defect size to detect as a defect (0.00 to 999999.99).

Common Settings

- Detection Count (Overall):** Specify the maximum number of defects to be detected for the whole of the Multi-Profile Defect unit. For example, when [3] is specified, the process searches for up to 3 defects.
- Detection Count (Each Region):** Specify the maximum number of defects to be detected in one region of the Multi-Profile Defect unit.
- Target Settings:**
 - Detection Order:** Select the identification order of the defects.
 - Segment: Ascend:** Sort defects based on smallest segment No. to largest.
 - Segment: Descend:** Sort defects based on largest segment No. to smallest.
 - X: Ascend:** Sort by the X coordinate in ascending order.
 - X: Descend:** Sort by the X coordinate in descending order.
 - Y: Ascend:** Sort by the Y coordinate in ascending order.
 - Y: Descend:** Sort by the Y coordinate in descending order.
 - Defect Level: Ascend:** Sort defects from lowest defect level to highest.
 - Defect Level: Descend:** Sort defects from highest defect level to lowest.
 - Defect Width: Ascend:** Sort defects from lowest defect width to highest.
 - Defect Width: Descend:** Sort defects from highest defect width to lowest.
 - Defect Size: Ascend:** Sort defects from lowest defect size to highest.
 - Defect Size: Descend:** Sort defects from highest defect size to lowest.
 - Primary Target:** Set the defect to be used for OK / NG judgment.
 - All:** Use the minimum and maximum values measured from all defects for the judgment.
 - Specify:** To judge only a particular defect, specify the No. of the defect that is to be the subject of judgment (0 to 4999). The measurement from the defect specified here is used for judgment.

Reference

- During operation, the defect level graph, position and defect level of the defect specified as the primary target are displayed. Selecting the defect by specifying the number is useful for checking the detection status of a specific defect.
- If [Primary Target] is set to [All], all the defect edge points will be displayed in green.

Graph Display (During Setting Only)

Specify things such as the segment to display the edge intensity graph and defect level graph of, and the display position on the screen.

Region No.

Specify the region of which to display the graph of.

If you select **JGL**, the region and segment number where the primary target is are automatically set.

Segment No.

Specify the segment for which to display the segment position, edge graph, edge intensity value, and measurement results on the screen. The setting range is 0 to 9999.

Point

The number of segments set in the current inspection region is updated automatically according to the change in the segment size and shift. The maximum number of segments per region is 10,000 (and a maximum of 90,000 for the entire unit), but the actual number of segments that can be set may be lower depending on other settings.

Reference

During operation, the position, edge graph, edge intensity value of the segment specified in Segment No. are displayed. Changing the Segment No. is useful for checking the detection status of specific segments.

Edge Intensity Graph Position

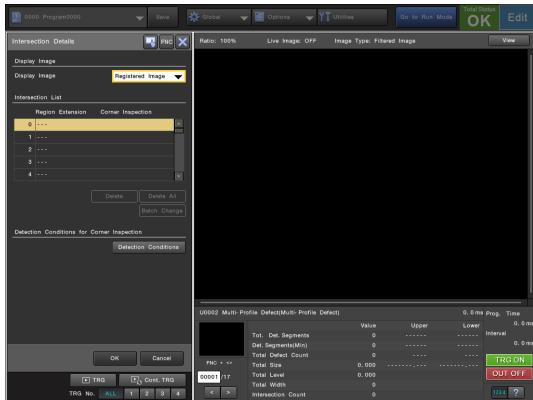
Select the position to display the edge intensity graph.

Defect Level Graph Position

Select the position to display the defect level graph.

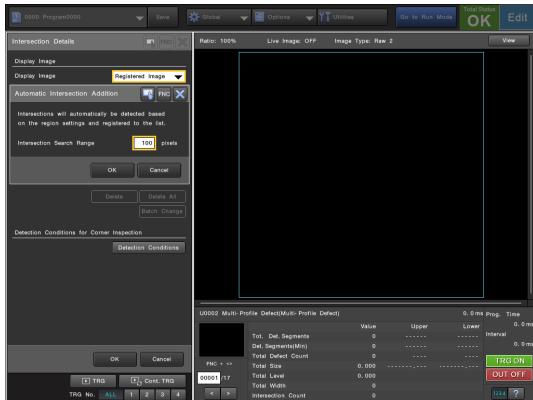
Intersection Details

Set the settings for the intersection of the model lines detected from the model line regions and set the corner inspection conditions for that intersection. You can register 128 intersections from No. 0 to 127.



If the [Intersection Details] screen is displayed when an intersection has not been registered:

The [Automatic Intersection Addition] screen appears.

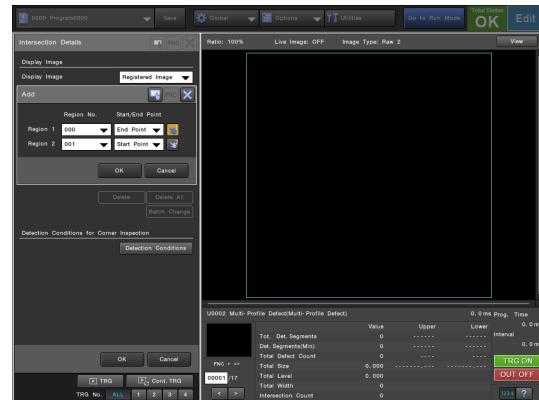


Specify the range to search for intersections from the end of the model line detection region in [Intersection Search Range] and then select [OK] to automatically register detected intersections.

Adding an Intersection

- Select the intersection number that you want to add in the [Intersection List] field.

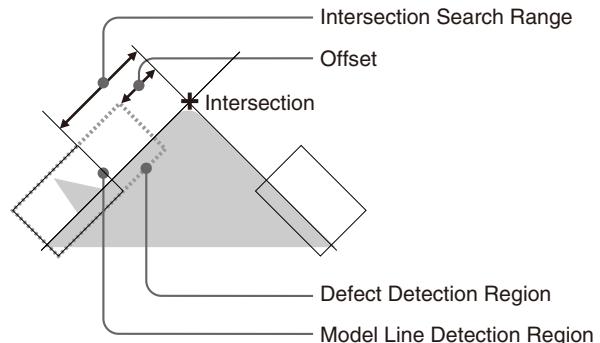
The [Add] screen appears.



- Select the region number of the two model line detection regions and the ends (start or end point) with which to create the intersection, and select [OK].

The intersection search with the specified conditions starts and the detected intersection is registered in the [Intersection List] field.

- Change the intersection settings as necessary.



Intersection Settings

- Intersection Search Range (Pixels):** Specifies the range to search for the intersection from the end of the model line detection region in pixels. Intersections are searched in the intersection search range during actual operations as well.
- Region Extension:** To extend the region from the end of the model line detection region, select [ON].
- Offset (Pixels):** When extending the inspection region from the end of the model line towards the intersection, the inspection region is extended up to the point which is the specified number of pixels in [Offset] away from the intersection.

Corner Inspection Settings

- To inspect for chips or burrs on the corner, select [ON].
- **Inspection Region:** Sets the inspection region for when inspecting the corner of the object.
 - **Scan Direction:** Specifies the direction in which to scan for edges in the corner inspection region (segment). Select from [Outward] or [Inward].
 - **Edge Direction:** Specifies the light-dark change direction to detect as an edge. Select from [Light to Dark], [Dark to Light], or [Both].
 - **Corner Detection Condition:** Specifies the Corner Detection Condition number to use for the specified corner inspection region. For more details, refer to "Setting Detection Conditions for Corner Inspection" (Page 2-214).

4 Select [OK].

Editing an Intersection

Changing intersection search conditions

Select the intersection number in the [Intersection List] field that you want to change and specify the intersection search range, corner inspection settings, and corner inspection region settings.

Changing all intersection search conditions at the same time

Select [Batch Change] and specify the intersection search range, corner inspection settings, and corner inspection region settings for all intersections.

Deleting a registered intersection

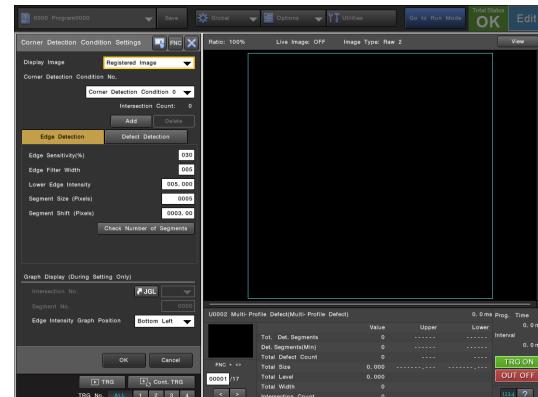
Select the intersection number that you want to delete in the [Intersection List] field and then select [Delete]. To delete all registered intersections at the same time, select [Delete All].



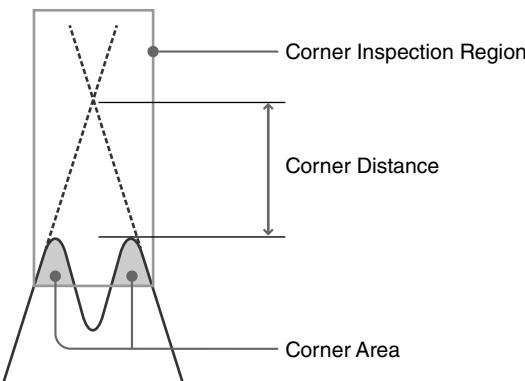
When configured intersections are deleted, the intersection number assigned to that intersection is left blank (the intersection numbers will not be automatically re-sorted). When new intersections are added, they are assigned the next number after the largest number that is already assigned as an intersection number. Therefore, if you repeatedly add and delete intersections, the intersection numbers may not be sequential. If this occurs, you can move up the intersection numbering to fill up the blank numbers (numbers that are not in use) by executing [Renumber Regions/Intersections].

Setting Detection Conditions for Corner Inspection

You can change the settings on the [Corner Detection Condition Settings] screen by selecting [Detection Conditions] in the [Detection Conditions for Corner Inspection] field.



Corner inspection is a function for inspecting burrs and chips near intersections. The function calculates corner area and distance, and inspects the corner.



- **Corner Area:** Indicates the area for contours in the corner inspection region by calculating the total of the detected positions for each segment in the corner inspection region.
- **Corner Distance:** Indicates the shortest distance from the corner to the intersection. The shortest distance is calculated from the distances between the intersection and the detected point of each segment in the corner inspection region which are projected onto the median line of the two model lines. The unit of measurement is the "number of pixels".

Corner Detection Condition No.

Select the number of the Corner Detection Condition to be changed.

You can also select [Add] to add new Corner Detection Conditions or select [Delete] to delete existing Corner Detection Conditions.

Edge Detection

Specify the edge detection condition in the corner inspection. For more details on the settings, refer to "Detection Conditions" (Page 2-209).

Defect Detection

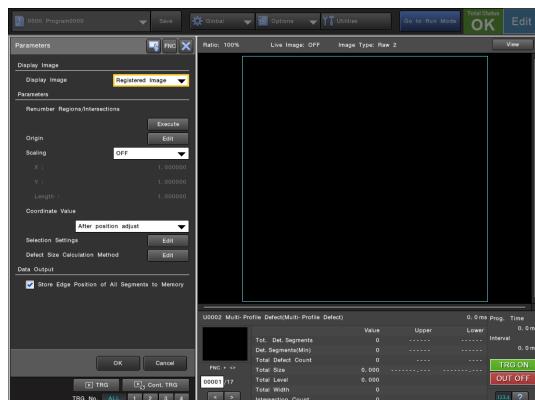
- Advance:** Specify the maximum and minimum values for the area and distance filters in the corner defect conditions.
- Target Settings:** Select [Detail] and then select the detection order and corner primary target.

Graph Display

- Intersection No.:** Specify the intersection of which to display the graph of. If you select JGL, the segment number where the primary target is set automatically.
- Segment No.:** Specify the segment for which to display the segment position, edge graph, and edge intensity value on the screen. The setting range is 0 to 9999.
- Edge Intensity Graph Position:** Select the position to display the edge graph.

Parameters

Specify other conditions for the Multi-Profile Defect tool as required.



Display Image

Display Image

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Renumber Regions/Intersections

When new regions are added, they are assigned the next number after the largest number that is already assigned as the region number. Moreover, when configured regions are deleted, the region number assigned to that region is left blank (the region numbers will not be automatically re-sorted). Therefore, if you repeatedly add and delete regions, the region numbers will reach the maximum value, even if the maximum number of regions is not actually used, and more regions cannot be added.

If this occurs, by executing [Renumber Regions/Intersections], you can move up the region numbering to fill up the blank numbers (numbers that are not in use), match region numbers and array element numbers for results data, and ensure there are enough region numbers.

This behavior is the same for intersections.

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Multi-Profile Defect

Scaling

The controller processes image data in pixels. The result data and setting parameters used for display, judgment and calculations can be converted and scaled to real life values and dimensions by using the pre-set scaling factor option.

- **OFF:** Do not use scaling.
- **ON:** Use scaling.

Reference

- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate Value

Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- **After position adjust:** The inspection uses the adjusted coordinate axes determined after position adjustment.
- **Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Selection Settings

- **Selection:** Specify the culling rate of detection data for creating a model line. To increase (for a more precise model line detection) or decrease (for faster processing) the number of reference values used to create the model line, select [Manual] and then specify the cull rate.
 - **Auto:** Set the culling rate automatically.
 - **Manual:** Set the desired culling rate.
- **Edge Selection (%):** When [Manual] is selected for the [Selection], specify the culling rate between 0 and 99.99%.

Point

Setting the cull rate too high will make the model line undetectable.

Defect Size Calculation Method

Select a defect size calculation method.

- **Defect Size Calculation Method:**

- **Total Diff. From Model Line:** The total difference from the model line is taken as the defect size.
- **Total Diff. From Threshold:** The total difference from the [Detection Threshold] value set in [Detection Conditions] (Defect Detection tab) is taken as the defect size.
- **Undetected Point:** Use this setting for handling the defect level for points where an edge could not be detected.
 - **Ignore:** Undetected points are treated as having a defect level of 0.
 - **Maximize:** Undetected points are treated as having the maximum value in the edge scan direction.
 - **Minimize:** Undetected points are treated as having the minimum value in the edge scan direction.
 - **Fill:** The defect level of undetected points is interpolated from the surrounding points.

Point

Selecting [Fill] increases processing time.

- **Apply Also to Model Line Calculation:** Applies the setting of [Undetected Point] to the calculation of the model line as well. This setting is effective only when the model line is a [Line], [Circle], or [Oval].

Data Output

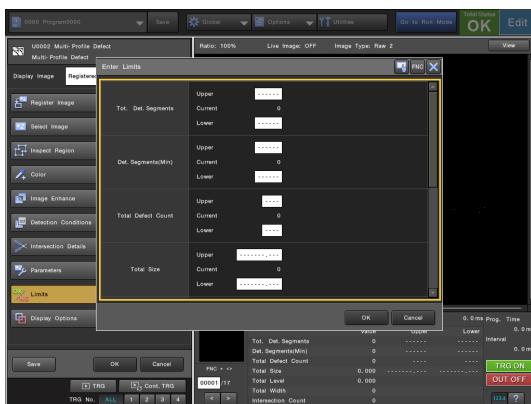
Store Edge Position of All Segments to Memory

Stores the edge positions of all segments to the memory as results data. If the result data for the edge position is not needed, you can reduce program memory consumption by clearing this check box.

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.



- [----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Tot. Det. Segments

Specify the tolerance for the segment detection count for the entire unit. The unit of measurement is the "number of segments" detected.

Det. Segments (Min.)

Specify the tolerance for the least segment detection count. The unit of measurement is the "number of segments" detected.

Total Defect Count

Specify the tolerance for the detected defect count for the entire unit.

The unit of measurement is the "number of defects" detected.

Total Size

Specify the tolerance for the total size of all defects. The unit of measurement is the "number of pixels".

Defect Size

Specify the tolerance for the defect size of the defect specified as the primary target.

The unit of measurement is the "number of pixels".

Defect Position

Specify the tolerance for the center of gravity of the defect specified as the primary target.

The unit of measurement is the "number of pixels" indicating the center of gravity coordinates.

Corner Area

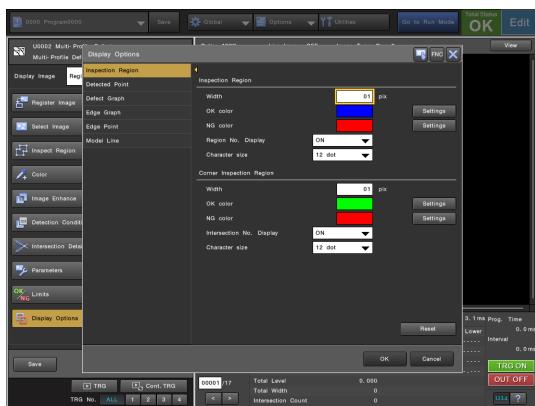
Set the tolerance for the area of the contour in the corner inspection region. The corner area is calculated as the sum total of the detected positions for each segment in the corner inspection region. The unit of measurement is the "number of pixels".

Corner Distance

Set the tolerance for the shortest distance from the corner to the intersection. The corner distance is calculated as the shortest distance of the distances between the intersection and the detected point of each segment in the corner inspection region which are projected onto the median line of the two model lines. The unit of measurement is the "number of pixels".

Display Options

Specify the display methods for things such as the inspection region, detected defects and defect graph. You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection Region

Inspection Region

Specify the line width and display color of the inspection region, and whether to show or hide the region number.

Corner Inspection Region

Specify the line width and display color of the corner inspection region, and whether to show or hide the intersection number.

Detected Point

Target

Specify how to display the detected defect points during operation.

- **OFF:** Hide the detected points.
- **Primary target:** Show the detected defect point for the primary target.
- **All** (default): Show the detected points for all the detected defects.

Primary Target

Specify the width and display color of the line indicating the detected defect.

Other Target

Specify the width and display color of the line indicating the detected defect other than the one specified as the primary target (Page 2-197).

Defect Graph

Defect graph

Specify whether to display the defect graph or not.

- **ON:** Display the defect graph.
- **OFF** (default): Hide the defect graph.

Point Selecting [ON] will increase the processing time.

Region No.

Specify the region number of which to display the defect level graph of.

Display Position

Specify where on the screen to display the defect level graph.

Wave

Specify the width and display color of the defect graph waveform.

Frame

Specify the width and display color of the defect graph frame.

Detection Threshold

Specify the width and display color of the line representing the detection threshold.

Filter lower limits

Specify the width and display color for the line representing the lower limit of the defect level filter.

Point Setting [Defect graph] to [ON] consumes additional program memory. Check the amount of remaining program memory before enabling.

Edge Graph

Edge graph

Select whether to display the edge graph.

- **OFF** (default): Hide the edge graph.
- **Inspection Region:** Displays the edge graph of the specified segment number for the specified inspection region.
- **Corner Inspection Region:** Displays the edge graph of the specified segment number for the corner inspection region set up in the specified intersection number.

Display Position

Specify where on the screen to display the edge graph.

Wave

Specify the width and display color of the edge graph waveform.

Frame

Specify the width and display color of the edge graph frame.

Sensitivity

Specify the width and display color of the line representing the edge sensitivity threshold.

Point Setting [Edge graph] to [Inspection Region] or [Corner Inspection Region] consumes additional program memory. Check the amount of remaining program memory before enabling.

Edge Point

Edge Point

Specify how to display the edge point detected during operation.

- **OFF** (default): Hide the edge point.
- **Primary target:** Display the detected edge point of the segment specified at [Primary Target] which has the maximum defect level.
- **Primary target, Max/Min:** Display the detected edge points of the three segments: The segment specified at [Primary Target] and those with maximum defect levels on the + and - sides respectively.

Profile

Specify whether to display the line connecting the detection point in the segment and the edge detection point.

- **OFF:** Hide the profile.
- **ON** (default): Display the profile.



Point This is not supported for the display in screen image type [Raw 2].

Target Region

Specify the region for which to display the profile.

Segments

Select whether to display the segments.

- **OFF** (default): Hide the segments.
- **ON:** Show the segments.



- This is not supported for the display in screen image type [Raw 2].
- If the segment size is larger than the segment shift, the segments will not be displayed.

Model line

Specify the line width and display color of the model line.

Reset

Returns the display options to their defaults.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

Intensity

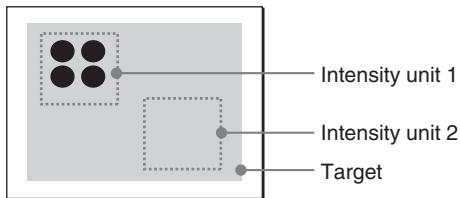
Intensity Tool

The intensity tool measures the maximum, minimum, average, and deviation of the grayscale intensity (brightness) within the inspection region.

This tool can be used for checking the presence/absence of parts based on the difference of intensity values between the target and background.

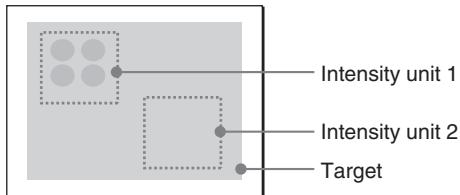
Measurement Overview

When the intensity difference is large



- Average intensity of intensity unit 1: 50
- Average intensity of intensity unit 2: 200
- Intensity difference: 150

When the intensity difference is small



- Average intensity of intensity unit 1: 150
- Average intensity of intensity unit 2: 200
- Intensity difference: 50

Main measurement results

The standard results and data returned by Intensity tool are as follows:

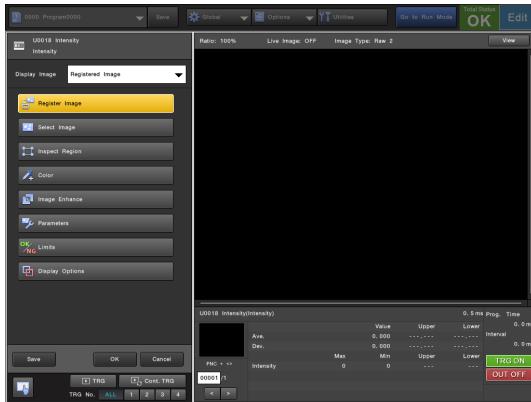
Average intensity	Outputs the average intensity in the inspection region on a scale of 0 to 255 (levels). <small>Tolerance inspection target</small>
Maximum intensity	Outputs the maximum intensity (the brightest part) in the inspection region. <small>Tolerance inspection target</small>
Minimum intensity	Outputs the minimum intensity (the darkest part) in the inspection region. <small>Tolerance inspection target</small>
Deviation	Outputs the intensity deviation in the inspection region. This deviation represents the variation level (standard deviation) calculated from the intensity of each pixel in the inspection region. <small>Tolerance inspection target</small>
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

Point When [Color to Binary] or [Color to Grayscale] extraction is used, the black-and-white image after the color extraction process is used for the intensity measurement.

Reference For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Top Menu

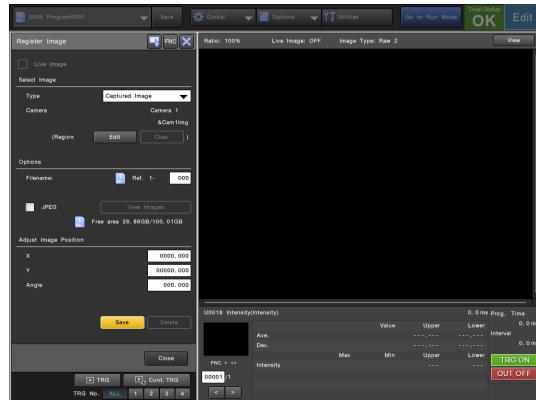
The top menu of the Intensity tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-221)	Register an image to be used as a template for settings.
Select Image (Page 2-221)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-221)	Define the region to be used for unit processing.
Color (Page 2-222)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-222)	Specify the filter processing to apply to the image.
Parameters (Page 2-222)	Specify other conditions for the Intensity tool as required.
Limits (Page 2-223)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-224)	Specify the display methods for things such as the inspection region and mask region.
Save (Page 2-224)	Save the current state to the program file.

Register Image

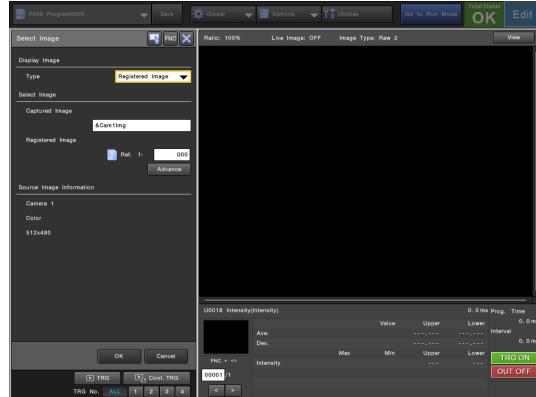
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

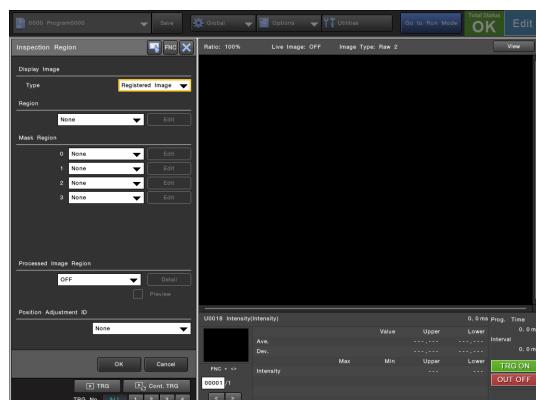
Specify the captured image and registered image to use for measurement.



For more details, see "Select Image" (Page 2-471).

Inspect Region

Define the region to be used for unit processing.

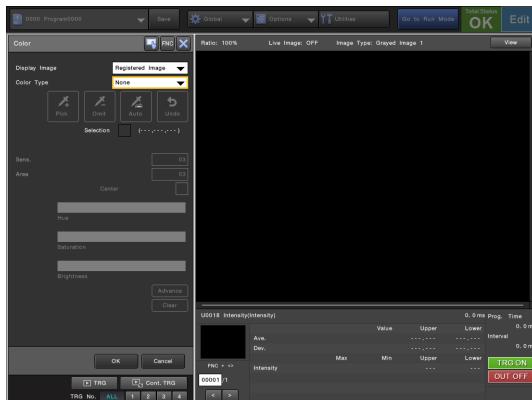


For more details, see "Region Settings" (Page 2-473).

Cela

Color

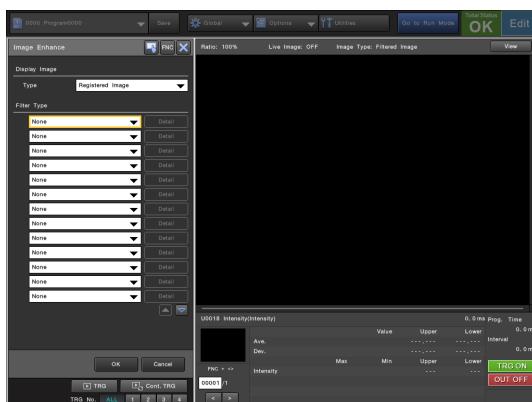
When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.



For more details, see "Color Extraction" (Page 2-483).

Image Enhance

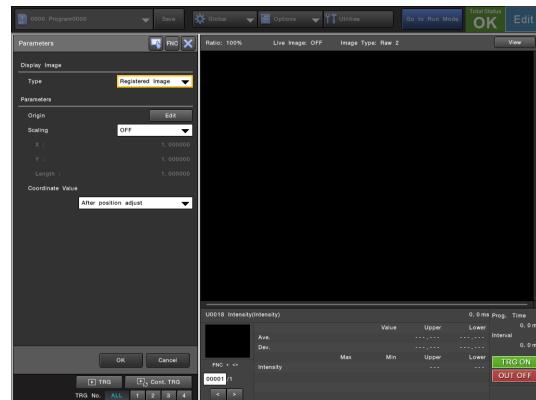
Specify the filter processing to apply to the image



For more details, see "Image Enhance" (Page 2-489).

Parameters

Specify other conditions for the Intensity tool as required.



Display Image

Type

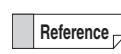
Switch the image displayed on the screen.

- **Captured image**: Displays the latest image from the specified camera (image variable).
 - **Registered image**: Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.



The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels. The result data and setting parameters used for display, judgment and calculations can be converted and scaled to real life values and dimensions by using the pre-set scaling factor option.

- **OFF**: Do not use scaling.
 - **ON**: Use scaling.



- The scaling value can be changed in the [Options] menu (Page 4-18).
 - For a summary list of the result data for which scaling can be used, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate Value

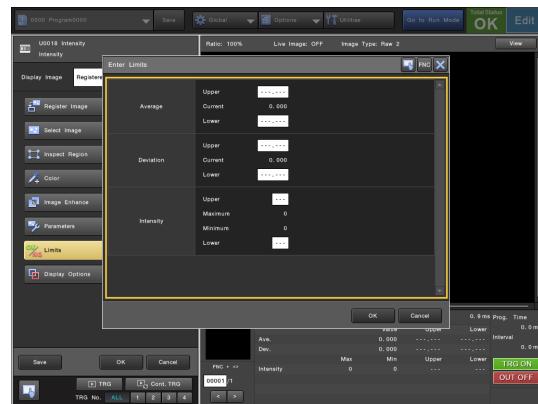
Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- **After position adjust:** The inspection uses the adjusted coordinate axes determined after position adjustment.
- **Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.

Reference

- [----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Average

Specify the tolerance for the detected average intensity. The unit of measurement is the "grayscale level" indicating the average intensity (0 to 255).

Deviation

Specify the tolerance for the deviation of the detected intensity.

The unit of measurement is the "grayscale level" indicating the deviation.

Intensity

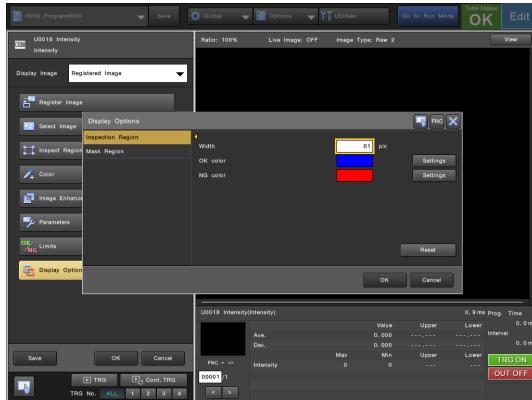
Specify the tolerance for the maximum and minimum values of the detected intensity.

The unit of measurement is the "grayscale level" indicating the intensity (0 to 255).

Intensity

Display Options

Specify the display methods for things such as the inspection region and mask region.
You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection region

Specify the line width and display color of the inspection region.

Mask region

Specify the line width and display color of the mask region.

Reset

Returns the display options to their defaults.

Save

Save the current state to the program file.
The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

Point

- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

Color

Color Tool

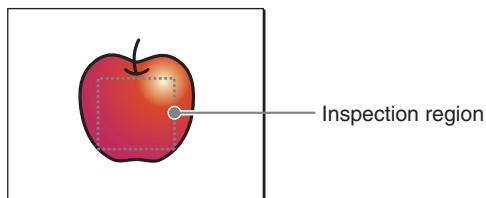
The color tool measures the average, deviation and intensity of the color information within the inspection region. The measurement can be based on Red/Green/Blue or Hue/Saturation/Brightness values. Acquiring the color information allows for the differentiation of targets and conditions through detailed, fine inspection of specific color elements.



The measurement results of the color tool will vary not only based on changes in the surrounding environment, but may also be affected by the individual differences between camera CCDs, lights and controller chipsets, and the white balance settings. Due to the measurement principle, false measurements may become greater when inspecting achromatic and or dark colors, or in environments with insufficient ambient light. Be sure to confirm settings and results of the actual inspection after there have been changes to the camera, light, measurement target, or surrounding environment.

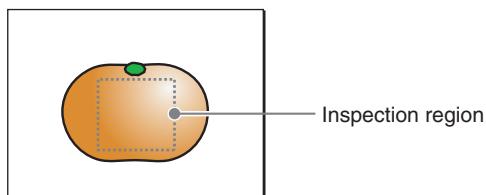
Measurement Overview

Example of measuring a red object



- R-Ave: 200
- G-Ave: 50
- B-Ave: 50

Example of measuring an orange object



- R-Ave: 250
- G-Ave: 200
- B-Ave: 40

Main measurement results

The standard results and data returned by Color tool are as follows:

Average intensity	Outputs the average RGB or HSB intensity in the inspection region on a scale of 0 to 255 (levels). <small>Tolerance inspection target</small>
Deviation	Outputs the RGB or HSB intensity deviation in the inspection region. <small>Tolerance inspection target</small>
Maximum intensity	Outputs the RGB or HSB maximum intensity in the inspection region. <small>Tolerance inspection target</small>
Minimum intensity	Outputs the RGB or HSB minimum intensity in the inspection region. <small>Tolerance inspection target</small>
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.



- The maximum and minimum intensity values of H in HSB mode are fixed to 0 as hue is measured on a circular scale.
- See "The HSB Color System" (Page 2-488) for color information parameters for the HSB mode.
- If a MultiSpectrum Mode image is specified, the measurement results will be values for UV, B, G, AM, R, FR, IR, and W respectively.

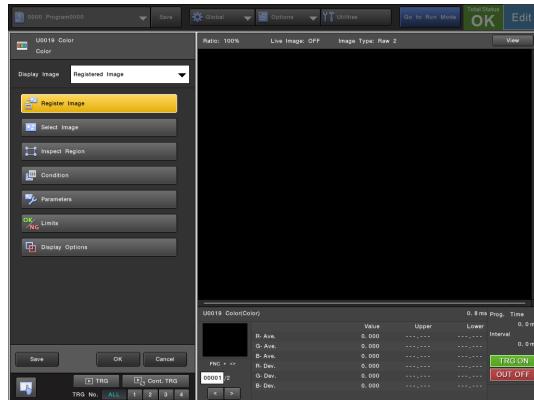


For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Color

Top Menu

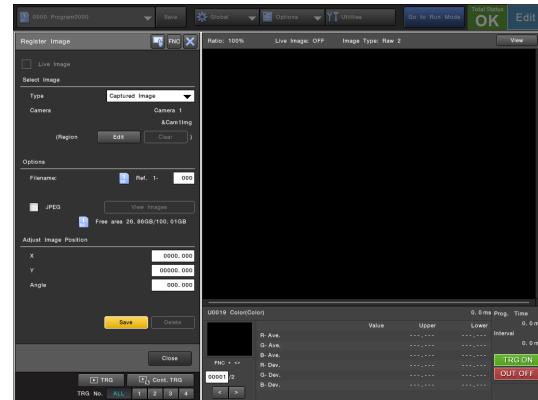
The top menu of the Color tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-226)	Register an image to be used as a template for settings.
Select Image (Page 2-226)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-226)	Define the region to be used for unit processing.
Condition (Page 2-227)	Specify the type of color measurement parameter.
Parameters (Page 2-227)	Specify other conditions for the Color tool as required.
Limits (Page 2-228)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-229)	Specify the display methods for things such as the inspection region and mask region.
Save (Page 2-229)	Save the current state to the program file.

Register Image

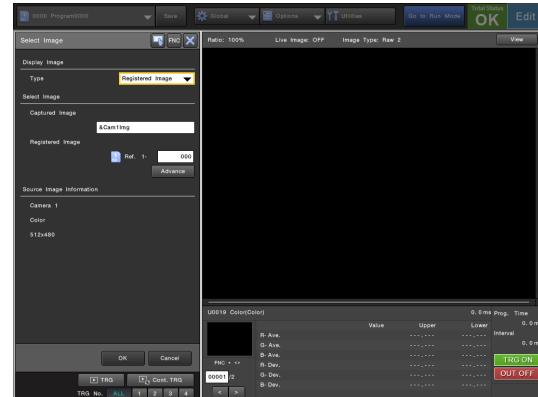
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

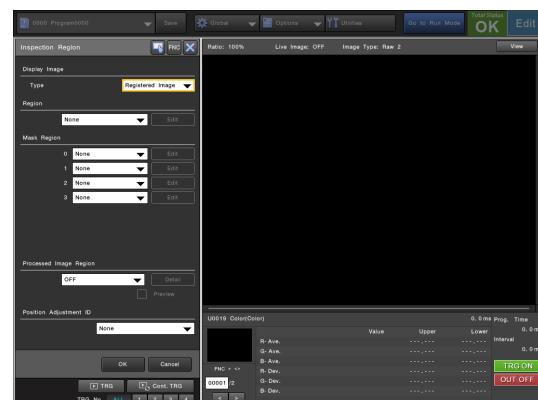
Specify the captured image and registered image to use for measurement.



For more details, see "Select Image" (Page 2-471).

Inspect Region

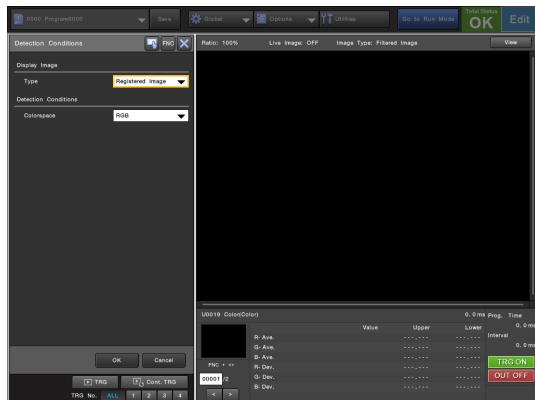
Define the region to be used for unit processing.



For more details, see "Region Settings" (Page 2-473).

Condition

Specify the type of color measurement parameter.



Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Detection Conditions

Colorspace

Select the colorspace type for the inspection.

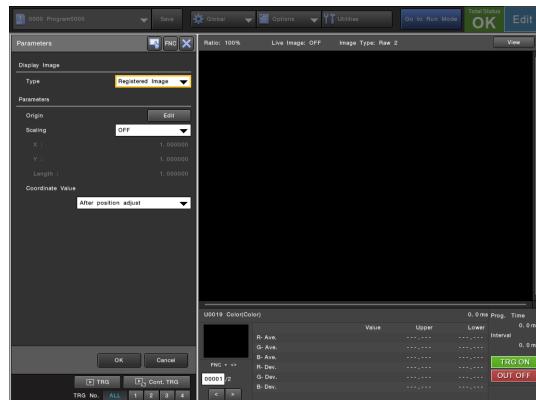
- **RGB (default):** Measure colors in RGB (Red, Green and Blue) terms.
- **HSB:** Measure colors in HSB (Hue, Saturation and Brightness) terms.



- The RGB and HSB parameters cannot be used simultaneously for measurement in the same unit.
- When [HSB] is selected, the maximum and minimum intensity value of H (Hue) are fixed to 0 as hue is measured on a circular scale.
- When an achromatic target is measured in [HSB] mode, the measured value of H (Hue) may be unstable due to the calculation principle.
- In "MultiSpectrum Mode" (Page 7-59), [MultiSpectrum] is displayed and cannot be changed.

Parameters

Specify other conditions for the Color tool as required.



Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.



The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels. The result data and setting parameters used for display, judgment and calculations can be converted and scaled to real life values and dimensions by using the pre-set scaling factor option.

- **OFF:** Do not use scaling.
- **ON:** Use scaling.



- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Color

Coordinate Value

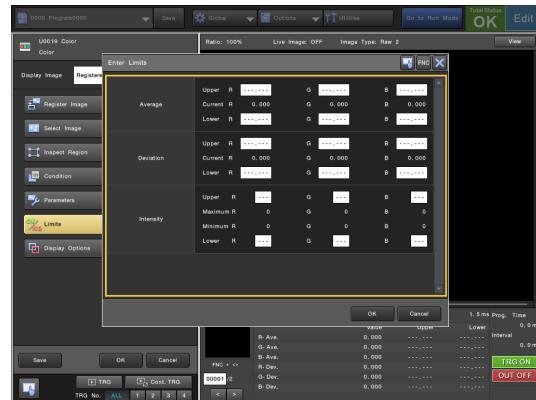
Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- After position adjust:** The inspection uses the adjusted coordinate axes determined after position adjustment.
- Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).

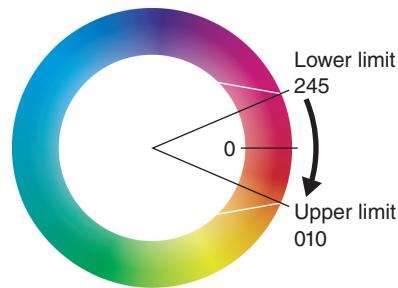


Use [Direct Input] to enter a value and set the tolerance.

Reference

- [-----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].
- You can specify values for R/G/B or H/S/B when using a color camera and UV/B/G/AM/R/FR/IR/W when using MultiSpectrum Light.
- When [HSB] is selected for [Colorspace], H (hue) is output as 0 to 255 in a looped fashion. This means that the lower limit can have a higher value than the upper limit.

Example: When the range around Red (hue value: 0) is to be judged OK



For more details about hue, see "The HSB Color System" (Page 2-488).

Average

Specify the tolerance for the average detected intensity. The unit of measurement is the "color intensity level" indicating the average intensity (0 to 255).

Deviation

Specify the tolerance for the deviation of the detected intensity. The unit of measurement is the "color intensity level" indicating the intensity deviation.

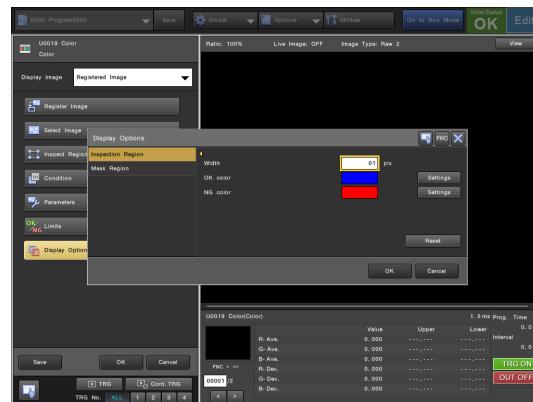
Intensity

Specify the tolerance for the maximum and minimum values of the detected intensity. The unit of measurement is the "color intensity level" indicating the intensity (0 to 255).

Display Options

Specify the display methods for things such as the inspection region and mask region.

You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection region

Specify the line width and display color of the inspection region.

Mask region

Specify the line width and display color of the mask region.

Reset

Returns the display options to their defaults.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

Point

- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

Color Grouping

Color Grouping Tool

The color grouping tool matches the color information of the object against the multiple color groups registered in advance.

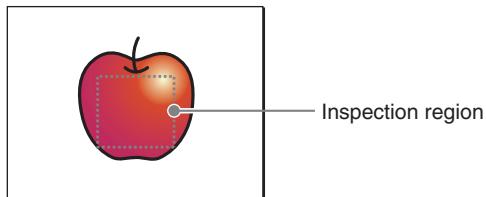
Identification of the color group with the largest area or identification of the object based on the proportion (%) of the area of each color group can be performed.



The measurement results of the color grouping tool will vary not only based on changes in the surrounding environment, but may also be affected by the individual differences between camera CCDs, lights and controller chipsets, and the white balance settings. Due to the measurement principle, false measurements may become greater when inspecting achromatic and or dark colors, or in environments with insufficient ambient light. Be sure to confirm settings and results of the actual inspection after there have been changes to the camera, light, measurement target, or surrounding environment.

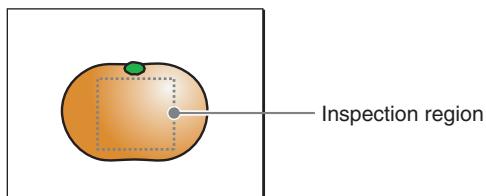
Measurement Overview (When red is registered in color group 0 and orange is registered in color group 1)

Example of measuring a red object



- Primary Candidate (Group No.) : 0
- Primary Candidate (Area) : 1800

Example of measuring an orange object



- Primary Candidate (Group No.) : 1
- Primary Candidate (Area) : 2100

Main measurement results

The standard results and data returned by Color Grouping tool are as follows:

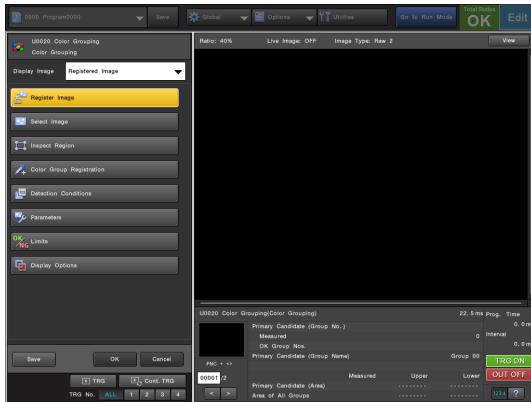
Primary Candidate (Group No.)	Outputs the number of the group with the biggest area. <small>[Tolerance inspection target]</small>
Primary Candidate (Area)	Outputs the area of the group with the biggest area. <small>[Tolerance inspection target]</small>
Individual Area	Outputs the area of each group individually. <small>[Tolerance inspection target]</small>
Primary Candidate (Area) (%)	Outputs the ratio (%) of the area of the group with the biggest area with respect to the [Area of All Groups] or [Entire Insp.Region] specified as the calculation target. <small>[Tolerance inspection target]</small>
Individual Area (%)	Outputs the ratio (%) of the individual area for each group with respect to the [Area of All Groups] or [Entire Insp.Region] specified as the calculation target. <small>[Tolerance inspection target]</small>
Area of All Groups	Outputs the total of the area of all the groups. <small>[Tolerance inspection target]</small>
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.



For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Top Menu

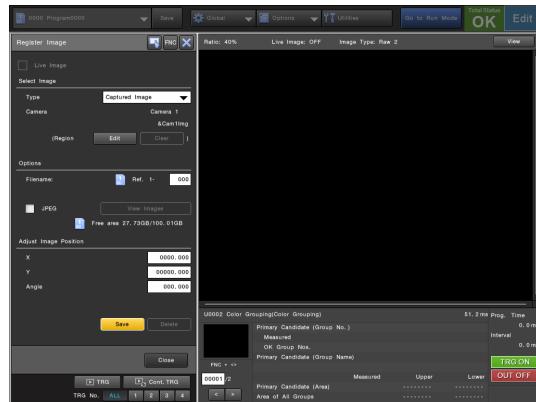
The top menu of the Color Grouping tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-231)	Register an image to be used as a template for settings.
Select Image (Page 2-231)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-231)	Define the region to be used for unit processing.
Color Group Registration (Page 2-232)	Register the color groups to cross-check the workpiece color data against.
Detection Conditions (Page 2-232)	Specify the type of color measurement parameter.
Parameters (Page 2-233)	Specify other conditions for the Color Grouping tool as required.
Limits (Page 2-234)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 2-234)	Specify the display methods for things such as the inspection region and mask region.
Save (Page 2-234)	Save the current state to the program file.

Register Image

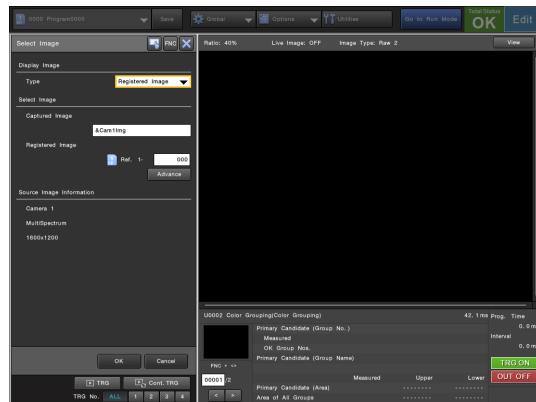
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

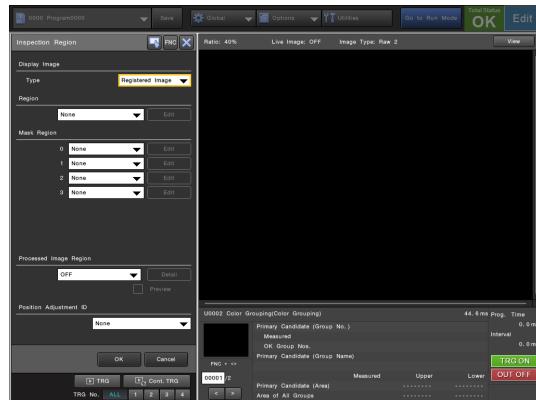
Specify the captured image and registered image to use for measurement.



For more details, see "Select Image" (Page 2-471).

Inspect Region

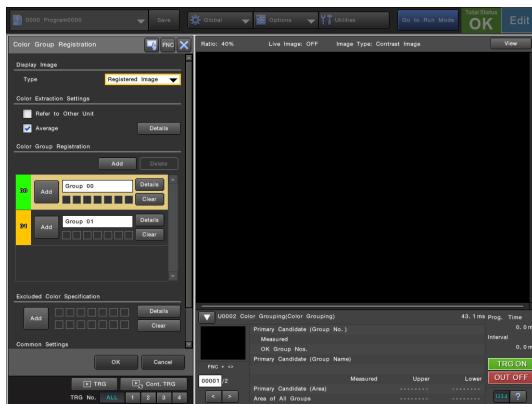
Define the region to be used for unit processing.



For more details, see "Region Settings" (Page 2-473).

Color Group Registration

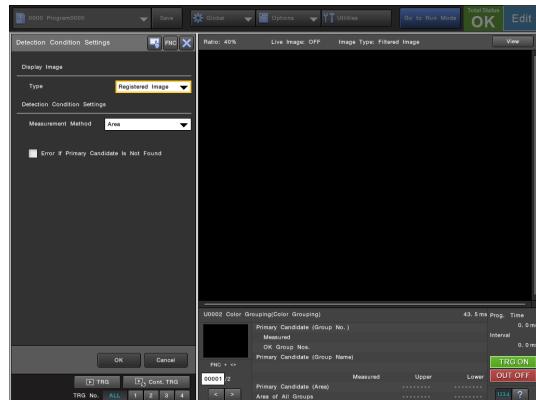
Register the color groups to cross-check the workpiece color data against.



For more details, see "Extracting Colors in MultiSpectrum Mode" (Page 7-79).

Detection Conditions

Specify the type of color measurement parameter.



Display Image

Type

Select the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Detection Condition Settings

Measurement Method

Select the measurement method for each group.

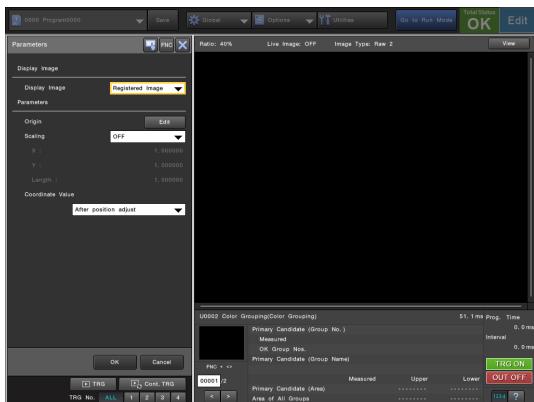
- **Area:** Measures the area of each group.
- **Ratio:** Measures by the proportion with respect to the area of all the groups. You can also specify [Area of All Groups] or [Entire Insp.Region] as the target when calculating the ratio.

Error If Primary Candidate Is Not Found

When this is enabled, the unit will result in an error if a primary candidate is not found.

Parameters

Specify other conditions for the Color Grouping tool as required.



Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

Reference The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels. The result data and setting parameters used for display, judgment and calculations can be converted and scaled to real life values and dimensions by using the pre-set scaling factor option.

- OFF:** Do not use scaling.
- ON:** Use scaling.

Reference

- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate Value

Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

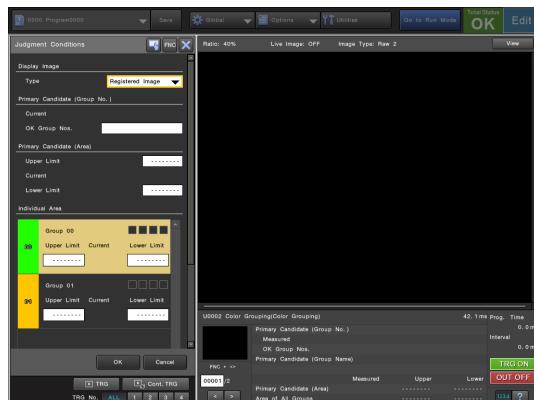
- After position adjust:** The inspection uses the adjusted coordinate axes determined after position adjustment.
- Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Color Grouping

Limits

Set the tolerance (upper and lower limits) for the measured value.

If the result is outside of the specified tolerance range, it is judged as [NG] (binary 1). If the result is within the tolerance range, it is judged as [OK] (binary 0).



Use [Direct Input] to enter a value and set the tolerance.

Reference

- [-----] indicates an empty state where no tolerance is set. In this state, no judgment will be performed on the measurement.
- To reset the tolerance setting to an empty state, select [Clear].

Primary Candidate (Group No.)

Select the Group Nos. for judging the primary candidate as OK.

Primary Candidate (Area)

Set the tolerance for the area of the primary candidate that was measured.

- If [Measurement Method] is [Area]: The unit of measurement is the [Number of Pixels] of the measured area (0 to 99999999).
- If [Measurement Method] is [Ratio]: The unit of measurement is the [Ratio (%)] (0.0 to 100.0) of the measured area with respect to the [Area of All Groups] or the [Entire Insp. Region].

Individual Area

Set the tolerance for the measured area by group.

- If [Measurement Method] is [Area]: The unit of measurement is the [Number of Pixels] of the measured area (0 to 99999999).
- If [Measurement Method] is [Ratio]: The unit of measurement is the [Ratio (%)] (0.0 to 100.0) of the measured area with respect to the [Area of All Groups] or the [Entire Insp. Region].

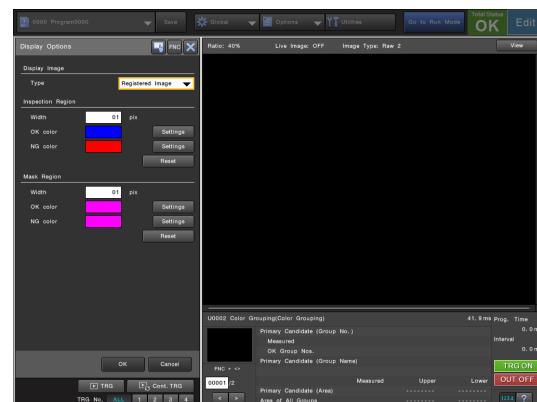
Area of All Groups

Set the tolerance for the area of all inspected groups. The unit of measurement is the [Number of Pixels] of the measured area (0 to 99999999).

Display Options

Specify the display methods for things such as the inspection region and mask region.

You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection Region

Specify the line width and display color of the inspection region.

Mask Region

Specify the line width and display color of the mask region.

Reset

Returns the display options to their defaults.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

Point

- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

OCR2

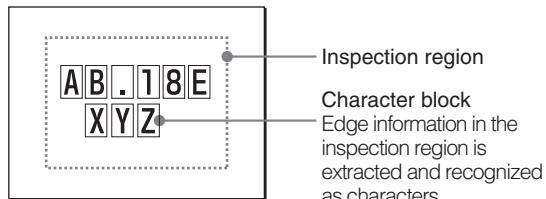
OCR2 Tool

A string of characters in the captured image can be recognized by extracting the character information within the inspection region and then matching them against the library data of character variations stored in the program. The recognized string can be directly output to an external device or the string, along with its correlation and stability data can be compared against pre-set, encoded and offset criteria.

Allowing the OCR2 tool to verify and judge the acceptance of the string as well as perform date, time, shift and serial code checks.

Compared to the conventional OCR, OCR2 contains many improvements such as support for a built-in library which has typical character shapes pre-stored, improved character extraction capabilities by using library data to extract characters, enhanced calendar reference and zero suppression function, having an added verification function, and enhanced external output function.

Measurement Overview



Main measurement results

The standard results and data returned by OCR2 tool are as follows:



Point

When [Recognition] or [Fixed] is selected for Block Mode, the string is handled by 1 line. The measurement result that corresponds to the second line is only output if [Auto] is selected as the block mode.

Line 1 string	Outputs the character string recognized on the first line. <small>(Tolerance inspection target)</small>
Line 2 string	Outputs the character string recognized on the second line. <small>(Tolerance inspection target)</small>
Line 1 reference string	Outputs the registered character string that is used as judgment criteria for the first line.
Line 2 reference string	Outputs the registered character string that is used as judgment criteria for the second line.
Recognized Character []	Outputs all detected characters. <small>(Tolerance inspection target) (Label specification target)</small>
Reference Character []	Outputs all registered characters which can be used for judgment. <small>(Label specification target)</small>
Number of Characters	Outputs the total number of recognized characters. <small>(Tolerance inspection target)</small>
1st Candidate Character []	Outputs all characters selected as first candidates from the recognition process. <small>(Label specification target)</small>
2nd Candidate Character []	Outputs all characters selected as second candidates from the recognition process. <small>(Label specification target)</small>
1st Candidate Correlation []	Outputs the correlation level (0 to 99) of all first candidate characters from the recognition process based on the library data. <small>(Label specification target)</small>
2nd Candidate Correlation []	Outputs the correlation level (0 to 99) of all second candidate characters from the recognition process based on the library data. <small>(Label specification target)</small>
1st Candidate Library Character Variation No.	Outputs the character variation number of the character pattern that has the highest match percentage for characters selected as first candidates from the recognition process. <small>(Label specification target)</small>
2nd Candidate Library Character Variation No.	Outputs the character variation number of the character pattern that has the highest match percentage for characters selected as second candidates from the recognition process. <small>(Label specification target)</small>
Stability []	Outputs the correlation level (0 to 99) difference between the first and second candidates for all the characters detected by the recognition process. <small>(Label specification target)</small>
Intensity Deviation []	Outputs the character contrast level (0 to 99) for all the extracted regions. <small>(Label specification target)</small>
Number of lines	Outputs the number of lines of characters.
Line 1 Number of Characters	Outputs the number of characters on the first line which have been detected by the recognition process.

OCR2

Line 2 Number of Characters	Outputs the number of characters on the second line which have been detected by the recognition process.
Line 1 Correlation (max)	Outputs the maximum correlation value from the characters detected by the recognition process on the first line.
Line 1 Correlation (min)	Outputs the minimum correlation value from the characters detected by the recognition process on the first line. <small>Tolerance inspection target</small>
Line 1 Stability (max)	Outputs the maximum stability value from the characters detected by the recognition process on the first line.
Line 1 Stability (min)	Outputs the minimum stability value from the characters detected by the recognition process on the first line. <small>Tolerance inspection target</small>
Line 2 Correlation (max)	Outputs the maximum correlation value from the characters detected by the recognition process on the second line.
Line 2 Correlation (min)	Outputs the minimum correlation value from the characters detected by the recognition process on the second line. <small>Tolerance inspection target</small>
Line 2 Stability (max)	Outputs the maximum stability value from the characters detected by the recognition process on the second line.
Line 2 Stability (min)	Outputs the minimum stability value from the characters detected by the recognition process on the second line. <small>Tolerance inspection target</small>
Block position []	Outputs the positions of all extraction blocks in pixels. <small>Label specification target</small>
Inspection region position	Outputs the position of the inspection region in pixels. (Available only for calculation referencing)
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

Reference

For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

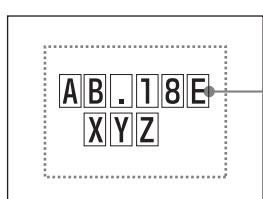
Point

If the Line n string and Line n reference string are specified for the PLC Link, EtherNet/IP, PROFINET, and EtherCAT, each character is stored in 2-word units. However, if they are output as Line n trimmed string and Line n trimmed reference string, four characters are stored in 2 words (Little Endian).

Measurement sample

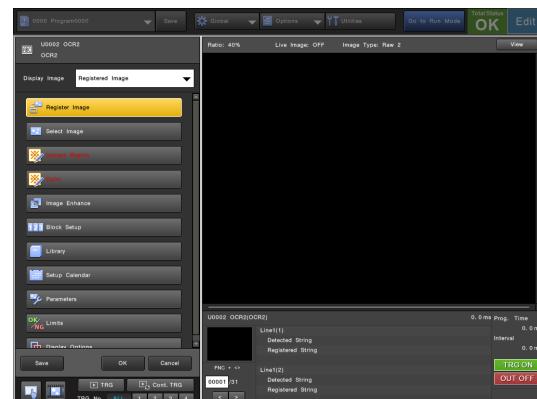
Example showing the results of an OCR2 inspection performed under the following conditions:

- Number of lines: 2
- Number of characters on the first line: 6
- Number of characters on the second line: 3



Top Menu

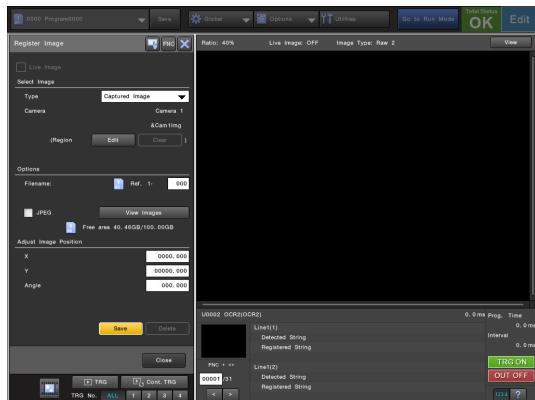
The top menu of the OCR2 tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-237)	Register an image to be used as a template for settings.
Select Image (Page 2-237)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-237)	Define the region to be used for unit processing.
Color (Page 2-238)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-238)	Specify the filter processing to apply to the image.
Block Setup (Page 2-238)	Specify the mode and parameters used for identifying and extracting individual characters in the inspection region.
Library (Page 2-241)	Register, add, delete and update the libraries of character patterns used for recognition.
Setup Calendar (Page 2-241)	Set the offset and allowable error for the calendar tolerance when using calendar form (year, month, day etc.) time information as judgment condition.
Parameters (Page 2-243)	Specify other conditions for the OCR2 tool as required.
Limits (Page 2-245)	Set the tolerance and judgment string for the inspection.
Display Options (Page 2-247)	Specify the display methods for things such as the inspection region and mask region.
Save (Page 2-248)	Save the current state to the program file.

Register Image

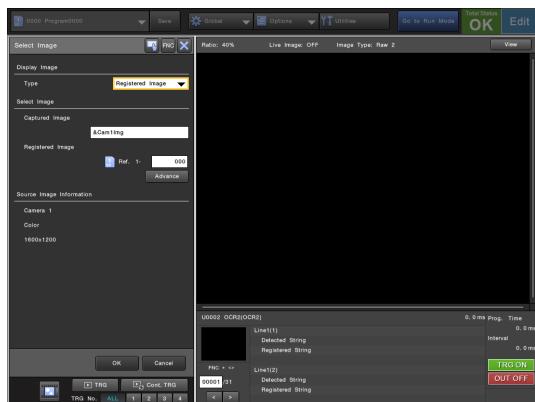
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

Specify the captured image and registered image to use for measurement.



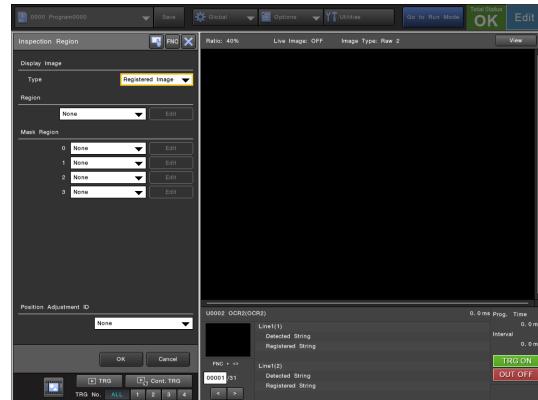
For more details, see "Select Image" (Page 2-471).

Inspect Region

Define the region to be used for unit processing.



- The smaller the inspection region, the shorter the processing time.
- If there is a background in the inspection region other than characters, text may not be correctly extracted. Set the inspection region in such a way that only the characters are enclosed as much as possible.
- Only rectangle, rotated rectangle, or arc inspection regions are available in OCR2 (rotated rectangles and arcs are only available when [Recognition] is selected.)
- The inspection region sizes that are available in OCR2 have the following restrictions:
 - Rectangle: A width of 2432 pixels or less and a height of 2050 pixels or less
 - Rotated Rectangle: The width and the height must be less than the number of pixels for the camera image and the area of the inspection region must be less than 80% of the area of the camera image
 - Arc: The length of the arc must be about 6720 pixels or less, the difference of Radius 1 and 2 must be less than the height of the camera image, and the area of the inspection region must be less than 80% of the area of the camera image
- You cannot use an image region.
- In the XG-X2800LJ, only rectangles can be specified as inspection regions; in other words, rotated rectangles and arcs cannot be specified as inspection regions.



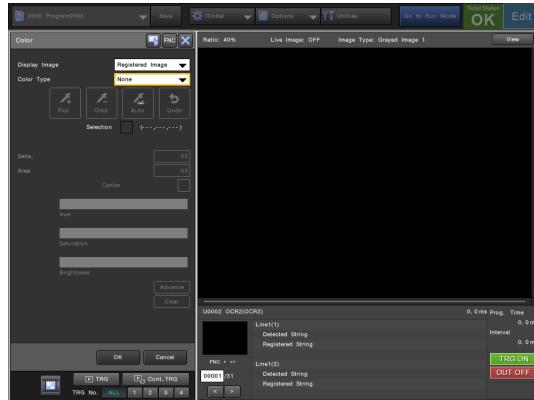
For more details, see "Region Settings" (Page 2-473).

OCR2

Color

When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.

- Point** If the text color is black and the background is white, select [Grayscale] or [RGB Grayscale] to stably extract character strings.

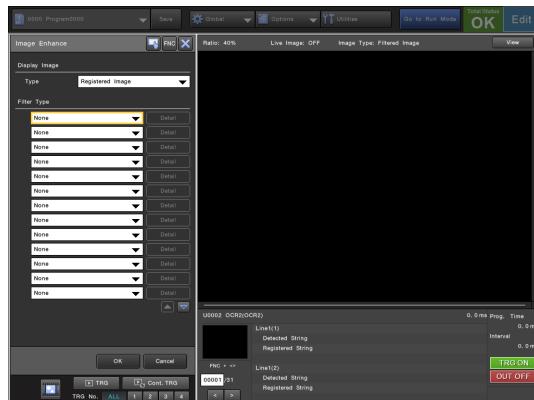


For more details, see "Color Extraction" (Page 2-483).

Image Enhance

Specify the filter processing to apply to the image.

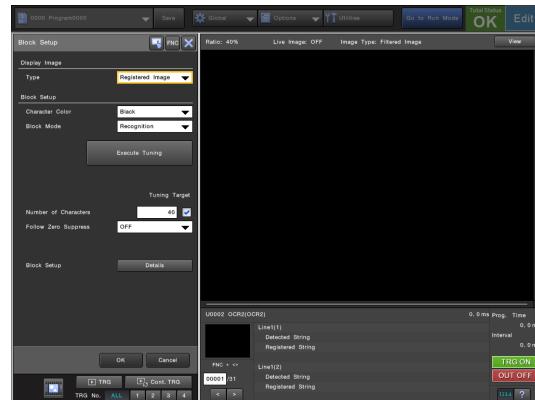
- Point** You cannot select the subtract filter for OCR2 measurement.



For more details, see "Image Enhance" (Page 2-489).

Block Setup

Specify the mode and parameters used for identifying and extracting individual characters in the inspection region.



Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Block Setup

Character Color

Select the color of characters to differentiate them from the background.

- Black** (default): Recognize black-colored parts as characters.
- White**: Recognize white-colored parts as characters.

Block Mode

"Extraction" is the process that separates the character information in the inspection region into individual characters.

A proper extraction process is necessary for correctly recognizing characters for a stable OCR2 inspection.

Select the block mode to extract individual characters properly.

- Recognition** (default): Automatically extracts up to 40 characters on one line from one inspection region.
- Auto**: Automatically extracts up to two lines (maximum of 20 characters per line) from one inspection region. The differential edge waveform from the automatic extraction for each character is displayed on the screen.
- Fixed**: Extract a single line (a maximum of 20 characters) by manually setting a region for each character.

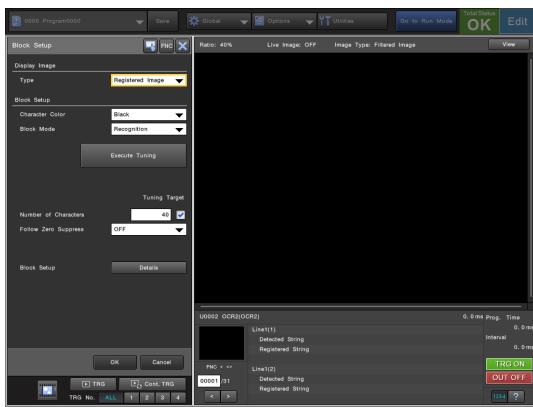
- Point**

- When [Recognition], [Fixed] is selected, the string is handled by 1 line.
- Changing the block mode resets various settings in the [Block Setup] menu.

[Recognition] Block Mode Settings

Point

- If characters cannot be extracted correctly with [Recognition], change the setting as follows:
- Set [Noise Cancellation] (Page 2-244) to [OFF].
 - Reduce the values for [Upper Noise Width] and [Upper Noise Height].
 - Increase the value for [Number of Characters].



Execute Tuning

Automatically adjusts the settings to the setting best suited for character extraction. Only the settings that are selected under [Tuning Target] will be adjusted.

Point

- If there is a setting error, tuning execution will fail.

Number of Characters

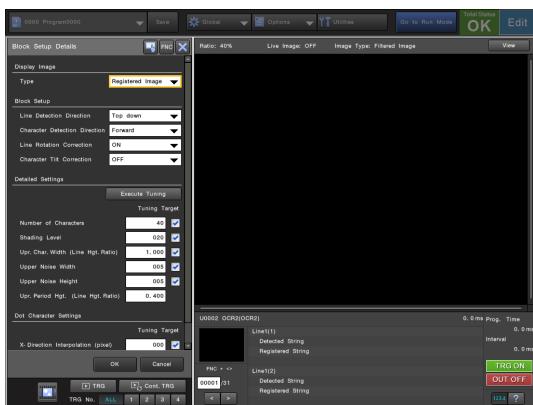
Specify the maximum number of characters (1 to 40) to be extracted from the inspection region (default 40).

Follow Zero Suppress

Makes [Number of Characters] automatically adjust according to the changes in length of the Registered String due to zero suppression (Page 2-242). Set [Number of Characters] based on the length of the longest zero-padded string.

Block Setup

Select [Details] to display the [Block Setup Details] screen and change the detailed recognition settings.



- Type:** Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

- Line Detection Direction:** Specifies the direction for cutting out lines. When the extraction is not properly done due to the noise on the background, extraction may be made possible by changing the line cut out position.

- **Top down:** Extracts the topmost line according to the read direction.
- **Bottom up:** Extracts the bottommost line according to the read direction.
- **Size:** Extracts the line with the greatest height regardless of the character direction.

- Character Detection Direction:** Specifies the direction for cutting out characters. When the characters are not properly extracted due to the noise on the background, extraction may be made possible by changing the cut out direction.

- **Forward:** Extracts the specified number of characters from the beginning of the character string in accordance with the character direction.
- **Reverse:** Extracts the specified number of characters from the end of the line in accordance with the character direction.
- **Size:** Extracts the specified number of characters in the wide character order regardless of the character direction.

- Line Rotation Correction:** If the line height varies because the extracted line is at an angle to the inspection region, select [ON].

- Character Tilt Correction:** If the extracted characters are deformed at an angle (such as italics), select [ON] to correct the tilt.

- Shading Level:** Sets the shading level for the cutout image. When the value is decreased, the characters become darker.

- Upr.Char.Width (Line Hgt.Ratio):** Specifies the upper limit for the width of a blocked character by its ratio against the height of the line. If the space between characters is narrow and two characters are erroneously detected as one, the characters can forcibly be extracted using this setting.

- Upper Noise Width:** Specifies in pixels the upper limit for the character width to treat as noise information. The noise information with a width that is less than the upper limit is excluded from being a block target.

- Upper Noise Height:** Specifies in pixels the upper limit for the character height to treat as noise information. The noise information with a height that is less than the upper limit is excluded from being a block target.

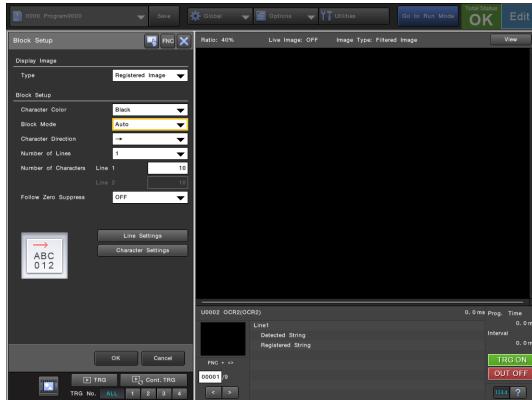
- Upr.Period Hgt. (Line Hgt.Ratio):** Specifies the upper limit for the height of the symbols period (.) and hyphen (-) by its ratio against the height of the line. Use this when periods and hyphens are falsely recognized.

- Dot Character Settings:** Specifies the interpolation settings for the X and Y directions in pixels respectively when interpolating the missing parts of characters such as dot characters and blurred characters before blocking.

[Auto] Block Mode Settings



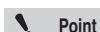
If characters are not properly extracted with [Auto], configure the detailed [Auto] settings by changing [Line Settings] and [Character Settings] or change the block mode to [Fixed] (Page 2-240). See "Stabilizing Character Recognition" (Page 2-249) for more details.



Character Direction

If the string is rotated 90° or more, change the character reading direction in 90-degree increments with reference to the horizontal axis of the image. A reference icon is displayed in the menu showing the character appearance and read direction.

- (Default): Read characters from left to right on the image (normal direction).
- ←: Read characters from right to left on the image (180° rotation).
- ↑: Read characters from bottom to top on the image (90° counterclockwise rotation).
- ↓: Read characters from top to bottom on the image (90° clockwise rotation).



If rotation of the target string is less than 90°, use the position adjustment unit to adjust the inspection region.

Number of Lines

Specify the maximum number of lines (1 or 2) of characters to be extracted from the inspection region (default 1).

Number of Characters

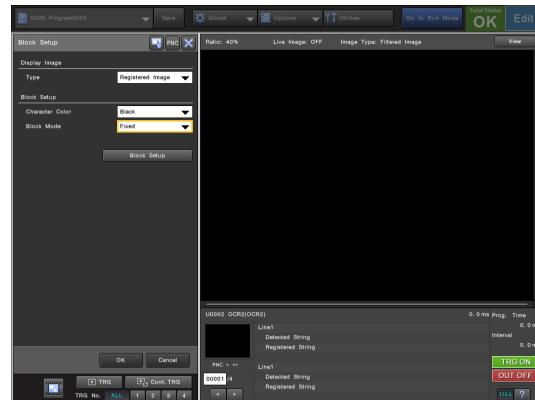
Specify the maximum number of characters (1 to 20) to be extracted from each line (default 10).

Follow Zero Suppress

Makes [Number of Characters] automatically adjust according to the changes in length of the Registered String due to zero suppression (Page 2-242). Set [Number of Characters] based on the length of the longest zero-padded string.

[Fixed] Block Mode Settings

When the characters cannot be extracted properly with the Auto extraction mode, set the block region manually for each character (up to 20 characters).



In the fixed extraction mode, only one line can be extracted in one region.

Block Setup

Select [Block Setup] and [Add], to add a new block. Configure the block region so that it encloses a single character.



- The shape of the block is fixed to a rotated rectangle.
- When position adjustment is used for the fixed extraction mode, the adjustment will be applied to all blocks in the unit.
- Make sure that only one character is included in a block region. Proper recognition cannot be achieved if two or more characters are present in the block.
- Make sure that the region does not go outside of the inspection region. Any part drawn outside the inspection region will not be included and correct extraction may not be possible.



- Refer to "Drawing a Region" (Page 2-474) for more details on drawing a region.
- When you select a block from the list, the value setting menu for [Rotated Rectangle] is displayed, allowing you to edit the region by specifying numerical values.
- To change the order of the blocks, select a block in the list, hold down the No.1 (FUNCTION) button of the handheld controller, and then move the 8-way key up or down.

Delete

Deletes the selected block from the list.

Fine Adjustment

Use fine adjustment to adjust to the character size in the individual block region.

- ON** (Default): Adjust to the actual character size in the region to allow for changing character sizes and a stable comparison.
- OFF**: Extract characters in the region of a specified fixed size.

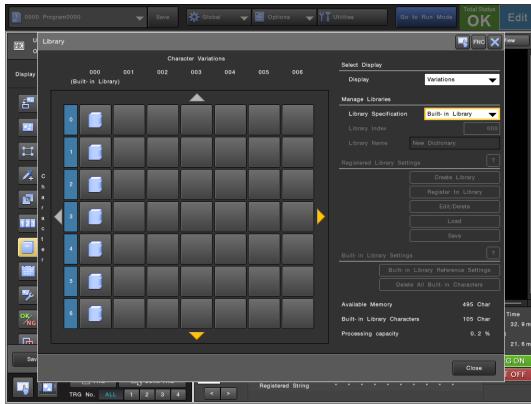


The [Fine Adjustment] setting is applied to all blocks in the inspection region.

Library

Select the library where the character patterns used for character recognition are registered. Besides using the pre-registered built-in library, you can also create and edit libraries as registered libraries.

In addition to alphanumeric characters (0-9, A-Z) and some symbols (such as dash, period, colon and forward slash), up to 20 user-defined characters can be registered in a single library.

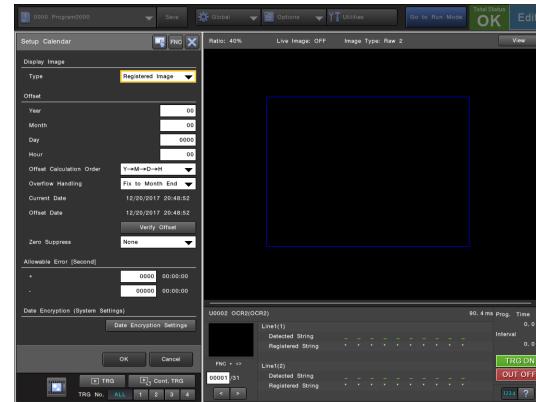


Refer to "Registering Characters for OCR2 Optical Character Recognition (Library Menu)" (Page 2-252) for more details about the library setting.

Reference To read contents of an encoded date/time stamp as a regular character string, register a library then create a conversion table to encode the registered string connected to the internal calendar. See [Date Encryption] (Page 2-242).

Setup Calendar

Set the offset and allowable error for the calendar tolerance when using calendar form (year, month, day etc.) time information as judgment condition.



Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Offset

Add an offset to the value or encoded value of the calendar OK / NG tolerance (Page 2-246) used in the judgment condition string. The offset date and time is displayed at [Offset Date] in the [Setup Calendar] menu.

Year

You can append an offset in the range of ± 10 years.

Month

You can append an offset in the range of ± 12 months.

Day

You can append an offset in the range of ± 1999 days.

Hour

You can append an offset in the range of ± 24 hours.

Offset Calculation Order

Specifies the date and time offset calculation order.

- **Y→M→D→H:** Adds the offset in the order of [Year], [Month], [Day], and [Hour].
- **H→D→M→Y:** Adds the offset in the order of [Hour], [Day], [Month], and [Year].

Overflow Handling

When adding [Year] or [Month] offsets, specify how to handle dates that do not exist.

- Carry Over:** The number of overflow days will be added to the next month.
- Fix to Month End:** Sets the date to the end of the month.
- Fix to Month Start:** Sets the date to the start of the next month.

For example, if the current date is January 31, 2017 and you specified [01] as the offset month, the offset date would become February 31, 2017 if applied as is. As dates after February 28 do not exist, three days would overflow. In this case, each [Overflow Handling] setting would handle this case as follows:

- If you selected [Carry Over]: March 3, 2017 (the three days that overflowed are added to the next month.)
- If you selected [Fix to Month End]: February 28, 2017 (the date is set to the end of the month.)
- If you selected [Fix to Month Start]: March 1, 2017 (the date is set to the start of the next month.)

Verify Offset

You can check the registered string after the offset is calculated for the specified date.

Zero Suppress

Remove zeros from the calendar and calculation tolerances used in the limit settings.

- None** (default): Include zeros.
- Space forward** (when Auto or Fixed block mode is selected) : Replace leading zeros with a space placed at the front of the number.
- Space backward** (when Auto or Fixed block mode is selected) : Replace leading zeros with a space placed at the back of the number.
- Remove zeros**: Remove all leading zeros.



- Zeros in both digits of the 2-digit year are exempt from zero suppression regardless of the setting.
- [Space forward] and [Space backward] can only be selected when [Fixed] or [Auto (Ratio)] is selected for Block Mode. If [Auto (Waveform)] is used, the space will not be extracted and the result will always not match the tolerance because a space is also a part of tolerance judgment.

Example: Conversion result of the registered character string using zero suppression

Zero suppression setting	Date & time tolerances	Calculation tolerance	Note
None	08/08/25	00350	
Space forward	08/_/25	_350	Use either of these two options when [Fixed] or [Auto (Ratio)] is used.
Space backward	08/8/_25	350_	
Remove zeros	08/8/25	350	

Underscore "_" is considered as a space.

Allowable Error [Second]

With regard to the judgment result for the calendar tolerance and encoded calendar tolerance (Page 2-246), specify the allowable difference between the controller's internal date & time and the inspected target's marked date & time at the turn of the date or time. Specify the allowable difference in the range of -99999 to 3599 seconds in terms of absolute value.

Example: Judgment results when the allowable error is set to ±60 seconds at the turn of the day

Current internal calendar time	2016.12.31		2017.1.1	
	~23:58:59	23:59:00 ~23:59:59	0:00:00 ~0:01:00	0:01:01~
Printing 2016/12/31	OK		OK	NG
Printing 2017/1/1	NG	OK	OK	

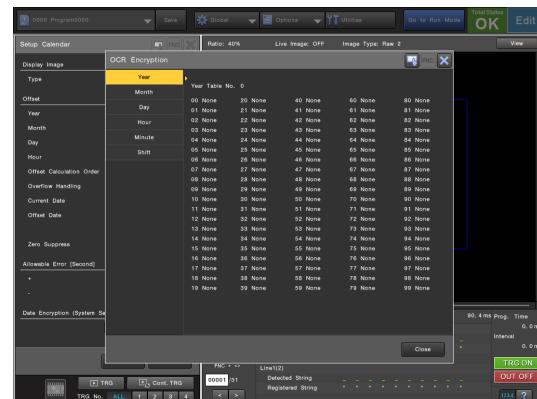
← Allowable error -60 seconds → ← Allowable error +60 seconds →

Date Encryption (System Settings)

Users can create a conversion table to decrypt the data read by the OCR2 unit when an encrypted date, time, or shift is printed on a target. Use this conversion table to keep the encoded registered string and the internal calendar linked and thus allow encoded date and time stamps to be read as normal character strings.



- The date/time encryption settings are saved as system settings data. Note that they are not included in the program data.
- When performing reading that supports date and time encryption, set the conversion table here, and then set the date/time encoding calendar tolerance to the registered character string of the OCR2 unit. For more details, see "Limits" (Page 2-245).



Create a conversion table for each conversion target unit (Year to Minute, Shift). Up to 10 conversion tables can be created per unit. Changing conversion tables is an easy way to manage when different inspection targets use different encoding patterns.

Point

- Characters for which the replacement text field is empty in the conversion table referenced will be handled as if they were unset in the registered string. Unset characters are removed and the remaining characters move forward to take their place. Additionally, if the entire registered string is unset, it will be read as blank space.
- You can enter up to 4 single-byte characters for replacement text. The following single-byte characters can be used.
0 to 9, A to Z, "-", ".", ":" , "/", "(", ")" , "+", a to t
(correspond to special characters ① to ⑩), space

Year

Specify a table number (0 to 9) and register a character string for each year (two digits) to be replaced.

Month

Specify a table number (0 to 9) and register a character string for each month to be replaced.

Day

Specify a table number (0 to 9) and register a character string for each day to be replaced.

Hour

Specify a table number (0 to 9) and register a character string for each hour to be replaced.

Minute

Specify a table number (0 to 9) and register a character string for each minute to be replaced.

Shift

Specify a table number (0 to 9) and register the replacement character string to the set time frame. Create a conversion table that indicates a specified period of time as a character, such as 9:00 to 12:00 as A, 12:00 to 15:00 as B or 15:00 to 18:00 as C.

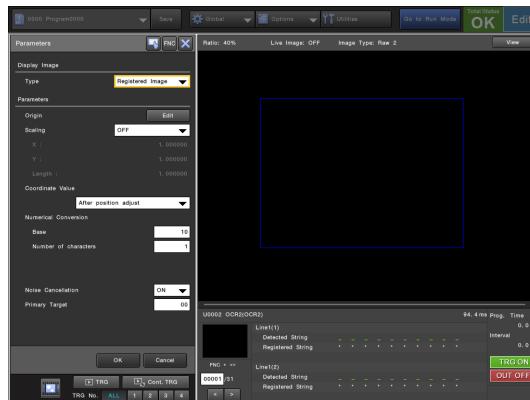
- Select [Add] under [Shift], and then register the replacement start time and replacement text together. Each table can encode up to 24 replacements.
- Specifying the replacement start time and corresponding replacement text in [Shift] will register them to the shift table. Repeating this operation will fragment the time frame, allowing you to register up to 24 replacement sets.

Point

By specifying the leading time in the [Sort] field, you can rearrange the display order of the shift table in order after the leading start time.

Parameters

Specify other conditions for the OCR2 tool as required.

**Display Image****Type**

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Parameters**Origin**

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

Reference

The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels. The result data and setting parameters used for display, judgment and calculations can be converted and scaled to real life values and dimensions by using the pre-set scaling factor option.

- **OFF** (default): Do not use scaling.
- **ON**: Use scaling.

Reference

- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate Value

Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- **After position adjust** (Default): The inspection uses the adjusted coordinate axes determined after position adjustment.
- **Before position adjust**: The distance from the position specified for the [Origin] of the inspection is used.

Numerical Conversion

Specify the number base and number of recognized characters used for conversion of numerical variables to string tolerances used in the limit settings.

- **Base**: Set the number base (10 to 36) used for converting the value of the reference variable into the calculation tolerance (Default: 10).

Example: Numerical conversion when Base is set to base 36

Calculation result	0	to	9	10	to	35
Calculation tolerance	0	to	9	A	to	Z

- **Number of Characters**: Specify the number of characters to use for the calculation tolerance after the conversion (1 to 6, default: 1).



The portion of the converted value that exceeds the set number of characters is not reflected to the tolerance. (Example of when the Base is 10 and the Number of characters is 2: the Calculation result 350 results in the Calculation tolerance being 50)

Mirror Invert (when [Auto], [Fixed] is selected)

Use mirror invert to properly recognize and process inverted characters for images that are captured with a mirror or through a prism.

- **OFF** (default): Do not recognize mirrored characters.
- **ON**: Recognize mirrored characters.



- The reading direction of Auto blocking will also change as a result of mirror inversion. The reading direction is shown by the icon in the [Block Setup] menu (Page 2-238).
- If [Mirror/Rotate Image] is used in the capture unit (Page 2-29), this mirror inversion is applied to the mirrored/rotated image.

Intensity Deviation Lower Limit

(when [Auto], [Fixed] is selected)

Specify the lower limit of character contrast deviation (0 to 255) for detecting characters and blank spaces. If the noise elements in the background are being recognized as characters, increase the lower limit. If the contrast between the character and its background is low and the character is being recognized as a space, decrease the lower limit.

Noise Cancellation

Exclude noise on the border of the block that can cause the fine adjustment function (Page 2-240) to work incorrectly.

- **ON** (Default): Exclude noises on the border during fine adjustment.
- **OFF**: Include noise on the border during fine adjustment.

Primary Target

Specify the primary target to be used for judgment result processing from all the characters detected in the recognition processed based on their sequence (0 (default) through 39).

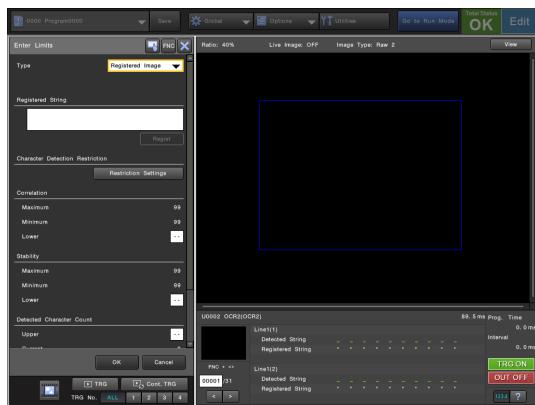


The primary target reference numbering numbers the characters sequentially from the first character of the first line up to the last character of the second line in the direction of reading.

Limits

Specify pass / fail strings and tolerances settings for the OCR2 inspection.

If the detected string does not match the registered string, or the measured value is outside the set tolerance, the inspection result will be "NG". If the detected string matches the registered string and the measured values satisfy the set tolerances, the inspection result will be "OK". By changing the [Detection Target Character Settings] settings, the available characters used for comparison can be limited as required for controlled comparison.



Select the desired tolerance and then enter a value.

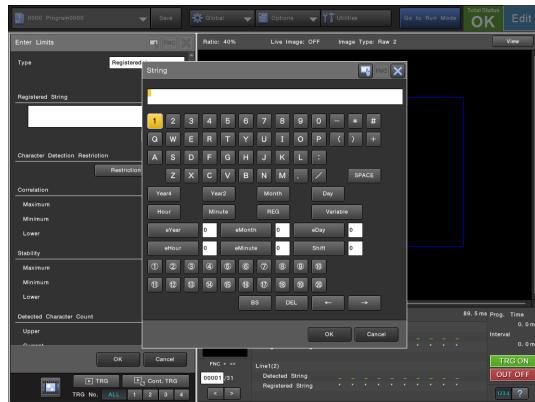
- If no limits or tolerances are set the unit will result in a pass (OK).
- The unit of tolerance varies depending on the limit parameter.



Point When a character is judged as "?" (recognition impossible), the result will be NG even if [Registered String] is blank if the Correlation or Stability lower limit is set.

Registered String

Register a string for judging the characters detected by the extraction process against. Input up to 40 characters and symbols (when [Recognition] is selected) or 20 characters and symbols (when [Auto] or [Fixed] is selected) as text.



- Fixed characters can also be combined with reference tolerances, which automatically change in coordination with external information such as date and time, and calculation tolerances, which refer to variables.
- REG (registered tolerance) can only be used by itself.

Special Characters and Wildcards

The following special options can be used.

- **SPACE**: Indicates a space.
- *****: When Correlation or Stability is set, this deems an unrecognizable state as NG while other characters are deemed OK.
- **#**: Regardless of the recognition result, the character in the position of # is not judged and is always deemed as OK. Example: Differences in results when using "*" versus "#"

Recognition result	Registered String	
	ABC*	ABC#
ABCD	→ OK	OK
ABC8	→ OK	OK
ABC?	→ NG	OK

The results are different when the correlation or stability of the fourth character goes below the lower limit, and cannot be recognized.

- **REG** (registered tolerance): A specific set of characters is set as the judgment string based on the registered or captured image. Selecting [Register] registers the detected characters from the current display image as the judgment string.



- The registered tolerance cannot be used in combination with other fixed characters or other tolerance types.
- When the captured image is selected for the display image and there is no previous result, SPACE (blank) is used for REG.

Calculation Tolerance (variable reference)

The numerical variable values are converted into character string tolerances. The conversion method follows the numerical conversion (Page 2-244) settings.

- Variable:** Specify a numerical type variable to register to the judgment string.

Example: For judging a 7-character string composed of a fixed text ("TEST") plus a 3-digit serial number (#Count01) to which 1 is added at each inspection in the Calculation unit (Numerical Conversion: base 10 / 3 digits, Zero Suppress: None.)

Registered String	Judgment string
TEST#Count01	→ TEST000-999 (reverts to 000 after 999)

Point Only numerical type variables can be specified.

Date & time tolerances

The following date and time functions from the internal calendar and clock can be used in the string judgment.

- Year4:** Four digit calendar year
- Year2:** Two digit calendar year
- Month:** Two digit month
- Day:** Two digit day
- Hour:** Two digit hour
- Minute:** Two digit minute

Example: Verifying the year/month/day (April 1, 2016) using the internal calendar tolerances.

Registered String	Judgment string
Year4/Month/Day	→ 2016/04/01

This example uses both calendar tolerance and a fixed character "/".

Reference

- A user-specified offset and allowable error can be set for the date/time functions of the internal calendar. See "Allowable Error [Second]" (Page 2-242) for more details.
- Zero suppression (Page 2-242) can be set for the Month, Day, Hour, and Minute.

Encrypted date, time and shift tolerances

The text mapped against the date, time and shift pattern in the encryption table can be used for string judgment. The number used in parentheses represent the encryption table number.

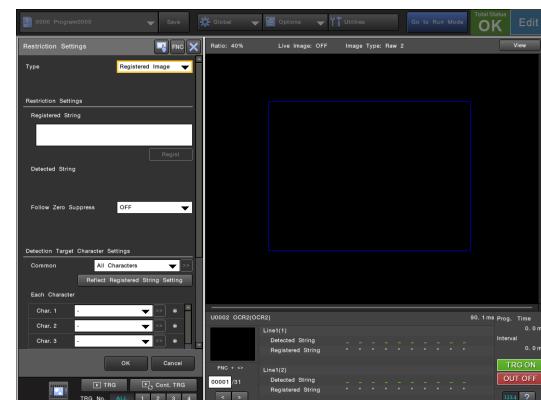
- eYear ()**: Correlates to the year in the encryption table.
- eMonth ()**: Correlates to the month in the encryption table.
- eDay ()**: Correlates to the day in the encryption table.
- eHour ()**: Correlates to the hour in the encryption table.
- eMinute ()**: Correlates to the minute in the encryption table.
- Shift ()**: Correlates to the shift in the encryption table.

Reference

A desired offset or allowable error for the transition can be set for the date/time encoding calendar tolerance. See "Allowable Error [Second]" (Page 2-242) for more details.

Character Detection Restriction

Select [Restriction Settings] and set the restrictions for recognized characters to be used as reference characters. Normally, all the characters registered in the library are used for character recognition. However, in the case where only specific characters are to be recognized and judged, the characters to reference can also be limited. By limiting the reference characters, the processing speed may be improved and false recognitions may be resolved. In addition to setting common settings for all characters, you can also set restrictions for each recognized character.



Restriction Settings

- Registered String:** Registers a string for judging the characters detected by the extraction process against. Input up to 40 characters and symbols as text.
- Register:** Registers the character recognition results for the current display image as the judgment string if REG (registered tolerance) is used as the registered string.
- Follow Zero Suppress:** Makes the restriction settings automatically adjust according to the changes in length of the Registered String due to zero suppression. Set the restriction settings based on the length of the longest zero-padded string. For example, if the current date is February 1, 2017, and Zero Suppress is set to [Remove zeros] and Registered String to [Year4/Month/Day], the zero-suppressed judgment string is 2017/2/1 (eight characters) but the longest string for which zero padding was applied is 2017/02/01 (10 characters).

Detection Target Character Settings

Specify valid characters (characters to reference in the library).

- Common:**

- **All Characters:** Use all the characters stored in the library for recognition.
- **Character Groups:** Use only the types of characters in the judgment string for recognition. The type relates to either an alphabetical, numerical, symbol or special character. For example, the recognition of character "A" uses only the library data for alphabetical characters A to Z.
- **Specified Order:** Use only the characters in the judgment string for recognition.
- **Specified Characters:** Use only selected characters for recognition.
- **All Numbers:** Use only numbers for recognition.
- **All Letters:** Use only letters for recognition.
- **All Symbols:** Use only symbols for recognition.
- **All Special Characters:** Use only special characters for recognition.

Reference

The limiting of character types can also be applied to each character individually by specifying in the fields under [Each Character]. When the Registered String contains a mix of fixed characters and changing characters, this is convenient as a setting that is different from the rest can be applied to only the character whose setting was changed under [Each Character].

Point

When REG (registered tolerance) is used for the judgment condition string, do not change the reference character setting from [All Characters]. Selecting other options may result in improper character recognition.

- **Reflect Registered String Setting:** Automatically sets valid characters by character from the characters used in the registered string.
- **Each Character:** You can specify valid characters by character in the order they appear in the registered string.

Correlation

Enter the lower limit for the minimum correlation % match of all recognized characters. If the correlation or stability value is below the lower limit after cross referencing with the library, "?" is output to indicate that the character is unrecognizable and the inspection result is NG.

Stability

Enter the lower limit for the minimum stability of all recognized characters. If the correlation or stability value is below the lower limit after cross referencing with the library, "?" is output to indicate that the character is unrecognizable and the inspection result is NG.

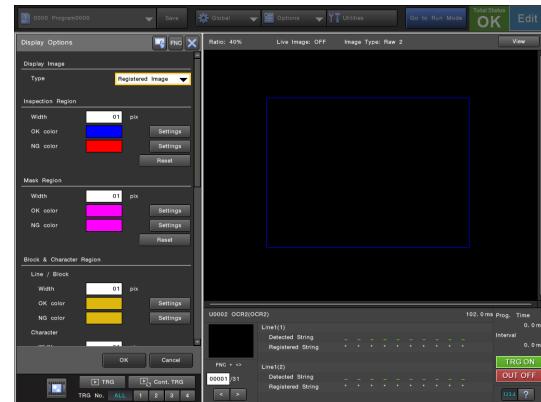
Detected Character Count

Enter the upper limit and lower limit for the total number of recognized characters. To make the upper and lower limits of Detected Character Count adjust according to the zero suppression processing, select [ON] in the [Follow Zero Suppress] field.

Display Options

Specify the display methods for things such as the inspection region and mask region.

You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection Region

Specify the line width and display color of the inspection region.

Mask Region

Specify the line width and display color of the mask region.

Block & Character Region (when [Recognition], [Auto] is selected)

Line / Block

Specify the line width and display color of the block region.

Character

Specify the line width and display color of the character region.

Block & Character Region (when [Fixed] is selected)

Fixed block region

Specify the line width and display color of the block region.

Fixed block region (fine adjusted)

Specify the line width and display color of the adjusted block region when [Fine Adjustment] (Page 2-240) is set to [ON].

Block Extraction

Block Extraction

Select whether to display the character extraction waveform.

- **ON** (default): Show the character extraction waveform.
- **OFF**: Hide the character extraction waveform.

Wave

Specify the width and display color of the character extraction waveform.

Frame

Specify the width and display color of the frame.

Threshold

Specify the width and display color of the line representing the block threshold.

Minimum wave height

Specify the width and display color of the line representing the minimum wave height.



Setting [Block Extraction] to [ON] consumes additional program memory. Check the amount of remaining program memory before enabling.

Cutout Image Display (when [Recognition] is selected)

Specify the display color of the extracted characters.

Reset

Returns the display options to their defaults.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

Stabilizing Character Recognition

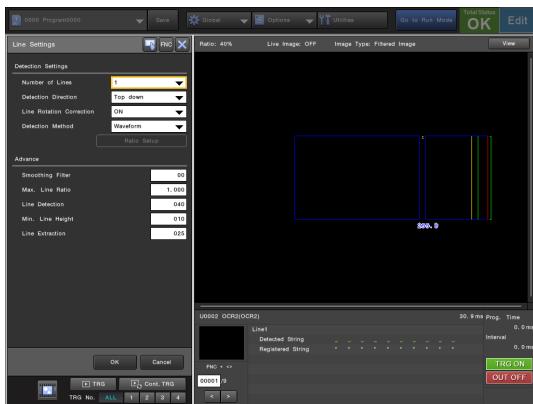
The auto extraction mode extracts characters (lines) by detecting the space between characters (lines) from the extraction waveform. If the spaces are too narrow or the characters (lines) are slanted, the waveform line may overlap and correct extraction may not be possible. To make extraction possible and stable, the extraction method can be set to [Fixed] or the detailed auto extraction settings can be adjusted in [Block Setup] while checking the displayed waveform.

Changing the [Line Settings]

Adjustments can be made to the methods used for line extraction.

1 Select [Line Settings] in the [Block Setup] menu.

The [Line Settings] menu appears.



2 For [Number of Lines], specify the number of lines (1 or 2) to extract from the inspection region.

3 For [Detection Direction], select the extraction direction.

Changing this option may help when extraction fails due to background noise.

- **Top down:** Extract the specified number of lines from the top with reference to the reading direction.
- **Bottom up:** Extract the specified number of lines from the bottom with reference to the reading direction.
- **Size:** Extract the specified number of lines in descending order of line height regardless of the reading direction.

4 If the line height varies due to the string being at angle to the inspection region, switch [Line Rotation Correction] on for rotation correction.

- **ON:** Enable rotation correction.
- **OFF:** No rotation correction.

- Point**
- The rotation correction is suitable for approximately $\pm 15^\circ$ of rotation. If the angle of the line to the inspection region is greater, use position adjustment.
 - If rotation correction is used, the rotation will be reflected in the character block region as well.

5 If the line extraction is unstable (due to the space between lines being narrow, etc.), choose the appropriate extraction method in [Detection Method].

- **Waveform:** Extract a line by detecting spaces based on changes in the line extraction waveform.
- **Ratio:** Extracts the line at a specified ratio to the projected waveform width of the entire line. This is effective when the ratio of the line height is constant even when the line space is small.

Point When the number of lines changes, do not select [Ratio]. Ratio specification forcibly extracts the specified number of lines regardless of the actual number of lines in the inspection region. This may cause false recognition.

Specifying the ratio

When [Ratio] is selected, [Ratio Setup] allows the setting of the line ratio.

- **Start:** Specify the start position of line extraction as a percentage ratio of the overall line extraction waveform (000.00 to 100.00).
- **Line Sep.** (only when the [Number of Lines] is set to 2): Specify the separation distance of line 1 and line 2 as a percentage of the overall line extraction waveform (000.00 to 100.00).
- **End:** Specify the end position of line extraction as a percentage ratio of the overall line extraction waveform (000.00 to 100.00).

Point The specified ratio returns to the default value if the [Number of Lines] setting is changed.

6 Change detailed waveform generation settings as necessary.

Typically, the extraction waveform generation method does not need to be changed. However, adjusting the generation method may improve the extraction result.

Smoothing filter

To aid proper character extraction of dot based characters, the number of times to apply the smoothing filter can be changed from 0 to 99. Increasing the smoothing filter increases the number of rows of pixels used in the generation of the line extraction waveform. This can subsequently lower the detection sensitivity for narrow gaps.

Max. Line Ratio

If two lines are being accidentally extracted as one due to a narrow line spacing, setting the [Max. Line Ratio] (0.100 to 1) enables the system to analyze the line extraction waveform and force the line height to be equal to the ratio of the inspection region or less ensuring separation of the two lines.

Reference This setting is displayed as a green (orange when the item is selected) bracket next to the line extraction waveform.

Line Detection

Specify the lower limit line detection threshold (0 to 255) to remove unwanted noise from the generated waveform used for line extraction.

Lowering the threshold increases the extraction sensitivity, but may increase the influence of noise.

Reference This setting is displayed as a straight green line across the line extraction waveform.

Min. Line Height

Specify the lower limit of the line height, equivalent to the width (0 to 255 pixels) used for line extraction from the generated waveform.

Setting the [Min. Line Height] eliminates noise in the extraction waveform.

Reference This setting is displayed as a yellow bracket next to the line extraction waveform.

Line Extraction

Specify the lower limit for taking a waveform as target for line extraction by means of the difference (0 to 255) from the line detection threshold. Waveforms with a maximum intensity below the lower limit can be excluded from the extraction targets.

Reference This setting is displayed as a straight yellow line across the line extraction waveform.

7 Select [OK].

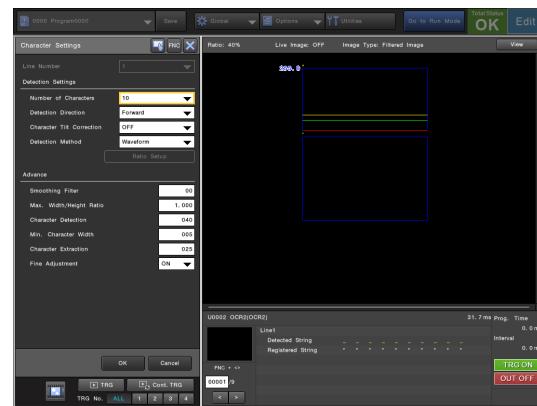
The [Block Setup] menu reappears.

Changing the [Character Settings]

Adjustments can be made to the methods used for character extraction.

1 Select [Character Settings] in the [Block Setup] menu.

The [Character Settings] menu appears.



2 Select the line number (1 or 2) in [Line Number] to change the character settings for.



This option cannot be selected when [Number of Lines] is set to 1.

3 Specify the number of characters (1 to 20) in [Number of Characters] to extract from the inspection region.

4 Using [Detection Direction], select the extraction direction.

Changing this option may help when character extraction fails due to background noise.

- **Forward:** Extract the specified number of characters from left to right with reference to the reading direction.
- **Reverse:** Extract the specified number of characters from right to left (typically reverse reading) with reference to the reading direction.
- **Size:** Extract the specified number of characters in the descending order of character width regardless of the reading direction.

5 If the characters are deformed or offset at an angle (such as italics), set [Character Tilt Correction] to on.

- **OFF:** No sloped character correction
- **ON:** Sloped character correction



The tilt correction can correct up to about $\pm 20^\circ$ of character tilt but does not correct for rotated characters.

6 If the character extraction is unstable (due to narrow character spacing, etc.), choose the appropriate extraction method in [Detection Method].

- **Waveform:** Extract a character by detecting spaces based on changes in the character extraction waveform.
- **Ratio:** Extracts the character at a specified ratio to the projected waveform width of all the characters. This is effective when the ratio of the number of characters and the character width is constant even when the character space is small.



Point When the number of characters changes, do not use [Ratio]. As it forces the OCR2 tool to extract a specified number of characters regardless of the actual number of characters in the inspection region, this may cause false recognition.

Specifying the ratio

When [Ratio] is selected, [Ratio Setup] allows the setting of the character ratio.

- **Start:** Specify the start position of character extraction as a percentage ratio of the overall character extraction waveform (000.00 to 100.00).
- **n-n+1:** Specify the separation distance of the "n" th character and the "n+1" character as a percentage of the overall character extraction waveform (000.00 to 100.00).
- **End:** Specify the end position of character extraction as a percentage ratio of the overall character extraction waveform (000.00 to 100.00).



Point The specified ratio returns to the default value if the [Number of Characters] setting is changed.

7 Change detailed waveform generation and character extraction settings as necessary.

Typically, the character extraction waveform generation method does not need to be changed. However, adjusting the generation method may improve the character extraction result.

Smoothing Filter

To aid proper character extraction of dot based characters, the number of times to apply the smoothing filter can be changed from 0 to 99. Increasing the smoothing filter increases the number of columns of pixels used in the generation of the character extraction waveform. This can subsequently lower the detection sensitivity for narrow character gaps.

Max. Width/Height Ratio

If two characters are being accidentally extracted as one due to narrow character spacing, setting the [Max. Width/Height Ratio] (0.100 to 9.999) enables the system to analyze the character extraction waveform and force the character width to be equal to the ratio of the character height or less ensuring character separation.



This setting is displayed as a green (orange when the item is selected) bracket next to the character extraction waveform.

Character Detection

Specify the lower limit character detection threshold (0 to 255) to remove unwanted noise from the generated waveform used for character extraction.

Lowering the threshold increases the extraction sensitivity, but may increase the influence of noise.



This setting is displayed as a straight green line across the character extraction waveform.

Min. Character Width

Specify the lower limit of the character width, equivalent to the width (0 to 255 pixels) used for character extraction from the generated waveform. Setting the [Min. Character Width] eliminates noise in the character extraction waveform.



This setting is displayed as a yellow bracket next to the character extraction waveform.

Character Extraction

Specify the lower limit for taking a waveform as target for character extraction by means of the difference (0 to 255) from the character detection threshold.

Waveforms with a maximum intensity below the lower limit can be excluded from the extraction targets.



This setting is displayed as a straight yellow line across the character extraction waveform.

Fine Adjustment

By using the actual character size to make fine adjustments to the size of the block region that was determined through the waveform, the influence of character size changes on the correlation value is reduced.

- **ON:** Reflects the actual character size to the block region
- **OFF:** Do not use fine adjustment

8 Select [OK].

The [Block Setup] menu reappears.

Registering Characters for OCR2 Optical Character Recognition (Library Menu)

While a built-in library can be used with the OCR2 unit, you can also register character patterns as a registered library if detecting characters using the built-in library is not stable. In addition to alphanumeric characters (A-Z, 0-9) and some symbols (such as dash, period, colon, forward slash), up to 20 user-defined characters can be registered in a single library.

Some functions in the Library menu and the sub-menu [Library] of the Edit Unit Menu work and behave differently. Refer to "Difference Between Sub Menus of the Edit Unit Menu and Other Built-in Menus" (Page 2-15) for further details.



The following operations are carried out after the current unit has been processed. Processing resumes after the operation has been completed.

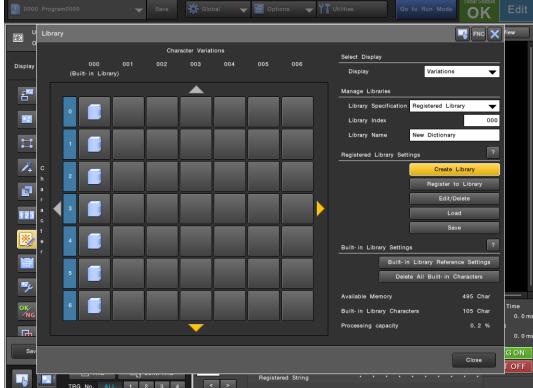
- Opening and closing the Library menu
- Register Individually/Register All
- Library index changes
- Library name changes
- Library deletion
- Loading and saving the library
- Enable/Disable
- Built-in Library Reference Settings
- Add/Delete All Built-in Library Characters



• Foreign characters, pictogram, or custom pattern can also be registered as user-defined characters.

• User-defined characters are displayed and managed by ID number (1) to (20) on the screen.

- 1 To register character patterns to a library, convert library specifications to a registered library.**
- 2 Select in [Library Index] the destination library (0 to 999) to register characters to.**



To use the OCR2 tool, character data must be registered in a library. If all character data has been removed from the selected library, the OCR2 tool will not work properly and return "?????" as the result.

Changing the list format

The display format can be changed using [Display].

- **Variations** (default): Displays the list of the registered characters in matrix format.
- **Registered**: Displays the registration status of each character.

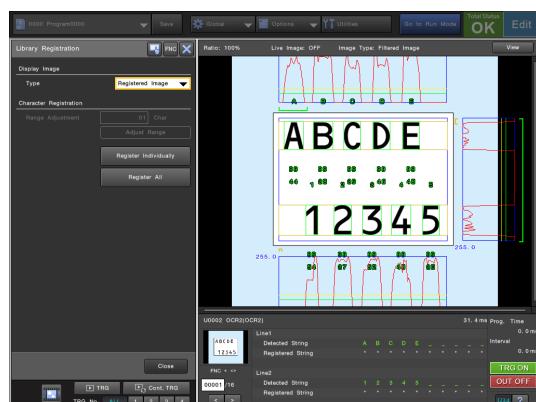
Changing the library name

Select [Library Name], and then enter the desired name (up to 60 single-byte characters).

3 To register a new library, select [Create Library].

4 Select [Register to Library].

The [Library Registration] menu appears.



If a library for the specified number does not exist, you cannot select [Register to Library], [Edit/Delete], and some other settings. Select a valid library or create a new library.

5 Choose the image to extract characters from.

- **Registered Image**: Displays the registered image of the OCR2 Unit specified in [Unit ID Selection].
- **Captured Image**: Displays the current image of the OCR2 Unit specified in [Unit ID Selection].
- **Archived Image**: Displays an image from the image archive of the OCR2 Unit specified in [Unit ID Selection] (only displayed in the Library menu). When there are multiple images registered in the image archive, toggle through the images by holding down the No. 1 (FUNCTION) button while moving the 8-way key left or right. If [Display Info] is set to [ON] when an archived image is selected, the total count, inspection date and time, and inspection result (string, correlation level, and extraction waveform) from the result data archived together with the image will be displayed.

6 Choose the character registration method.

The following methods can be used for character registration.

Character Registration:

- Register Individually:** Allows extracted characters to be registered one by one.
- Register All:** Allows registration of all the extracted characters together as a string.

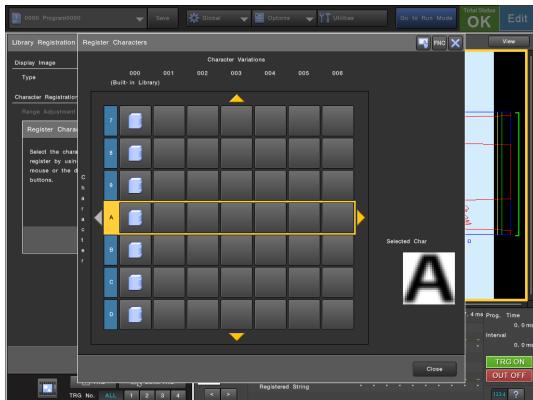


Up to 600 characters (a maximum of 200 characters for one character type) can be registered in one library, but is dependent on the processing memory available.

7 Register the extracted character.

When [Register Individually] is selected

Select the character to be registered and then select the [Register] button. The [Register Characters] menu appears. Choose a row to register the character to and press the No.0 (ENTER) button. Repeat until all the required characters are registered.

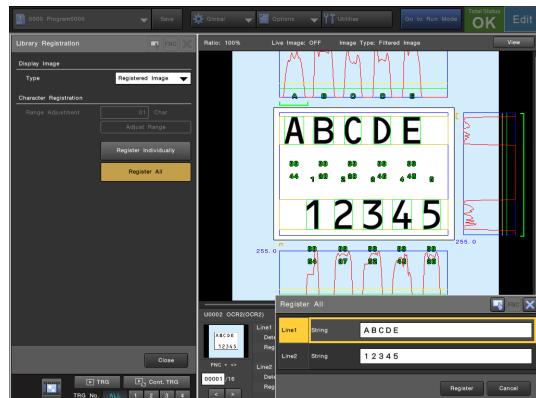


If multiple character registrations are made for one character type, the additional characters are automatically registered as character variations. Registering several variations of a character allows more stable recognition when there are changes in the character, by finding the closest matching character from the registered variations.

When [Register All] is selected

The [Register All] menu appears.

Each currently extracted line of detected string is automatically input as a string to be registered. Correct any errors before registering the string.



- Exclude any undesired characters from the string by using an asterisk "*".
- If more than one of the same character exists in the extracted string, the repeated characters will be registered as character variations. To avoid repeated characters being registered, use an asterisk "*" in their place.

8 When registration is complete, select [Close].

The screen reverts to the [Library] menu.



- If the same image is registered to several different character types in the library, the character with the smallest ASCII code is output as the result. To avoid such mismatches, do not register the same image to different character types.
- If the OCR2 unit recognizes a character registered as a user-defined character, (1) to (20) is displayed on screen, and the lower case "a" to "t" are used for output and decimal conversion.

9 Select [Close].

Editing and deleting registered characters

Characters in the library can be edited or deleted using the procedure below.

 **Point** Deleted characters cannot be restored.

1 Select [Edit/Delete] on the [Library] menu.

The [Edit/Delete] menu appears.

 **Point** If a library for the specified number does not exist, you cannot select [Edit/Delete]. Select a valid library or create a new library.

2 Perform the necessary operation.

Enable/Disable

Temporarily enables or disables the selected character pattern. An X is used to show the character has been disabled. It can be enabled again later on since the data itself is not deleted.

Delete Character

Deletes the selected character pattern. If the pattern is from the built-in library, the built-in library data will be disabled but not deleted (user library data will be deleted).

Delete Variation

Deletes all the variations for a character type. If built-in library data is included, the built-in library data will be disabled but not deleted (user library data will be deleted).

Delete All

Deletes all the characters from the selected library. All built-in library data will be disabled (they will not be deleted).

 **Point** If the library is saved after deleting all the characters, any OCR2 units that reference the library will return "????" as the recognition result and correct inspection cannot be done.

3 Select [Close].

Loading library data from an SD card

To load library data saved on an SD card use the procedure below.

 **Point**

- The loaded data is added to the library currently selected. If the data to be loaded is to be used on its own setup, select a new library to load the data into.
- Library data created from different resolutions of cameras can be loaded into the library. However, please check the operation after loading the data to verify whether character recognition can be performed correctly or not using the library data that was loaded.

1 Select [Load] on the [Library] menu.

The [Load] menu appears.

2 Select the folder that contains the library data.

3 Select [Execute].

The library data is loaded from the SD card, and added into the current library.

 **Point** Execute is disabled if the library file (xgdic.dat) is not present in the folder specified in Step 2.

Saving library data to an SD card

To save the registered library data to an SD card for use by other programs or controllers, follow the procedure below.

1 Select [Save] on the [Library] menu.

The [Save] menu appears.

2 Select the save destination.

3 Select [Execute].

The library data is saved to the specified folder on the SD card.

 **Reference** The library data is saved to the specified folder with the file name "xgdic.dat".

 **Point** Do not change the file name "xgdic.dat". If the library filename is changed from xgdic.dat, it will not be recognized by the controller.

Referencing and deleting characters of the built-in library

Built-in Library Reference Settings

Set whether to enable or disable the built-in library for each character type.

Delete All Built-in Characters

Deletes from the library file specified by the library number all the registered character patterns which were taken from the built-in library.

Add Built-in Library Characters

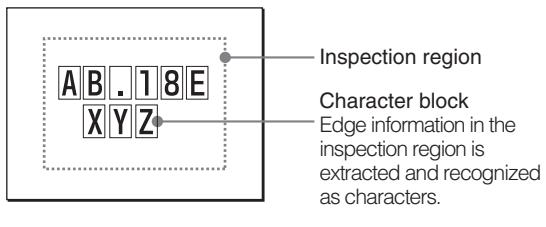
Adds the built-in library to the library file specified by the library number.

OCR

OCR Tool

A string of characters in the inspection region can be recognized, extracted and verified against a series of libraries and character variations stored in the program. The recognized string can be directly output to an external device or the string, along with its correlation and stability data can be compared against pre-set, encoded and offset criteria. Allowing the OCR tool to verify and judge the quality of the string as well as capabilities for performing date, time, shift and serial code checks.

Measurement Overview



Main measurement results

The standard results and data returned by OCR tool are as follows:

Line 1 string	Outputs the character string recognized on the first line. <small>(Tolerance inspection target)</small>
Line 2 string	Outputs the character string recognized on the second line. <small>(Tolerance inspection target)</small>
Line 1 Reference string	Outputs the registered character string that is used as judgment criteria for the first line.
Line 2 Reference string	Outputs the registered character string that is used as judgment criteria for the second line.
Recognized Character []	Outputs all detected characters. <small>(Tolerance inspection target) (Label specification target)</small>
Reference Character []	Outputs all registered characters which can be used for judgment. <small>(Label specification target)</small>
1st Candidate Character []	Outputs all characters selected as first candidates from the recognition process. <small>(Label specification target)</small>
2nd Candidate Character []	Outputs all characters selected as second candidates from the recognition process. <small>(Label specification target)</small>
1st Candidate Correlation []	Outputs the correlation level (0 to 99) of all first candidate characters from the recognition process based on the library data. <small>(Label specification target)</small>
2nd Candidate Correlation []	Outputs the correlation level (0 to 99) of all second candidate characters from the recognition process based on the library data. <small>(Label specification target)</small>
Stability []	Outputs the correlation level (0 to 99) difference between the first and second candidates for all the characters detected by the recognition process. <small>(Label specification target)</small>
Intensity Deviation []	Outputs the character contrast level (0 to 99) for all the extracted regions. <small>(Label specification target)</small>
Number of lines	Outputs the number of lines of characters.
Line 1 Number of Characters	Outputs the number of characters on the first line which have been detected by the recognition process.
Line 2 Number of Characters	Outputs the number of characters on the second line which have been detected by the recognition process.
Line 1 Correlation (max)	Outputs the maximum correlation value from the characters detected by the recognition process on the first line.
Line 1 Correlation (min)	Outputs the minimum correlation value from the characters detected by the recognition process on the first line. <small>(Tolerance inspection target)</small>

OCR

Line 1 Stability (max)	Outputs the maximum stability value from the characters detected by the recognition process on the first line.
Line 1 Stability (min)	Outputs the minimum stability value from the characters detected by the recognition process on the first line. Tolerance inspection target
Line 2 Correlation (max)	Outputs the maximum correlation value from the characters detected by the recognition process on the second line.
Line 2 Correlation (min)	Outputs the minimum correlation value from the characters detected by the recognition process on the second line. Tolerance inspection target
Line 2 Stability (max)	Outputs the maximum stability value from the characters detected by the recognition process on the second line.
Line 2 Stability (min)	Outputs the minimum stability value from the characters detected by the recognition process on the second line. Tolerance inspection target
Block position []	Outputs the positions of all extraction blocks in pixels. Label specification target
Inspection region position	Outputs the position of the inspection region in pixels. (Available only for calculation referencing)
Unit judgment value	Outputs the binary result of the unit based on the measured value and the specified tolerance range (upper / lower limits). The unit is judged as [NG] (binary 1) when outside the tolerance range and [OK] (binary 0) when inside.

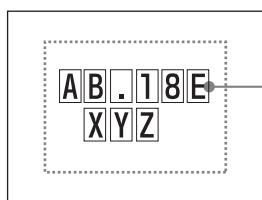
Reference

For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

Example showing the results of an OCR inspection performed under the following conditions:

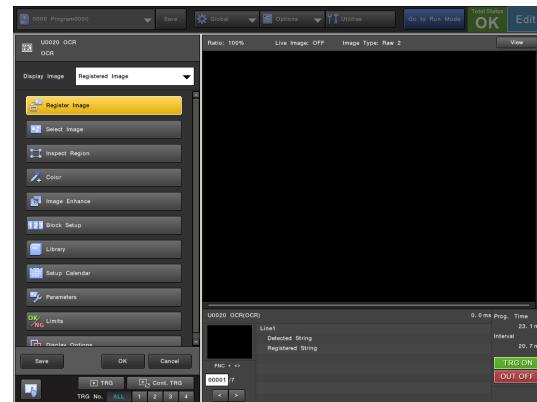
- Number of lines: 2
- Number of characters on the first line: 6
- Number of characters on the second line: 3



Characters recognized on the first line
AB.18E
Characters recognized on the second line
XYZ

Top Menu

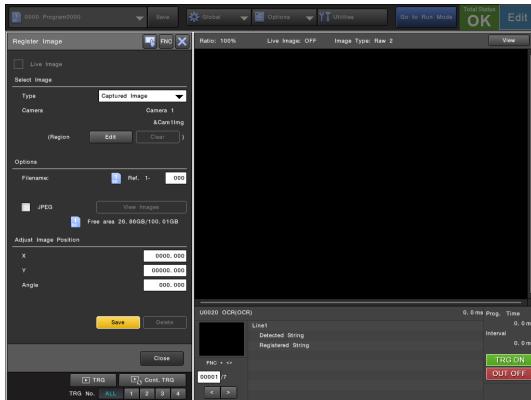
The top menu of the OCR tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-257)	Register an image to be used as a template for settings.
Select Image (Page 2-257)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-257)	Define the region to be used for unit processing.
Color (Page 2-258)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-258)	Specify the filter processing to apply to the image.
Block Setup (Page 2-258)	Specify the mode and parameters used for identifying and extracting individual characters in the inspection region.
Library (Page 2-260)	Register, add, delete and update the libraries of character patterns used for recognition.
Setup Calendar (Page 2-260)	Set the offset and allowable error for the calendar tolerance when using calendar form (year, month, day etc.) time information as judgment condition.
Parameters (Page 2-262)	Specify other conditions for the OCR tool as required.
Limits (Page 2-263)	Set the tolerance (lower limit) and judgment string for the inspection.
Display Options (Page 2-265)	Specify the display methods for things such as the inspection region and mask region.
Save (Page 2-266)	Save the current state to the program file.

Register Image

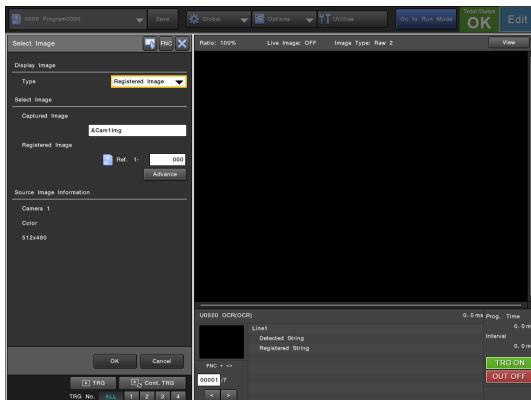
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

Specify the captured image and registered image to use for measurement.



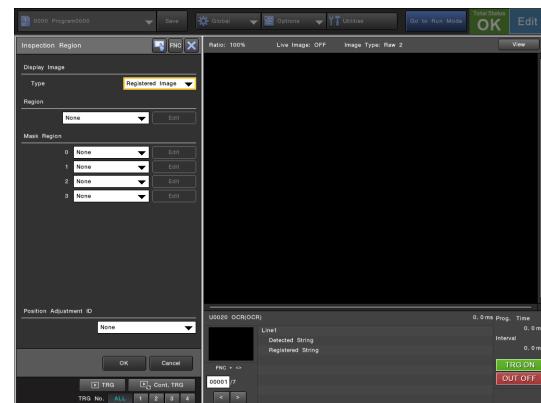
For more details, see "Select Image" (Page 2-471).

Inspect Region

Define the region to be used for unit processing.



- The smaller the inspection region, the shorter the processing time.
- If there is a background in the inspection region other than characters, text may not be correctly extracted. Set the inspection region in such a way that only the characters are enclosed as much as possible.
- You can only use a rectangle as the OCR inspection region.
- You cannot use an image region.
- A region size that exceeds a width of 2,432 pixels or a height of 2,050 pixels cannot be set in the image capture area.

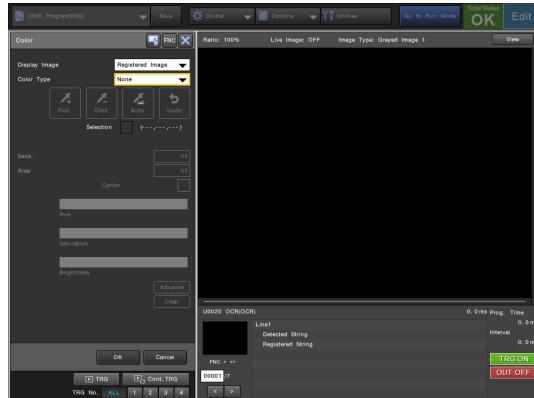


For more details, see "Region Settings" (Page 2-473).

Color

When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.

- Point** If the text color is black and the background is white, select [Grayscale] or [RGB Grayscale] to stably extract character strings.

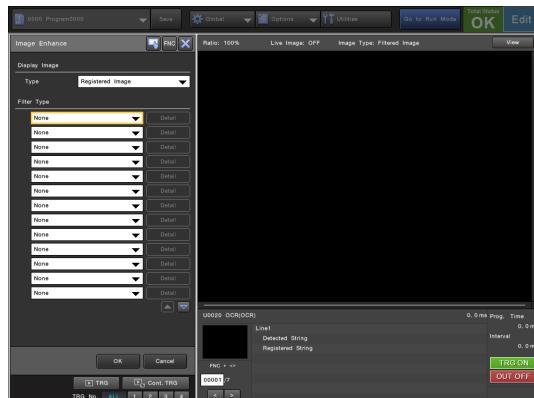


For more details, see "Color Extraction" (Page 2-483).

Image Enhance

Specify the filter processing to apply to the image.

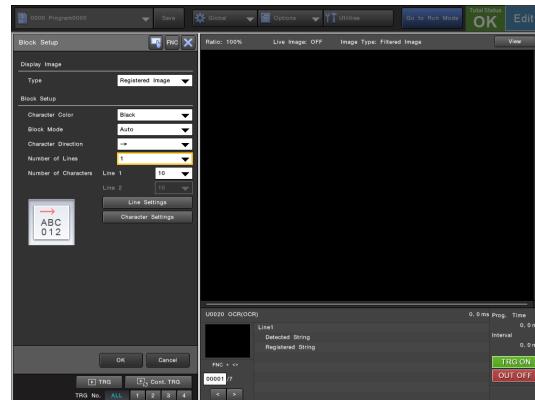
- Point** You cannot select the subtract filter for OCR measurement.



For more details, see "Image Enhance" (Page 2-489).

Block Setup

Specify the mode and parameters used for identifying and extracting individual characters in the inspection region.



Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Block Setup

Character Color

Select the color of characters to differentiate them from the background.

- **Black** (default): Recognize black-colored parts as characters.
- **White**: Recognize white-colored parts as characters.

Block Mode

"Extraction" is the process that separates the character information in the inspection region into individual characters. A proper extraction process is necessary for correctly recognizing characters for a stable OCR inspection.

Select the block mode to extract individual characters properly.

- **Auto** (default): Automatically extracts up to two lines (maximum of 20 characters per line) from one inspection region. The differential edge waveform from the automatic extraction for each character is displayed on the screen.
- **Fixed**: Extract a single line (a maximum of 20 characters) by manually setting a region for each character.

- Point**

- When [Fixed] is selected, all extracted characters are brought together into the first line.
- Changing the block mode resets various settings in the [Block Setup] menu.

[Auto] Block Mode Settings

Point If characters are not properly extracted with [Auto], configure the detailed [Auto] settings by changing [Line Settings] and [Character Settings] or change the block mode to [Fixed] (Page 2-259). See "Stabilizing Character Recognition" (Page 2-267) for more details.

Character Direction

If the string is rotated 90° or more, change the character reading direction in 90-degree increments with reference to the horizontal axis of the image. A reference icon is displayed in the menu showing the character appearance and read direction.

- (Default): Read characters from left to right on the image (normal direction).
- ←: Read characters from right to left on the image (180° rotation).
- ↑: Read characters from bottom to top on the image (90° counterclockwise rotation).
- ↓: Read characters from top to bottom on the image (90° clockwise rotation).

Point If rotation of the target string is less than 90°, use the position adjustment unit to adjust the inspection region.

Number of Lines

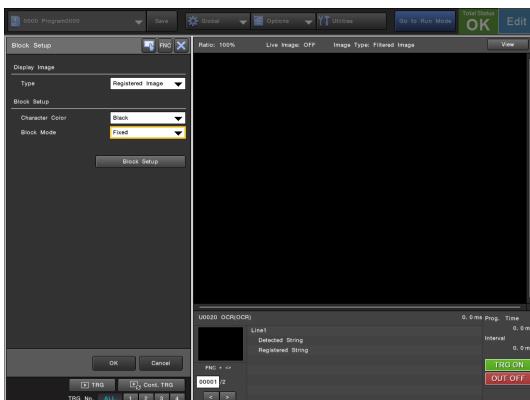
Specify the maximum number of lines (1 or 2) of characters to be extracted from the inspection region (default 1).

Number of Characters

Specify the maximum number of characters (1 to 20) to be extracted from each line (default 10).

[Fixed] Block Mode Settings

When the characters cannot be extracted properly with the Auto extraction mode, set the block region manually for each character (up to 20 characters).



Point In the fixed extraction mode, only one line can be extracted in one region.

Block Setup

Select [Block Setup] and [Add], to add a new block. Configure the block region so that it encloses a single character.

Point

- The shape of the block is fixed to a rotated rectangle.
- When position adjustment is used for the fixed extraction mode, the adjustment will be applied to all blocks in the unit.
- Make sure that only one character is included in a block region. Proper recognition cannot be achieved if two or more characters are present in the block.
- Make sure that the region does not go outside of the inspection region. Any part drawn outside the inspection region will not be included and correct extraction may not be possible.

Reference

- Refer to "Drawing a Region" (Page 2-474) for more details on drawing a region.
- When you select a block from the list, the value setting menu for [Rotated Rectangle] is displayed, allowing you to edit the region by specifying numerical values.
- To change the order of the blocks, select a block in the list, hold down the No.1 (FUNCTION) button of the handheld controller, and then move the 8-way key up or down.

Delete

Deletes the selected block from the list.

Fine Adjustment

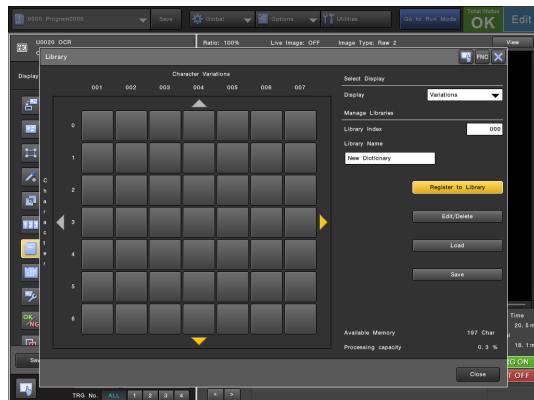
Use fine adjustment to adjust to the character size in the individual block region.

- ON** (Default): Adjust to the actual character size in the region to allow for changing character sizes and a stable comparison.
- OFF**: Extract characters in the region of a specified fixed size.

Point The [Fine Adjustment] setting is applied to all blocks in the inspection region.

Library

Select the library where the character patterns used for character recognition are registered. New and existing libraries can also be created and updated through this option. In addition to alphanumeric characters (0-9, A-Z) and symbols (dash, period, colon and forward slash), up to 20 user-defined characters can be registered in a single library.

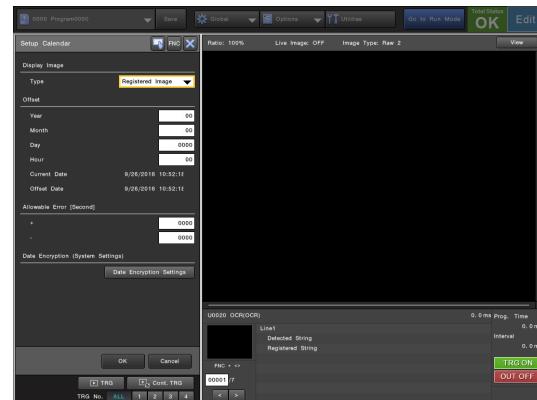


Refer to "Registering Characters for Optical Character Recognition (Library Menu)" (Page 2-270) for more details about the library setting.

Reference To read contents of an encoded date/time stamp as a regular character string, register a library then create a conversion table to encode the registered string connected to the internal calendar (Page 2-261).

Setup Calendar

Set the offset and allowable error for the calendar tolerance when using calendar form (year, month, day etc.) time information as judgment condition.



Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Offset

Add an offset to the value or encoded value of the calendar OK / NG tolerance (Page 2-264). The offset date and time is displayed at [Offset Date] in the [Setup Calendar] menu. The setting ranges are: ±10 for [Year], ±12 for [Month], ±1999 for [Day], and ±24 for [Hour].

Allowable Error [Second]

Specify the allowable difference between the controller's internal date & time and the inspected target's marked date & time at the turn of the date or time. The specified values (±0 to 3599 seconds) can be used as an additional offset to the value or encoded value of the calendar OK / NG tolerance (Page 2-264).

Example: Judgment results when the allowable error is set to ±60 seconds at the turn of the day

Current internal calendar time	2016.12.31		2017.1.1	
	~23:58:59	23:59:00	0:00:00	0:01:00~
Printing 2016/12/31	OK		OK	NG
Printing 2017/1/1	NG	OK	OK	

← →

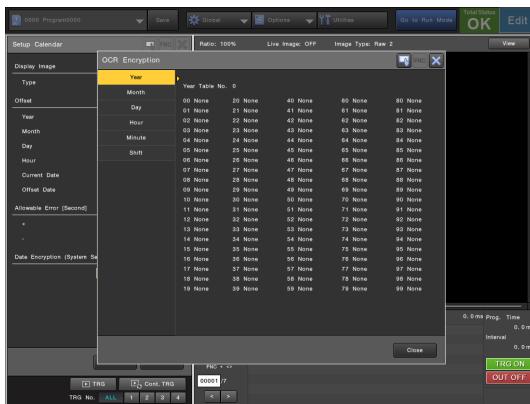
Allowable error -60 seconds Allowable error +60 seconds

Date Encryption (System Settings)

Users can create a conversion table to decrypt the data read by the OCR unit when an encrypted date, time, or shift is printed on a target. Use this conversion table to keep the encoded register string and the internal calendar linked and thus allow encoded date and time stamps to be read as normal character strings.

Point

- The date/time encryption settings are saved as system settings data. Note that they are not included in the program data.
- When performing reading that supports date and time encryption, set the conversion table here, and then set the date/time encoding calendar tolerance to the registered character string of the OCR unit. For more details, see "Limits" (Page 2-263).



Create a conversion table for each conversion target unit (Year to Minute, Shift). Up to 10 conversion tables can be created per unit. Changing conversion tables is an easy way to manage when different inspection targets use different encoding patterns.

Point

- Characters for which the replacement text field is empty in the current conversion table will be handled as if they were unset in the register string. Unset characters are removed and the remaining characters move forward to take their place. Additionally, if the entire registered string is unset, it will be read as blank space.
- You can enter up to 4 single-byte characters for replacement text. The following single-byte characters can be used.
0 to 9, A to Z, "-", ".", ":"/, a to t (correspond to special characters 1 to 20), space

Year

Specify a table number (0 to 9) and register a character string for each year (two digits) to be replaced.

Month

Specify a table number (0 to 9) and register a character string for each month to be replaced.

Day

Specify a table number (0 to 9) and register a character string for each day to be replaced.

Hour

Specify a table number (0 to 9) and register a character string for each hour to be replaced.

Minute

Specify a table number (0 to 9) and register a character string for each minute to be replaced.

Shift

Specify a table number (0 to 9) and register the replacement character string to the set time frame. Create a conversion table that indicates a specified period of time as a character, such as 9:00 to 12:00 as A, 12:00 to 15:00 as B or 15:00 to 18:00 as C.

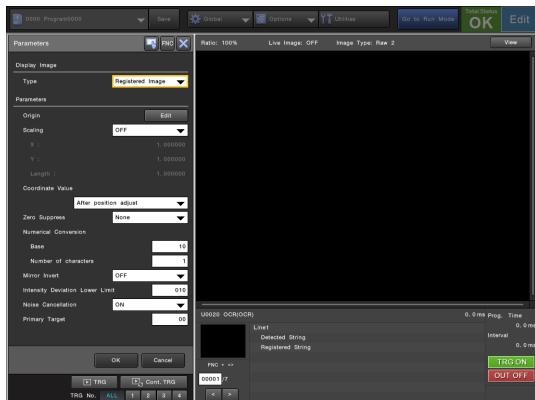
- Select [Add] under [Shift Setting], and then register the replacement start time and replacement text together. Each table can encode up to 24 replacements.
- Specifying the replacement start time and corresponding replacement text in [Shift Setting] will register them to the shift table. Repeating this operation will fragment the time frame, allowing you to register up to 24 replacement sets.

Point

By specifying the leading time in the [Sort] field, you can rearrange the display order of the shift table in order after the leading start time.

Parameters

Specify other conditions for the OCR tool as required.



Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

Reference

The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels. The result data and setting parameters used for display, judgment and calculations can be converted and scaled to real life values and dimensions by using the pre-set scaling factor option.

- OFF:** Do not use scaling.
- ON:** Use scaling.

Reference

- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate Value

Select the coordinate system to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- After position adjust:** The inspection uses the adjusted coordinate axes determined after position adjustment.
- Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Zero Suppress

Remove zeros from the calendar and calculation tolerances used in the limit settings.

- None** (default): Include zeros.
- Space forward:** Replace leading zeros with a space placed at the front of the number.
- Space backward:** Replace leading zeros with a space placed at the back of the number.
- Remove zeros:** Remove all leading zeros.

Point

- Zeros in both digits of the 2-digit year are exempt from zero suppression regardless of the setting.
- As a space is recognized when using [Fixed] or [Auto (Ratio)], use [Space forward] or [Space backward] with them. If [Auto (Waveform)] is used, the space will not be extracted and the result will always not match the tolerance because a space is also a part of tolerance judgment.

Example: Conversion result of the registered character strings using zero suppression

Zero suppression setting	Date & time tolerances	Calculation tolerance	Note
None	08/08/25	00350	
Space forward	08/_/25	_350	Use either of these two options when [Fixed] or [Auto (Ratio)] is used.
Space backward	08/8/_25	350_	
Remove zeros	08/8/25	350	

Underscore "_" is considered as a space.

Numerical Conversion

Specify the number base and number of recognized characters used for conversion of numerical variables to string tolerances used in the limit settings.

- Base:** Set the number base (10 to 36) used for converting the value of the reference variable into the calculation tolerance (Default: 10).

Example: Numerical conversion when Base is set to base 36

Calculation result	0	to	9	10	to	35
Calculation tolerance	0	to	9	A	to	Z

- Number of Characters:** Specify the number of characters to use for the calculation tolerance after the conversion (1 to 6, default: 1).

Point

The portion of the converted value that exceeds the set number of characters is not reflected to the tolerance. (Example of when the Base is 10 and the Number of characters is 2: the Calculation result 350 results in the Calculation tolerance being 50)

Mirror Invert

Use mirror invert to properly recognize and process inverted characters for images that are captured with a mirror or through a prism.

- **OFF** (default): Do not recognize mirrored characters.
- **ON**: Recognize mirrored characters.



- The reading direction in the block extraction mode will also change as a result of mirror inversion. The reading direction is shown by the icon in the [Block Setup] menu (Page 2-258).
- If [Mirror/Rotate Image] is used in the capture unit (Page 2-29), this mirror inversion is applied to the mirrored/rotated image.

Intensity Deviation Lower Limit

Specify the lower limit of character contrast deviation (0 to 255) for detecting characters and blank spaces. If the noise elements in the background are being recognized as characters, increase the lower limit. If the contrast between the character and its background is low and the character is being recognized as a space, decrease the lower limit.

Noise Cancellation

Exclude noise on the border of the block that can cause the fine adjustment function (Page 2-259) to work incorrectly.

- **ON** (Default): Exclude noises on the border during fine adjustment.
- **OFF**: Include noise on the border during fine adjustment.

Primary Target

Specify the primary target to be used for judgment result processing from all the characters detected in the recognition processed based on their sequence (0 (default) through 39).

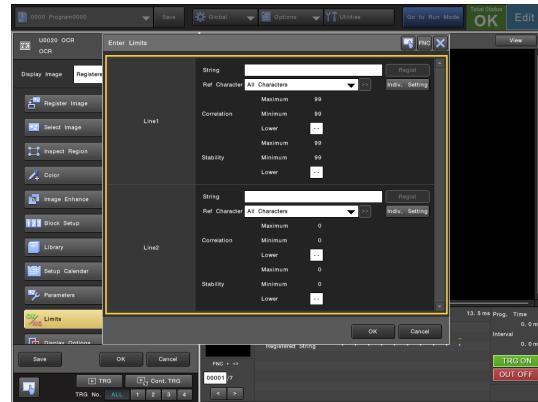


The primary target reference numbering starts on the first line at the first character, and correlates to the sequence that the characters are detected on the two lines.

Limits

Specify pass / fail strings and tolerances (lower limit) settings for the OCR inspection.

If the detected string does not match the registered string, or the detected value for correlation or stability is below the lower limit, the inspection result will be "NG". If the detected string matches the registered string and the detected value for correlation and stability is equal to or above the lower limit, the inspection result will be "OK". By changing the [Ref. Character] setting, the available characters used for comparison can be limited as required for controlled comparison.



Select the desired tolerance and then enter a value.

- If no limits or tolerances are set the unit will result in a pass (OK).
- The unit of tolerance varies depending on the limit parameter.



When a character is judged as "?" (recognition impossible), the result will be NG even if [String] is blank if the Correlation or Stability lower limit is set.

String

Register a string for judging the characters detected by the extraction process against. Select [String] and enter up to 20 characters or symbols as a fixed string.

- Fixed characters can be combined with live tolerances that automatically change such as date and time.
- REG (registered tolerance) can only be used by itself.

Special Characters and Wildcards

The following special options can be used.

- **SPACE:** Indicates a space.
- *: When Correlation or Stability is set, this deems an unrecognizable state as NG while other characters are deemed OK.
- #: Regardless of the recognition result, the character in the position of # is not judged and is always deemed as OK. Example: Differences in results when using "*" versus "#"

Recognition result	String	
	ABC*	ABC#
ABCD	→ OK	OK
ABC8	→ OK	OK
ABC?	→ NG	OK

The results are different when the correlation or stability of the fourth character goes below the lower limit, and cannot be recognized.

- **REG** (registered tolerance): A specific set of characters is set as the string based on the registered or captured image. Selecting [Regist] registers the detected characters from the current display image as the judgment string.

- Point**
- The registered tolerance cannot be used in combination with other fixed characters or other tolerance types.
 - When the captured image is selected for the display image and there is no previous result, SPACE (blank) is used for REG.

Date & time tolerances

The following date and time functions from the internal calendar and clock can be used in the string judgment.

- **Year4:** Four digit calendar year
- **Year2:** Two digit calendar year
- **Month:** Two digit month
- **Day:** Two digit day
- **Hour:** Two digit hour

Example: Verifying the year/month/day (April 1, 2016) using the internal calendar tolerances.

String	Registered string
Year4/Month/Day	→ 2016/04/01

This example uses both calendar tolerance and a fixed character "/".

- Reference**
- A user-specified offset and allowable error can be set for the date time functions of the internal calendar. See "Allowable Error [Second]" (Page 2-260) for more details.
 - Zero suppression (Page 2-262) can be set for the Month, Day, and Hour.

Encrypted date, time and shift tolerances

The text mapped against the date, time and shift pattern in the encryption table can be used for string judgment. The number used in parentheses represent the encryption table number.

- **eYear ()**: Correlates to the year in the encryption table.
- **eMonth ()**: Correlates to the month in the encryption table.
- **eDay ()**: Correlates to the day in the encryption table.
- **eHour ()**: Correlates to the hour in the encryption table.
- **eMinute ()**: Correlates to the minute in the encryption table.
- **Shift ()**: Correlates to the shift in the encryption table.

Reference A desired offset or allowable error for the transition can be set for the date/time encoding calendar tolerance. See "Allowable Error [Second]" (Page 2-260) for more details.

Calculation Tolerance (variable reference)

The numerical variable values are converted into character string tolerances. The conversion method follows the numerical conversion (Page 2-262) settings.

- **Variable:** Specify a numerical type variable to register to the judgment string.

Example: For judging a 7-character string composed of a fixed text ("TEST") plus a 3-digit serial number (#Count01) to which 1 is added at each inspection in the Calculation unit (Numerical Conversion: base 10 / 3 digits, Zero Suppression: None.)

String	Judgment string
TEST#Count01	→ TEST000-999 (reverts to 000 after 999)

Point Only numerical type variables can be specified.

Ref Character

Typically, all the characters stored in the library are used for judgment, however the range of characters used can be limited. Limiting the characters used can help resolve false rejects and mis-detection for similar characters such as an "E" and an "F" while also increasing processing speed.

- All Characters:** Use all the characters stored in the library for recognition.
- Character Groups:** Use only the types of characters in the judgment string for recognition. The type relates to either an alphabetical, numerical, symbol or special character. For example, the recognition of character "A" uses only the library data for alphabetical characters A to Z.
- Specified Order:** Use only the characters in the judgment string for recognition.
- Specified Characters:** Use only selected characters for recognition.

Reference The limiting of character types can also be applied to each individual character by selecting [Indiv. Settings]. This is also useful when the registered string includes multiple character types.

Point When REG (registered tolerance) is used for the string, do not change the reference character setting from [All Characters]. Selecting other options may result in improper character recognition.

Correlation

Enter the lower limit for the minimum correlation % match of all recognized characters. If the correlation or stability value is below the lower limit after cross referencing with the library, "?" is output to indicate that the character is unrecognizable and the inspection result is NG.

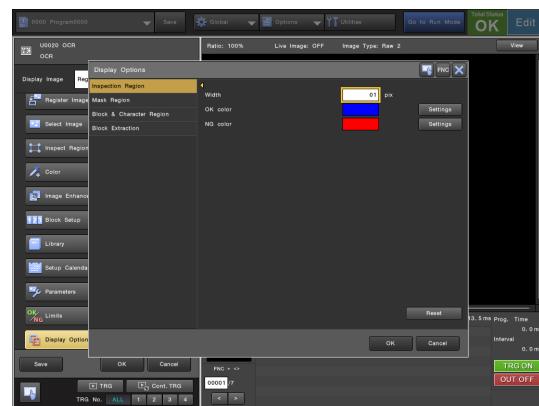
Stability

Enter the lower limit for the minimum stability of all recognized characters. If the correlation or stability value is below the lower limit after cross referencing with the library, "?" is output to indicate that the character is unrecognizable and the inspection result is NG.

Display Options

Specify the display methods for things such as the inspection region and mask region.

You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection region

Specify the line width and display color of the inspection region.

Mask region

Specify the line width and display color of the mask region.

Block & Character Region (when fixed extraction is used)

Fixed block region

Specify the line width and display color of the block region.

Fixed block region (fine adjusted)

Specify the line width and display color of the adjusted block region when [Fine Adjustment] (Page 2-259) is set to [ON].

Block & Character Region (when auto extraction is used)

Line / Block

Specify the line width and display color of the block region.

Character

Specify the line width and display color of the character region.

Block Extraction

Block Extraction

Select whether to display the character extraction waveform.

- **ON** (default): Show the character extraction waveform.
- **OFF**: Hide the character extraction waveform.

Wave

Specify the width and display color of the character extraction waveform.

Frame

Specify the width and display color of the frame.

Threshold

Specify the width and display color of the line representing the block threshold.

Minimum wave height

Specify the width and display color of the line representing the minimum wave height.



Setting [Block Extraction] to [ON] consumes additional program memory. Check the amount of remaining program memory before enabling.

Reset

Returns the display options to their defaults.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



Point

- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

Stabilizing Character Recognition

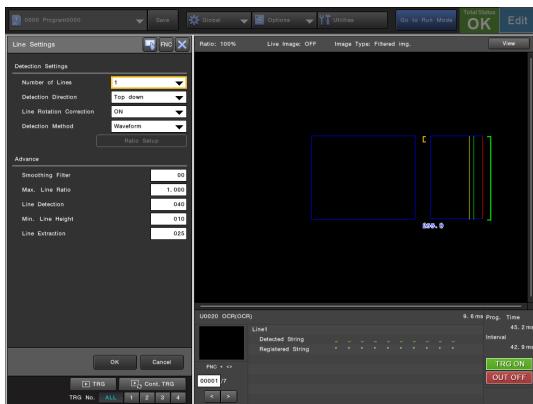
The auto extraction mode extracts characters (lines) by detecting the space between characters (lines) from the extraction waveform. If the spaces are too narrow or the characters (lines) are slanted, the waveform line may overlap and correct extraction may not be possible. To make extraction possible and stable, the extraction method can be set to [Fixed] or the detailed auto extraction settings can be adjusted in [Block Setup] while checking the displayed waveform.

Changing the [Line Settings]

Adjustments can be made to the methods used for line extraction.

1 Select [Line Settings] in the [Block Setup] menu.

The [Line Settings] menu appears.



2 For [Number of Lines], specify the number of lines (1 or 2) to extract from the inspection region.

3 For [Detection Direction], select the extraction direction.

Changing this option may help when extraction fails due to background noise.

- **Top down:** Extract the specified number of lines from the top with reference to the reading direction.
- **Bottom up:** Extract the specified number of lines from the bottom with reference to the reading direction.
- **Size:** Extract the specified number of lines in descending order of line height regardless of the reading direction.

4 If the line height varies due to the string being at angle to the inspection region, switch [Line Rotation Correction] on for rotation correction.

- **ON:** Enable rotation correction.
- **OFF:** No rotation correction.



- The rotation correction is suitable for approximately $\pm 15^\circ$ of rotation. If the angle of the line to the inspection region is greater, use position adjustment.
- If rotation correction is used, the rotation will be reflected in the character block region as well.

5 If the line extraction is unstable (due to the space between lines being narrow, etc.), choose the appropriate extraction method in [Detection Method].

- **Waveform:** Extract a line by detecting spaces based on changes in the line extraction waveform.
- **Ratio:** Extracts the line at a specified ratio to the projected waveform width of the entire line. This is effective when the ratio of the line height is constant even when the line space is small.



When the number of lines changes, do not select [Ratio]. Ratio specification forcibly extracts the specified number of lines regardless of the actual number of lines in the inspection region. This may cause false recognition.

Specifying the ratio

When [Ratio] is selected, [Ratio Setup] allows the setting of the line ratio.

- **Start:** Specify the start position of line extraction as a percentage ratio of the overall line extraction waveform (000.00 to 100.00).
- **Line Separation** (only when the [Number of Lines] is set to 2): Specify the separation distance of line 1 and line 2 as a percentage of the overall line extraction waveform (000.00 to 100.00).
- **End:** Specify the end position of line extraction as a percentage ratio of the overall line extraction waveform (000.00 to 100.00).



The specified ratio returns to the default value if the [Number of Lines] setting is changed.

6 Change detailed waveform generation settings as necessary.

Typically, the extraction waveform generation method does not need to be changed. However, adjusting the generation method may improve the extraction result.

Smoothing filter

To aid proper character extraction of dot based characters, the number of times to apply the smoothing filter can be changed from 0 to 99. Increasing the smoothing filter increases the number of rows of pixels used in the generation of the line extraction waveform. This can subsequently lower the detection sensitivity for narrow gaps.

Max. Line Ratio

If two lines are being accidentally extracted as one due to a narrow line spacing, setting the [Max. Line Ratio] (0.100 to 1) enables the system to analyze the line extraction waveform and force the line height to be equal to the ratio of the inspection region or less ensuring separation of the two lines.



This setting is displayed as a green (orange when the item is selected) bracket next to the line extraction waveform.

Line Detection

Specify the lower limit line detection threshold (0 to 255) to remove unwanted noise from the generated waveform used for line extraction.

Lowering the threshold increases the extraction sensitivity, but may increase the influence of noise.

Reference This setting is displayed as a straight green line across the line extraction waveform.

Min. Line Height

Specify the lower limit of the line height, equivalent to the width (0 to 255 pixels) used for line extraction from the generated waveform.

Setting the [Min. Line Height] eliminates noise in the extraction waveform.

Reference This setting is displayed as a yellow bracket next to the line extraction waveform.

Line Extraction

Specify the lower limit for taking a waveform as target for line extraction by means of the difference (0 to 255) from the line detection threshold. Waveforms with a maximum intensity below the lower limit can be excluded from the extraction targets.

Reference This setting is displayed as a straight yellow line across the line extraction waveform.

7 Select [OK].

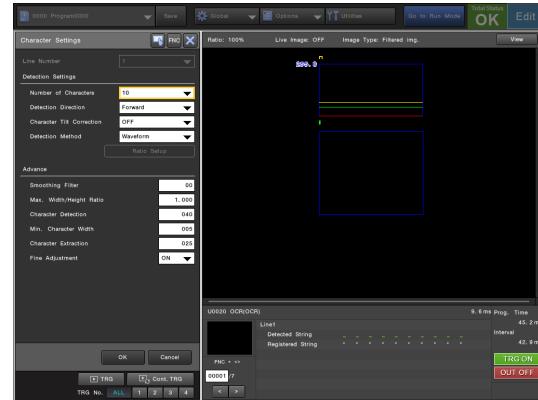
The [Block Setup] menu reappears.

Changing the [Character Settings]

Adjustments can be made to the methods used for character extraction.

1 Select [Character Settings] in the [Block Setup] menu.

The [Character Settings] menu appears.



2 Select the line number (1 or 2) in [Line Number] to change the character settings for.

Point This option cannot be selected when [Number of Lines] is set to 1.

3 Specify the number of characters (1 to 20) in [Number of Characters] to extract from the inspection region.

4 Using [Detection Direction], select the extraction direction.

Changing this option may help when character extraction fails due to background noise.

- **Forward:** Extract the specified number of characters from left to right with reference to the reading direction.
- **Reverse:** Extract the specified number of characters from right to left (typically reverse reading) with reference to the reading direction.
- **Size:** Extract the specified number of characters in the descending order of character width regardless of the reading direction.

5 If the characters are deformed or offset at an angle (such as italics), set [Character Tilt Correction] to on.

- **OFF:** No sloped character correction
- **ON:** Sloped character correction

Point The tilt correction can correct up to about $\pm 20^\circ$ of character tilt but does not correct for rotated characters.

6 If the character extraction is unstable (due to narrow character spacing, etc.), choose the appropriate extraction method in [Detection Method].

- **Waveform:** Extract a character by detecting spaces based on changes in the character extraction waveform.
- **Ratio:** Extracts the character at a specified ratio to the projected waveform width of all the characters. This is effective when the ratio of the number of characters and the character width is constant even when the character space is small.



Point When the number of characters changes, do not use [Ratio]. As it forces the OCR tool to extract a specified number of characters regardless of the actual number of characters in the inspection region, this may cause false recognition.

Specifying the ratio

When [Ratio] is selected, [Ratio Setup] allows the setting of the character ratio.

- **Start:** Specify the start position of character extraction as a percentage ratio of the overall character extraction waveform (000.00 to 100.00).
- **n-n+1:** Specify the separation distance of the "n" th character and the "n+1" character as a percentage of the overall character extraction waveform (000.00 to 100.00).
- **End:** Specify the end position of character extraction as a percentage ratio of the overall character extraction waveform (000.00 to 100.00).



Point The specified ratio returns to the default value if the [Number of Characters] setting is changed.

7 Change detailed waveform generation and character extraction settings as necessary.

Typically, the character extraction waveform generation method does not need to be changed. However, adjusting the generation method may improve the character extraction result.

Smoothing Filter

To aid proper character extraction of dot based characters, the number of times to apply the smoothing filter can be changed from 0 to 99. Increasing the smoothing filter increases the number of columns of pixels used in the generation of the character extraction waveform. This can subsequently lower the detection sensitivity for narrow character gaps.

Max. Width/Height Ratio

If two characters are being accidentally extracted as one due to narrow character spacing, setting the [Max. Width/Height Ratio] (0.100 to 9.999) enables the system to analyze the character extraction waveform and force the character width to be equal to the ratio of the character height or less ensuring character separation.



This setting is displayed as a green (orange when the item is selected) bracket next to the character extraction waveform.

Character Detection

Specify the lower limit character detection threshold (0 to 255) to remove unwanted noise from the generated waveform used for character extraction.

Lowering the threshold increases the extraction sensitivity, but may increase the influence of noise.



This setting is displayed as a straight green line across the character extraction waveform.

Min. Character Width

Specify the lower limit of the character width, equivalent to the width (0 to 255 pixels) used for character extraction from the generated waveform. Setting the [Min. Character Width] eliminates noise in the character extraction waveform.



This setting is displayed as a yellow bracket next to the character extraction waveform.

Character Extraction

Specify the lower limit for taking a waveform as target for character extraction by means of the difference (0 to 255) from the character detection threshold.

Waveforms with a maximum intensity below the lower limit can be excluded from the extraction targets.



This setting is displayed as a straight yellow line across the character extraction waveform.

Fine Adjustment

By using the actual character size to make fine adjustments to the size of the block region that was determined through the waveform, the influence of character size changes on the correlation value is reduced.

- **ON:** Reflects the actual character size to the block region
- **OFF:** Do not use fine adjustment

8 Select [OK].

The [Block Setup] menu reappears.

Registering Characters for Optical Character Recognition (Library Menu)

Image based characters can be registered to the library for use in optical character recognition. In addition to alphanumeric characters (A-Z, 0-9) and symbols (dash, period, colon, forward slash), up to 20 user-defined characters can be registered in a single library.

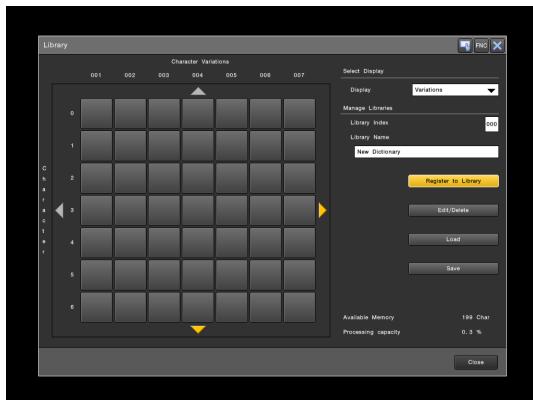
Some functions in the Library menu and the sub-menu [Library] of the Edit Unit Menu work and behave differently. Refer to "Difference Between Sub Menus of the Edit Unit Menu and Other Built-in Menus" (Page 2-15) for further details.

- Point** The following operations are carried out after the current unit has been processed. Processing resumes after the operation has been completed.
- Opening and closing the Library menu
 - Register Individually/Register All
 - Library index changes
 - Library name changes
 - Library deletion
 - Loading and saving the library

Reference

- Foreign characters, pictogram, or custom pattern can also be registered as user-defined characters.
- User-defined characters are displayed and managed by ID number (1) to (20) on the screen.

1 Select in [Library Index] the destination library (0 to 999) to register characters to.



- Point** To use the OCR tool, character data must be registered in a library. If all character data has been removed from the selected library, the OCR tool will not work properly and return "?????" as the result.

Changing the list format

The display format can be changed using [Display].

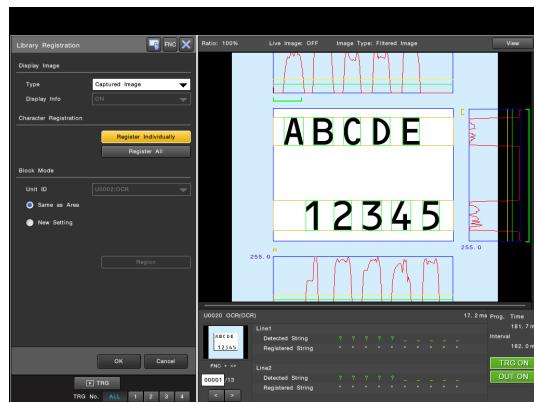
- **Variations** (default): Displays the list of the registered characters in matrix format.
- **Registered**: Displays the registration status of each character.

Changing the library name

Select [Library Name], and then enter the desired name (up to 60 single-byte characters).

2 Select [Register to Library].

The [Library Registration] menu appears.



3 Choose the image to extract characters from.

- **Registered Image**: Displays the registered image of the OCR Unit specified in [Block Mode].
 - **Captured Image**: Displays the current image of the OCR Unit specified in [Block Mode].
 - **Archived Image**: Displays an image from the image archive (only displayed in the Library menu). When there are multiple images registered in the image archive, toggle through the images by holding down the No. 1 (FUNCTION) button while moving the 8-way key left or right.
- If [Display Info] is set to [ON] when an archived image is selected, the total count, inspection date and time, and inspection result (string, correlation level, and extraction waveform) from the result data archived together with the image will be displayed.

Point

If the [Same as Area] is used and [Display Image] is set to [Registered Image], the character extraction is not displayed. Also, individual registration cannot be done. To register individual characters use [New Setting] and set 1 or more fixed block regions.

4 Choose the character registration and extraction method.

The following two methods can be used for character registration along with the extraction method.

Character Registration:

- Register Individually:** Allows extracted characters to be registered one by one.
- Register All:** Allows registration of all the extracted characters together as a string.

Point Up to 200 characters can be registered in one library, but is dependent on the processing memory available.

Block mode

- In the case of the Library menu:
 - Same as Area (default):** Uses the same extraction settings as the referenced unit.
 - New Setting:** Allows the manual placement of a fixed extraction region. Use this option if it's not practical to use the extraction settings initially set in the unit. See "Directly specifying a fixed extraction region (when the Library menu is open as a standard menu)" (Page 2-273) for more details.
- In the [Library] sub menu (Page 2-260) of the OCR unit only the extraction settings used in [Block Setup] can be used.

Reference For more information about character extraction, refer to the XG-X VisionEditor Reference Manual.

5 Register the extracted character.

When [Register Individually] is selected

Select the character to be registered. The [Register Characters] menu appears. Choose a row to register the character to and press the No.0 (ENTER) button. Repeat until all the required characters are registered.



Reference If multiple character registrations are made for one character type, the additional characters are automatically registered as character variations. Registering several variations of a character allows more stable recognition when there are changes in the character, by finding the closest matching character from the registered variations.

When [Register All] is selected

The [Register All] menu appears.

Choose the appropriate line number and manually enter the string that is currently extracted.



- Point**
- Exclude any undesired characters from the string by using an asterisk "*".
 - If more than one of the same character exists in the extracted string, the repeated characters will be registered as character variations. To avoid repeated characters being registered, use an asterisk "*" in their place.

6 When registration is complete, select [OK].

The screen reverts to the [Library] menu.

- Point**
- If the same image is registered to several different character types in the library, the character with the smallest ASCII code is output as the result. To avoid such mismatches, do not register the same image to different character types.
 - If the OCR unit recognizes a character registered as a user-defined character, (1) to (20) is displayed on screen, and the lower case "a" to "t" are used for output and decimal conversion.

7 Select [Close].

Editing and deleting registered characters

Characters in the library can be edited or deleted using the procedure below.

 **Point** Deleted characters cannot be restored.

1 Select [Edit/Delete] on the [Library] menu.

The [Edit/Delete] menu appears.

2 Perform the necessary operation.

Enable/Disable

Temporarily enables or disables the selected character pattern. An X is used to show the character has been disabled. It can be enabled again later on since the data itself is not deleted.

Delete Character

Deletes the selected character pattern.

Delete Variation

Deletes all the variations for a character.

Delete All

Deletes all the characters from the selected library.

 **Point** If the library is saved after deleting all the characters, any OCR units that reference the library will return "?????" as the recognition result and correct inspection cannot be done.

3 Select [Close].

Loading library data from an SD card

To load library data saved on an SD card use the procedure below.

 **Point** The loaded data is added to the library currently selected. If the data to be loaded is to be used on its own setup, select a new library to load the data into.

- Library data created from different resolutions of cameras can be loaded into the library. However, please check the operation after loading the data to verify whether character recognition can be performed correctly or not using the library data that was loaded.

1 Select [Load] on the [Library] menu.

The [Load] menu appears.

2 Select the folder that contains the library data.

3 Select [Execute].

The library data is loaded from the SD card, and added into the current library.

 **Point** Execute is disabled if the library file (xgdic.dat) is not present in the folder specified in Step 2.

Saving library data to an SD card

To save the registered library data to an SD card for use by other programs or controllers, follow the procedure below.

1 Select [Save] on the [Library] menu.

The [Save] menu appears.

2 Select the save destination.

3 Select [Execute].

The library data is saved to the specified folder on the SD card.

 **Reference** The library data is saved to the specified folder with the file name "xgdic.dat".

 **Point** Do not change the file name "xgdic.dat". If the library filename is changed from xgdic.dat, it will not be recognized by the controller.

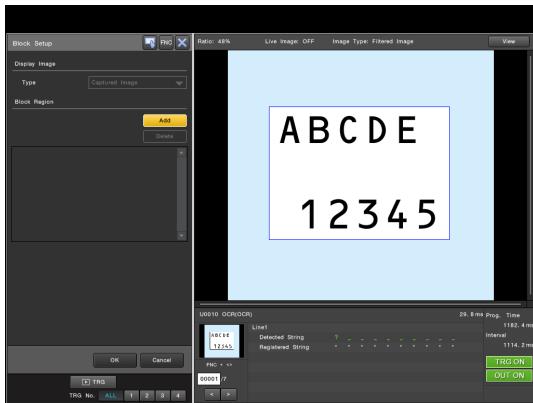
Directly specifying a fixed extraction region (when the Library menu is open as a standard menu)

This function allows the specifying of up to 20 individual blocks for character extraction in accordance with each character.

- Point** If the [Block Mode] is set to [Fixed], only one line can be extracted from a single region.

1 Select [Region].

The [Block Setup] menu appears.



2 Select [Add] under [Block Region].

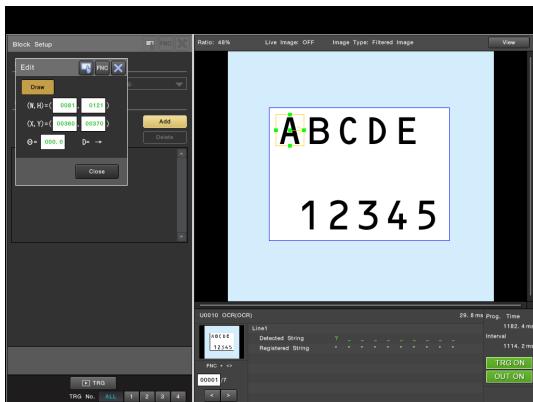
The block can be manually drawn around the desired character.

Reference

- The shape of the block is fixed to a rotated rectangle.
- Additional blocks are initially set to the same size and are automatically placed next to the previous block.
- To delete a block select [Delete] and choose the block to delete.

3 Draw the block region.

Draw a block around the outside of the desired character. Refer to "Drawing a Rotated Rectangle" (Page 2-475) for more details.



Point

- Make sure that only one character is included in a block region. The OCR tool will not function correctly if two or more characters are present in the block.
- Make sure that the region does not go outside of the inspection region. Any part drawn outside the inspection region will not be included and correct extraction may not be possible.

4 To finish drawing the block, press the No. 2 (ESCAPE) button on the handheld controller.

5 Select [Close].

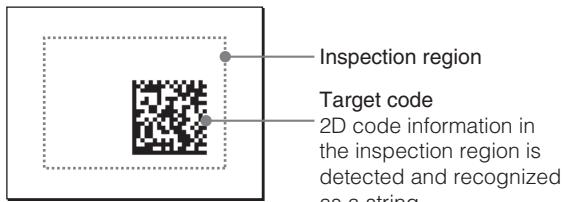
2D Code Reader

2D Code Reader Tool

The 2D Code Reader detects a 2D code in the inspection region, decodes the information contained in the 2D code and outputs the data as a string.

In addition to decoding and outputting the code, the tool can also verify and judge the data against a pre-registered string or content which dynamically changes such as a calendar or serial number. Multiple judgment strings can also be registered so that the tool can be used for sorting based applications.

Measurement Overview



2D Code Reader Unit: Supported Codes

Codes in the following formats are supported.

QR

The unit can read Model1 and Model 2 QR codes.



Point Linking functions are not supported.

Micro QR

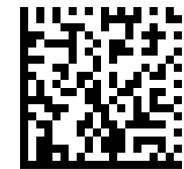
The unit can read Micro QR code.



Point Linking functions are not supported.

DataMatrix

The unit can read Data Matrix (ECC200).



Point

- ECC000 - ECC140 are not supported.
- Linking functions are not supported.

Rectangular DataMatrix

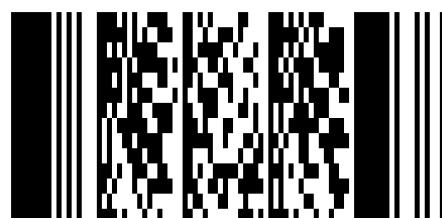
The unit can read Rectangular Data Matrix.



Point Linking functions are not supported.

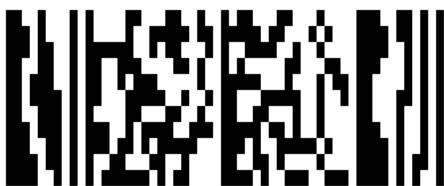
PDF417

The unit can read PDF417 barcodes and verify their print quality.



MicroPDF417

The unit can read MicroPDF417 barcodes and verify their print quality.

**Composite Code**

The unit can read Composite Codes (CC-A, CC-B, and CC-C).

**Main measurement results**

The standard results and data returned by 2D Code Reader tool are as follows:

Code Length	The length of the read data is output in bytes. [Tolerance inspection target]
Readout	Outputs the decoded data as a string. [Tolerance inspection target]
Position X	Outputs the center X coordinate (pixels) of the detected 2D code. [Tolerance inspection target]
Position Y	Outputs the center Y coordinate (pixels) of the detected 2D code. [Tolerance inspection target]
Position XY	Outputs the center XY coordinates (pixels) of the detected 2D code.
Deviation angle	Outputs the angle difference of the detected 2D code from the base angle. [Tolerance inspection target]
Pos. XY / Deviation Angle	Outputs the center XY coordinates (pixels) and detected angle (angle) of the detected 2D code.
Split 1 Length to Split 8 Length	Outputs the length of the read split data No. 1 to No. 8 in bytes.
Split 1 Readout to Split 8 Readout	Outputs the character strings of split data No. 1 to No. 8. [Tolerance inspection target]
Cell size	Outputs the code resolution of the detected 2D code as the number of pixels per cell.
Unused error correction	Outputs the available (unused) error correction of the detected 2D code as a percentage (0 - 100%).
Number of rows	Outputs the number of cells of the detected 2D code in the vertical direction.
Number of columns	Outputs the number of cells of the detected 2D code in the horizontal direction.
Cell color	Outputs the printed color of the detected 2D code. (0: Not detected, 1: Black on white background, 2: White on black background)
Mirrored reading	Outputs mirrored reading information regarding the detected 2D code. (0: Not detected, 1: No mirror inversion, 2: With Mirror inversion)
Code angle	Outputs the detection angle of the detected 2D code, using the base angle as 0°.
Code data length	Outputs the length of all code data contained in the detected 2D code as bytes.
Read error	Outputs whether or not a reading error occurred. (0: Reading successful, 1: Reading failed)
Read error reason	Outputs the cause of a reading error. (0: Reading successful, 1: Code detection failed, 2: Decoding failed, 3: Timeout)
Multi Reference No.	Outputs the lowest number of the reference setting that was matched.
Reference 1 to Reference 16	Outputs the characters strings of reference patterns No. 1 to No. 16.
Reference result	Outputs an overall judgment result for all reference settings.
Reference Result1 to Reference Result16	Outputs reference results No. 1 to No. 16. (-1: Matching impossible, 0: Matched, 1 or higher: No. of the digit where mismatch occurred).
Code Area: Point 1X	Outputs the region information (first coordinate X) (pixels) of the detected 2D code.
Code Area: Point 1Y	Outputs the region information (first coordinate Y) (pixels) of the detected 2D code.
Code Area: Point 1XY	Outputs the region information (first coordinate XY) (pixels) of the detected 2D code.

2D Code Reader

Code Area: Point 2X	Outputs the region information (second coordinate X) (pixels) of the detected 2D code.
Code Area: Point 2Y	Outputs the region information (second coordinate Y) (pixels) of the detected 2D code.
Code Area: Point 2XY	Outputs the region information (second coordinate XY) (pixels) of the detected 2D code.
Code Area: Point 3X	Outputs the region information (third coordinate X) (pixels) of the detected 2D code.
Code Area: Point 3Y	Outputs the region information (third coordinate Y) (pixels) of the detected 2D code.
Code Area: Point 3XY	Outputs the region information (third coordinate XY) (pixels) of the detected 2D code.
Code Area: Point 4X	Outputs the region information (fourth coordinate X) (pixels) of the detected 2D code.
Code Area: Point 4Y	Outputs the region information (fourth coordinate Y) (pixels) of the detected 2D code.
Code Area: Point 4XY	Outputs the region information (fourth coordinate XY) (pixels) of the detected 2D code.
Quality Verification	Outputs the overall grade for the print quality verification of 2D code and each grade for each print quality verification item as a value from 4 (A) to 0 (F). <small>Tolerance inspection target</small>
Unit judgment value	When the measurement result of the tolerance judgment target is outside the specified tolerance (upper limit and lower limit), or when the read string does not match the reference setting string, it is judged as [NG] (binary 1). When the result is within the tolerance and the detected string matches the reference setting string, it is judged as [OK] (binary 0).

Point

- For the measurement results where a character string is output (Readout, Split Data 1 - 8, Reference Pattern 1 - 16), the character string result is acquired when no array element is specified (example: ID_DATA[]), and the numeric value result is acquired when an array element is specified (example: ID_DATA[0]).
- If [PC Program] was set as the destination for results output, then for measurement results where a character string is output (Readout, Split Data 1 - 8, Reference Pattern 1 - 16), the maximum number of characters which can be output for 1 item is limited to 80. Use "Data Split" (Page 2-282) as necessary.
- When handling binary data, numeric data following 0 (null) is not displayed and cannot be matched.

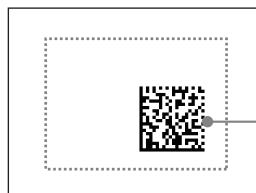
Reference

For the lists of available measurement output values and setting parameters, see "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

Example showing the results of a measurement performed under the following conditions:

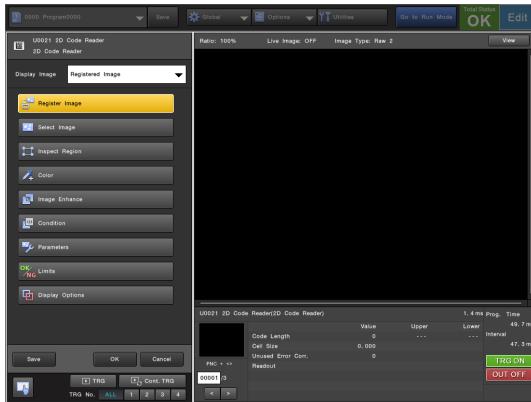
- Code Type: DataMatrix
- Start Digit: 1
- Data Length: 100
- Data Split: ON
 - DATA1: Start Digit 9, Data Length 6
 - DATA2: Start Digit 16, Data Length 6



Readout:
KEYENCE VISION SYSTEM
Split data 1 : VISION
Split data 2 : SYSTEM

Top Menu

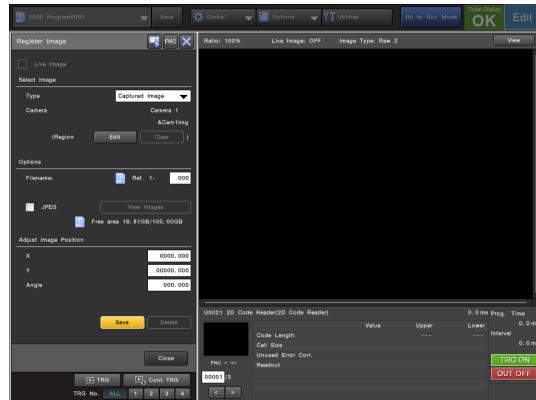
The top menu of the 2D Code Reader tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-277)	Register an image to be used as a template for settings.
Select Image (Page 2-277)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-226)	Define the region to be used for unit processing.
Color (Page 2-278)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-278)	Specify the filter processing to apply to the image.
Condition (Page 2-279)	Specify the conditions to detect 2D Code during measurement.
Parameters (Page 2-281)	Specify other conditions for the 2D Code Reader tool as required.
Limits (Page 2-284)	Set the matching pattern to be compared with the read code data and the tolerance (upper and lower limits) for the detection results measured value.
Display Options (Page 2-288)	Specify the display methods for things such as the inspection region and mask region.
Save (Page 2-288)	Save the current state to the program file.

Register Image

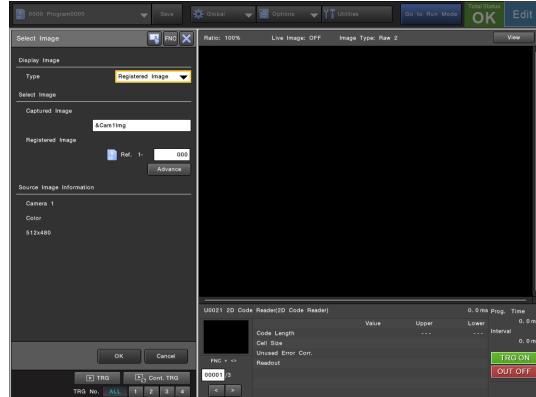
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

Specify the captured image and registered image to use for measurement.



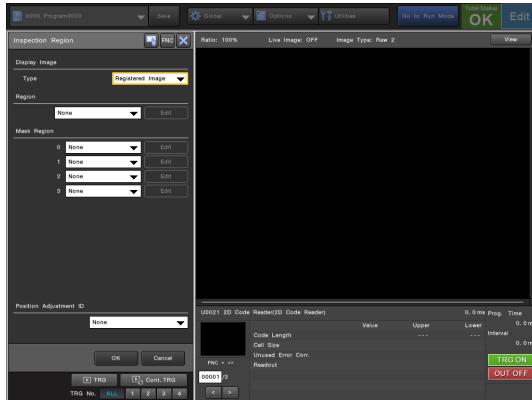
For more details, see "Select Image" (Page 2-471).

Inspect Region

Define the region to be used for unit processing.



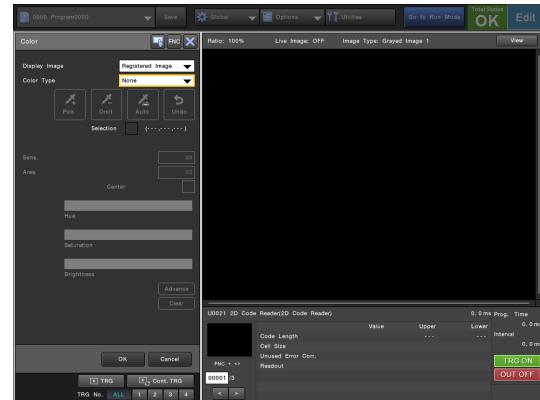
- The smaller the inspection region, the shorter the processing time.
- When there is a background other than the 2D code in the inspection region, there may be a large increase in the processing time and automatic tuning time. Set the region as necessary.
- It is not possible to specify which code to detect when there are 2 or more codes in the inspection region that match the detection conditions (the behavior is uncertain).
- You can only use a rectangle as the 2D Code Reader inspection region.
- You cannot use an image region.
- A region size that exceeds a width of 2,432 pixels or a height of 2,050 pixels cannot be set in the image capture area.



For more details, see "Region Settings" (Page 2-473).

Color

When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.



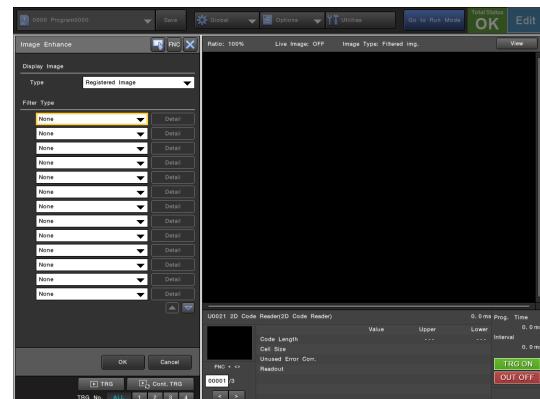
For more details, see "Color Extraction" (Page 2-483).

Image Enhance

Specify the filter processing to apply to the image.



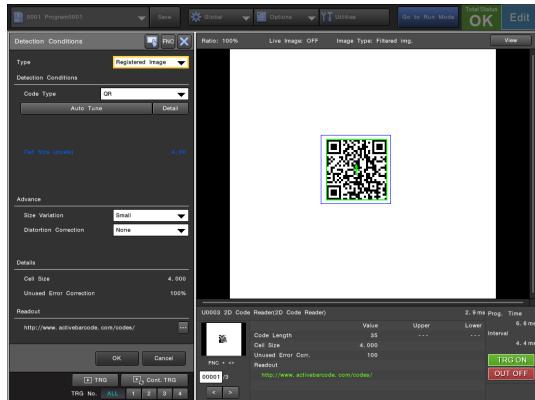
You cannot select the Subtract filter for 2D Code Reader measurement.



For more details, see "Image Enhance" (Page 2-489).

Condition

Specify the conditions to detect 2D Code during measurement.



Display Image

Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Detection Conditions

Code Type

Select the type of 2D code to inspect for.

- QR** (default setting): Measures QR type code.
- Micro QR**: Measures Micro QR type code.
- DataMatrix**: Measures DataMatrix type code.
- Rectangle DataMatrix**: Measures rectangular DataMatrix type code.
- PDF417**: Measures PDF417 type code.
- MicroPDF417**: Measures MicroPDF417 type code.
- Composite Code**: Measures composite code that is made up of 1D and 2D codes. For more details, see "Using Composite Code" (Page 2-289).



If you change the code type, some settings on the screen are reset.

Auto Tune

Use automatic tuning to automatically adjust settings to that which is best suited for the detection of the code.



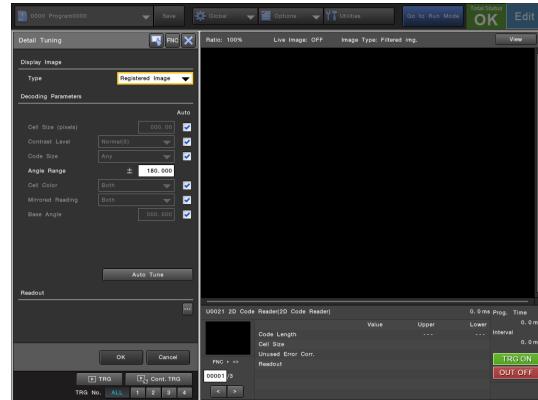
The AT command can be used in order to execute automatic tuning from an external device or menu. For more information about AT command, see the XG-X2000 Series Communications Control Manual.



- Automatic tuning will fail when a settings error is present or when the state is such that even normal detection is not successful (timeout, angle range setting is too small, etc.).
- If the inspection region is large, the influence of background noise may cause automatic tuning to fail or may increase the amount of time required for automatic tuning. Reduce the size of the inspection region as necessary.
- It is not possible to specify which code to detect when there are 2 or more codes in the inspection region (the behavior is uncertain). Make sure that one code is shown in the inspection region when capturing images.

Detail

When the optimal settings cannot be acquired by automatic tuning, or to change the settings that were created by automatic tuning, select [Detail] and manually specify the tuning details on the [Detail Tuning] screen.



For items to be set by automatic tuning, select the [Auto] check box. If the check box is cleared, change the setting for each item accordingly based on the code to inspect.

Cell Size (pixels)

Specify the resolution (number of pixels per cell) that is the standard for the 2D code which will be read (default 0.00). Setting a value that is close to the actual 2D code to read allows for faster and more stable detection.



A cell size of 4.0 pixels or higher is recommended.

2D Code Reader

Contrast Level

Select the contrast level which will be used as a reference when extracting code features from the following: Highest/ High/ Normal/ Low/ Lowest (default: Normal).

Setting a lower value will increase the possibility of detecting the code even when the contrast is poor, however, if the value is set too low the detection will be susceptible to the influence of noise and detection may become unstable. When automatic tuning is used, a value slightly lower than the maximum detectable value is used based on the image used during the tuning.

Code Size

Specify the 2D code size (based on number of horizontal and vertical cells). The available settings are:

- QR: 21 × 21 to 177 × 177
- Micro QR: 11 × 11 to 17 × 17
- DataMatrix: 10 × 10 to 144 × 144
- Rectangle DataMatrix: 8 × 18 to 16 × 48

When automatic tuning is used, the Code Size is set to the numbers of cells in the detected 2D code (default: Any).

When [Any] is selected, code detection is possible regardless of the numbers of cells, however the processing time is longer than if the correct code size is selected.

 **Point** If a number of cells has been selected, 2D codes with different numbers of cells are not detected.

Cell Color

Select the color of the code to be detected relative to the background.

- **Both** (default): Detection of both black codes on white backgrounds and white codes on black backgrounds are possible. However, the processing time will be longer than when [Black] or [White] is selected.
- **Black**: Detection of black codes on white backgrounds only.
- **White**: Detection of white codes on black backgrounds only.

Mirrored Reading

Changes the internal processing in order to read mirror-image codes when images are captured through a mirror, a prism, from the reverse side of a transparent sheet, or other similar circumstances.

- **Both** (default): Both normal codes and mirror-image codes are detected. However, processing time will be longer than when [Standard Only] or [Mirrored Only] is selected.
- **Standard Only**: Only normal codes are detected (mirrored codes cannot be detected).
- **Mirrored Only**: Only mirrored codes are detected (normal codes cannot be detected).

 **Point** If [Mirror/Rotate Image] is used in the capture unit (Page 2-29), this mirror inversion is applied to the inverted or rotated image.

Base Angle

Specify the base angle for code detection (default: 0.000).

 **Reference** The base angle 0° state for each code is the state shown in "2D Code Reader Unit: Supported Codes" (Page 2-274).

Angle Range

Specify the code angle detection range relative to the base angle (default setting: 180.000). Limiting the angle range can result in faster and more stable detection.

 **Reference** The value set for [Base Angle] is used as the reference angle for the detection range set with [Angle Range].

Auto Tune

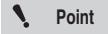
To check what the result of automatic tuning will be based on the current settings of the [Detail Tuning] screen, select [Auto Tune] to start the tuning process.

Advance

Size Variation

Specify the level of variation to allow when the size of the code changes. The smaller the allowed variation, the shorter the processing time and less chance for false detection.

- **Small** (default setting): Detects codes with a ±10% size variation.
- **Medium**: Detects codes with a ±20% size variation.
- **Large**: Detects codes with a ±30% size variation.
- **Unlimited**: Allows detection of all size variations.

 **Point** When [Unlimited] is selected, operation is possible even when Cell Size (pixels) has not been set. However, specifying a value that is close to the actual 2D code size will allow for faster and more stable detection.

Distortion Correction

Use this setting for distorted codes.

- **None** (default setting): Distortion correction is not performed.
- **Linear**: Additional processing is performed to correct for linear distortion (due to camera mounting angle) up to 30°.

Extended Search (only when DataMatrix or Rectangle DataMatrix is selected)

- **OFF** (default setting): Code detection is attempted several times in a short period of time. If no code is detected an error is returned.
- **ON**: Code detection is attempted repeatedly until code is detected. Compared to when [OFF] is selected, detection capability may increase but processing time may also increase greatly if detection results in a failure.

Cell size

Displays the code resolution of the detected 2D code as the number of pixels per cell.

Unused error correction

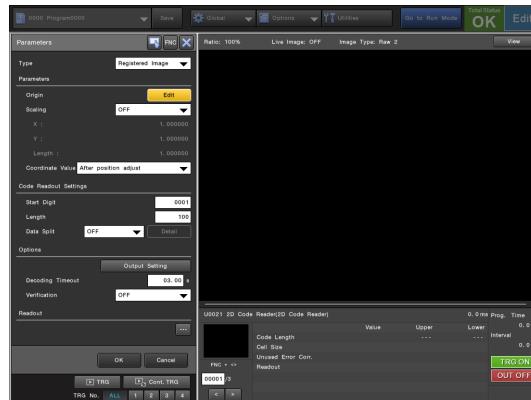
Displays the available (unused) error correction of the detected 2D code as a percentage (0 - 100%).

Readout

Displays the data read using the current settings.

Parameters

Specify other conditions for the 2D Code Reader tool as required.



Type

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.



The origin can be set outside the process region.
The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels internally. However, you can convert the result data and setting parameters used for on-screen display, judgment, and calculation to the desired units, such as actual dimension values. (This process is called "scaling".)

- OFF** (default setting): Do not use scaling.
- ON**: Use scaling.



- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, see "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate Value

Select the coordinate axes to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- **After position adjust** (default setting): The inspection uses the adjusted coordinate axes determined after position adjustment.
- **Before position adjust**: The distance from the position specified for the [Origin] of the inspection is used.

Code Readout Settings

Start Digit

Specify the digit (1 to 9999) to use as the start point for reading data from the detected code.

Length

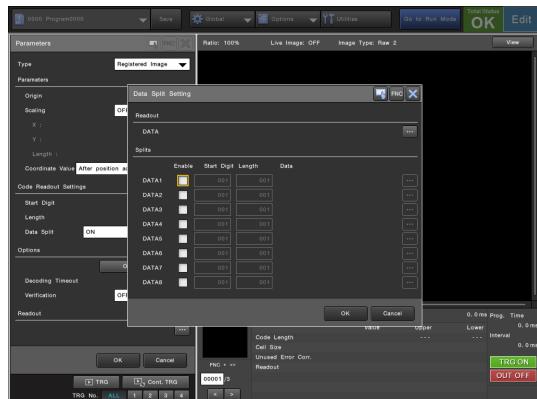
Specify the number of characters to read (1 to 512 characters, in bytes) beginning from the starting digit.

Point As this function forcibly divides the data at the designated points, if the start or end digit is in the middle of a kanji, kana, or other 2-byte character, the character may become garbled.

Data Split

Select whether or not to split the data into segments when reading it. The data which is divided and read, can be referenced individually and output externally as a reference pattern.

- **OFF** (default setting): The read data is not divided.
- **ON**: The read data is split into a maximum of eight segments for output and judgment. When [Detail] is selected, the [Data Split Setting] menu is displayed; specify Enable/Disable, the starting digit, and data length for each split data.

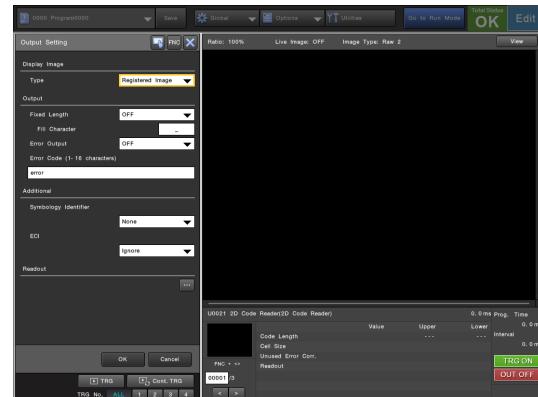


Point Because this forcibly divides the data at the designated points, if the starting digit or data length is in the middle of a kanji, kana, or other 2-byte character, the character may become garbled.

Options

Output Setting

Displays the [Output Setting] screen for setting the parameters for output of the read data.



- **Fixed Length**: Select whether to fix the data output length.
 - **OFF** (default setting): Outputs the data for the number of read characters up to a maximum of the value that was set for [Length]. (The data output length varies according to the number of characters that were read.)
 - **ON**: Outputs only the data for the predetermined number of characters that was set in [Length]. If the number of read characters is less than this number, the character data specified in [Fill Character] is added.
- **Fill Character**: Specify the supplemental character to complete the data if the number of read characters is insufficient with [Fixed Length] set to [ON] (default setting: _ (underscore)).
- **Error Output**: Select whether to output errors that occurred during data reading.
 - **OFF** (default setting): Do not output.
 - **ON**: Outputs the specified character string.
- **Error Code (1-16 characters)**: Specify the character string to output if an error occurs with [Error Output] set to [ON]; up to 16 characters can be specified (default setting: error).
- **Symbology Identifier**: Select whether to add an identifier (three characters: three bytes) to identify a symbol.
 - **None** (default setting): Do not add a symbol identifier.
 - **Output**: Add the symbol identifier (three bytes) that is defined in ISO/IEC 15424/ JIS X 0530 "Data carrier identifiers (including symbology identifiers)" to the start of the read data.

The symbol identifiers to be added are as follows.

Code type	Added data	Condition
QR Code (including Micro QR)	JQ0	Model 1 (or Micro QR)
	JQ1	Model 2 (not including ECI)
	JQ2	Model 2 (including ECI)
	JQ3	Model 2 (not including ECI, FNC1: exists in No. 1 position)
	JQ4	Model 2 (including ECI, FNC1: exists in No. 1 position)
	JQ5	Model 2 (not including ECI, FNC1: exists in No. 2 position)
DataMatrix (including Rectangle DataMatrix)	JQ6	Model 2 (including ECI, FNC1: exists in No. 2 position)
	jd1	ECC 200 (not including ECI)
	jd2	ECC 200 (not including ECI, FNC1: exists in No. 1 or No. 5 position)
	jd3	ECC 200 (not including ECI, FNC1: exists in No. 2 or No. 6 position)
	jd4	ECC 200 (including ECI)
	jd5	ECC 200 (including ECI, FNC1: exists in No. 1 or No. 5 position)
	jd6	ECC 200 (including ECI, FNC1: exists in No. 2 or No. 6 position)

If you append an identifier (three characters: three bytes) to identify symbols when using PDF417/MicroPDF417, the appended character string is "JL0".

- **ECI:** Select the handling of codes which contain Extended Channel Interpretation (ECI). (This does not affect the reading of codes which do not contain ECI.)
 - **Ignore** (default setting): ECI data is not output.
 - **Output:** ECI data is output

Decoding Timeout

Set a maximum processing time. When the processing time at a unit exceeds the set value (0.01 s to 60 s: default 3 s) due to the conditions of the captured image, it is determined that there is an error in the unit processing and timeout occurs.

 **Point** The set value is approximate. There may be some difference in the time when actual timeout occurs.

Verification

For the 2D code captured, perform verification according to the specified print quality evaluation specified by a third-party organization. In addition to the output of verification results, the overall symbol grade is judged high or low with regards to the specified threshold. The verification results can be used as judgment conditions.

- **OFF** (default setting): The verification function is not used.
- **ISO/IEC 15415:** Print quality is verified by the ISO/IEC 15415 standard. It is the 2D code print quality evaluation standard specified by the International Organization for Standardization (ISO). It is mainly used for evaluation of the 2D code printed on labels.
- **AIM DPM-1-2006:** Print quality is verified by the AIM DPM-1-2006 standard. It is the direct parts marking 2D code print quality evaluation standard specified by the Automatic Identification Manufacturers (AIM). It is based on ISO/IEC15415.
- **SAE AS9132** (Only when DataMatrix or Rectangle DataMatrix is selected): Print quality is verified by the SAE AS9132 standard. It is the print quality evaluation standard of the DataMatrix code used in the aerospace industry specified by the Society of Automotive Engineers (SAE).

 **Point**

- The verification function of the controller is just a function to evaluate the 2D code print quality for the captured image according to the standard. It cannot be used as an official 2D code verification unit.
- When verification [SAE AS9132] is selected and the code type on the [Condition] screen is changed from DataMatrix (or Rectangle DataMatrix) to QR (or Micro QR), the verification is initialized to [OFF].
- The only evaluation method that you can specify when using PDF417/MicroPDF417 is [ISO/IEC 15415].
- If you change the verification settings, the print quality tolerance settings on the [Limits] screen will be reset.

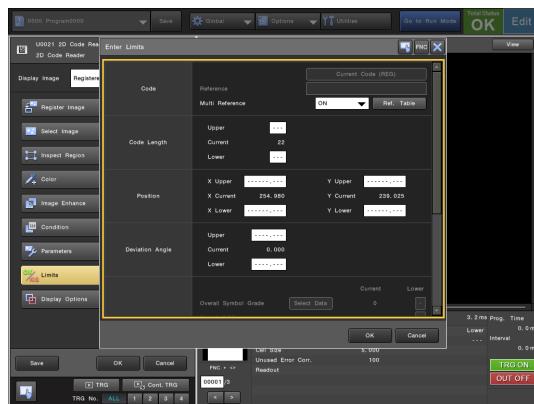
Readout

Displays the data read using the current settings.

2D Code Reader

Limits

Set the matching pattern to be compared with the read code data and the tolerance (upper and lower limits) for the detection results measured value. When the code reading result does not match the criteria or when the measured value is outside of the specified tolerance range, it is judged as "NG". When the result matches the criteria and the measured value is within the tolerance range, it is judged as "OK".



Select the desired tolerance and then enter a value.

- If no limits or tolerances are set, judgment is not performed even when a measurement is executed.
- The unit of the tolerance varies depending on the type of the measured value.

Code

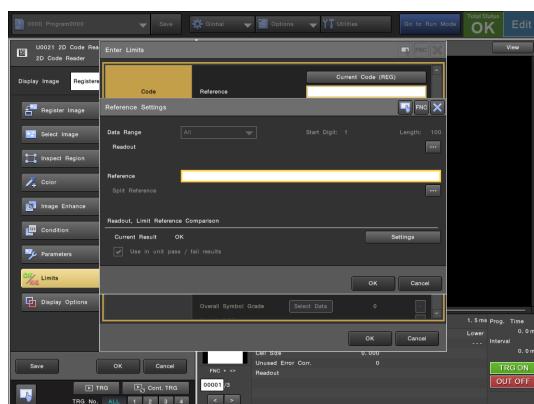
Current Code (REG)

Register up to 512 characters (512 bytes) from the data that was read with the current settings as a REG reference pattern.

- If the reference pattern field is blank and the Multi Reference (Page 2-286) is set to [OFF], REG is automatically input; the read result for the currently displayed image is registered.
- For more details about REG, see "REG (registered string)" (Page 2-284).

Reference Settings

When [Reference] is selected, the Reference Settings menu appears where a matching pattern, a matching method, or other matching criteria can be specified.



- When the [Multi Reference] (Page 2-286) is set to [ON], [Reference] cannot be selected.
- To set multiple references, select [Ref. Table] (Page 2-286) to display the [Multi Reference Table Settings] screen; select [Edit] to display the reference setting menu for the desired reference.

- **Data Range:** Select the data range to check against the reference pattern (default setting: [All]). If [Data Split] (Page 2-282) on the [Parameters] screen is set to [ON], the split (1 through 8) can be specified and checked against any area of the read data.



When [Data Split] is not set to [ON] on the [Parameters] screen, [All] is fixed.

- **Readout:** Displays the data read using the current settings.
- **Reference:** When the input field is selected, the software keyboard appears; enter up to 32 characters or symbols (32 bytes) as a reference pattern.

- You can combine fixed characters with reference tolerances that automatically change the content together with external information such as date and time, and the Calculation tolerance which references a variable.
- Readout: Specify the current read data as the reference pattern.
- Special characters: The following control characters can be used in the string.

* , #: Checks only the presence of data corresponding to one character (one byte) and ignores the reference.

!: Ignores the reference of arbitrary characters from the point where ! is used and onwards.

Example: Differences in results when using "*" ("#") versus "!"

Reading results	Reference pattern	
	AB* (AB#)	AB!
AB	→	NG OK
ABC	→	OK OK
ABCD	→	NG OK

REG (registered string): The reading result from the currently displayed image is used as the reference pattern. When [OK] is selected on the confirmation screen, the read result from the currently displayed image is registered as a reference pattern (In a normal reference pattern, up to 32 characters (32 bytes) can be entered. In the case of REG, however, up to 512 characters (512 bytes) can be registered).

Furthermore, selecting [Current Code (REG)] on the [Limits] screen also allows the reading result to be registered again.



The CW command can be used to rewrite the REG data on the controller. For more details, see the XG-X2000 Series Communications Control Manual.



- It is not possible to use two or more of the special character "!" in the reference pattern. If two or more are used, matching is not possible.
- The REG (registered string) cannot be used in combination with other fixed characters or other tolerance types. It also cannot be used with multiple reference patterns.
- When the captured image is selected for the display image and there is no previous result, REG is cleared (a blank field is registered). Be sure that a code has been detected before registering the reading results.

- **Date & time tolerances:** The following date time functions from the internal calendar can be used in the string.

Year4: Four digit calendar year

Year2: Two digit calendar year

Month: Two digit month

Day: Two digit day

Hour: Two digit hour

Example: Verifying the current year/month/day (January 1, 2017) using the date tolerances which are linked to the internal calendar.

String	Registered pattern
Year4/Month/Day →	2017/01/01

This example uses both the calendar tolerance and the fixed character "/".



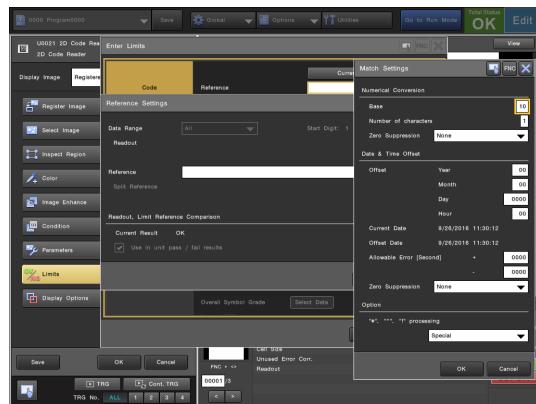
- A user specified offset and allowable error can be set for the date time functions of the calendar tolerance. For more details, see "Allowable Error [Second]" (Page 260).
- Zero suppression (Page 2-262) can be set for the Month, Day, and Hour.

- **Variable:** Variable values are converted into string tolerances. The conversion method is determined by the settings in the [Numerical Conversion] series of options.

Example: For a 7-character string composed of text ("TEST") plus a 3-digit serial number (#Count01) to which 1 is added at each inspection in the Calculation unit (Numerical Conversion: base 10 / 3 digits, zero suppression: None.)

String	Registered string
TEST#Count01 →	TEST000 to 999 (After 999, the count returns to 000.)

• **Match Settings:** On the [Match Settings] screen, the detailed matching method can be specified.



- **Numerical Conversion:** Specify the number base and number of recognized characters used for conversion of numerical variables to string tolerances used in the limit settings.

Base: Set the base (10 to 36) used for converting the value of the reference variable into the calculation tolerance (default setting: base 10).

Example: Numerical conversion when base is set to base 36.

Calculation result	0	to	9	10	to	35
Calculation tolerance	0	to	9	A	to	Z

Number of characters: Specify the number of characters to use after conversion of the calculation tolerance (1 to 6, default setting: 1).



Converted numerical values that result in the number of characters being exceeded are excluded (Example of when the Base is 10 and the Number of characters is 2 : the Calculation result 350 results in the Calculation tolerance being 50).

Zero Suppression: Judgment is done with the zeros at the start of the Calculation tolerance removed. For more details, see the description of "Zero suppression" in "Date & Time Offset" (Page 2-285).

- Date & Time Offset

Offset: Add an offset to the values of the date and time tolerances which are used in the string for judgment. The offset result is displayed as the offset data in the [Setup Calendar] screen. The range of offset values that can be specified are: Year: ±10, Month: ±12, Day:±1999, Hour:±24 (By default, all of the offset values are set to 0).

Allowable Error [Second]: Specify the allowable error in time difference between the internal calendar and the external device (target character string) at the turn of the day or hour. This error is used for judgment of the calendar tolerance. Enter absolute values up to 3599 seconds on both + and - sides (default:0).

2D Code Reader

Example: Judgment results when the allowable error is set to ± 60 seconds at the turn of the day

Current internal calendar time	2016.12.31		2017.1.1	
	-23:58:59	23:59:00 ~23:59:59	0:00:00 ~0:01:00	0:01:01~
Printing 2016/12/31	OK		OK	NG
Printing 2017/1/1	NG	OK	OK	

Allowable error -60 seconds Allowable error +60 seconds

Zero Suppression: Judgment is done with the zeros at the start of the Date & time tolerances and Calculation tolerance removed.

None (default setting): Do not suppress zeros.

Space forward: Replace leading zeros with a space placed at the front of the number.

Space backward: Replace leading zeros with a space placed at the back of the number.

Remove zeros: Remove all leading zeros.

Point Zeros in both digits of the 2-digit year are exempt from zero suppression regardless of the setting.

Example: Conversion result of the registered character strings using zero suppression

Zero suppression setting	Date & time tolerance	Calculation tolerance
None	08/08/25	00350
Space forward	08/_8/25	_350
Space backward	08/8/_25	350_
Remove zeros	08/8/25	350

Underscore "_" is used to symbolize a space.

- "#", "*", "!" processing:** Select whether "#", "*", and "!" are used as special characters (default setting) for reference pattern judgment or used as ordinary characters as they are.
- Use in unit pass / fail results:** Select this box to use the matching result for unit judgment (default setting: enabled). Clear the check box in order to execute reference only without affecting judgment when using multiple reference settings.

Point If [Multi Reference] (Page 2-286) is set to [OFF], this option is fixed to enabled state.

Multi Reference

Select [ON] when setting multiple reference settings (default setting: [OFF]).

Point When this setting is changed from [ON] to [OFF], the second and later reference settings are cleared.

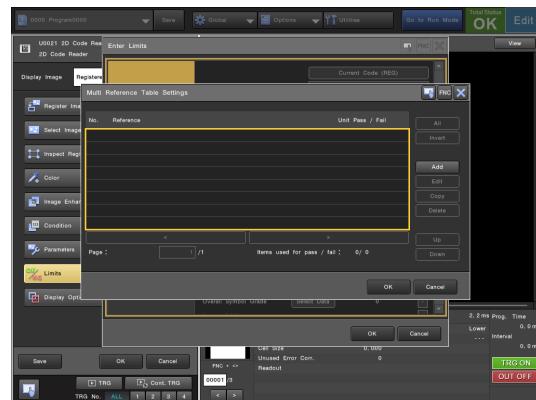
Ref. Table

Multiple reference conditions can be added, modified and deleted in the table display. Select to display the [Multi Reference Table Settings] screen on which multiple reference conditions can be displayed and/or edited.



Point

The [Ref. Table] cannot be selected when [OFF] is selected for [Multi Reference].



- All:** Selects all the reference settings displayed in the list.
- Invert:** Inverts the current selection.
- Add/Edit:** Add/Edit reference settings (up to 16 conditions). Select this to display the [Reference Settings] screen (Page 2-284) on which reference settings such as the reference pattern and match settings can be specified; specify various conditions such as the reference pattern, and so on.
- Copy:** Copy the currently selected reference settings.
- Delete:** Delete the currently selected reference settings.
- Up/Down:** Change the order of the currently selected reference settings.



- A maximum of 16 reference settings can be added.
- When multiple reference settings are made, it is possible to reference a combination of ranges from the read data, and to perform sorting based on the results data according to which of the reference setting numbers was matched.
- When used for sorting, clear the [Use in unit pass / fail results] check box on the [Reference Settings] screen (default setting: enabled) in order to execute reference only without the mismatch results affecting the judgment.

Code length

Set the tolerance for the number of characters read from the code.

The measured value is the number of characters (bytes) which was read at the inspection.



Point

- The number of characters applies to the read range specified in the Code Readout Settings on the [Parameters] screen.
- Alphanumeric and other half-size characters are handled as one byte per character, while kanji, kana, and other full-size characters are handled as two bytes per character.

Position

Specify the tolerance for the coordinates of the detected position of the code.
The measured value is the number of pixels indicating position.

Deviation Angle

Specify the tolerance for the tilt angle of the code.
The measured value is an angle in degrees.



The deviation angle is the angle difference from the [Base Angle] on the [Condition] screen.

Quality Verification

Specify the tolerance for the print quality verification result of the 2D code.

Overall Symbol Grade

Specify the overall symbol grade tolerance of the print quality. If you select [Select Data], you can specify the items to include in the overall symbol grade judgment on the [Overall Symbol Grade Condition] screen.

- The overall symbol grade is the lowest value of the items selected.
- For each print quality item, numerical data (4 (A) to 0 (F)) can be output from the data output unit. (If evaluation is not performed, -1 is output.)
- The print quality verification items that can be used vary depending on the print quality verification method.

	Verification method		
	ISO/IEC 15415	AIM DPM- 1-2006	SAE AS9132
Decode (DEC)	○	○	-
Quiet Zone (QZ)	-	-	○
Symbol Contrast (SC)	○	-	○
Cell Contrast (CC)	-	○	-
Modulation (MOD)	○	-	-
Cell Modulation (CM)	-	○	-
Angular Distortion (AD)	-	-	○
Module Fill (MF)	-	-	○
Reflectance Margin (RM)	○	○	-
Fixed Pattern Damage (FPD)	○	○	-
Axial Nonuniformity (AN)	○	○	-
Grid Nonuniformity (GN)	○	○	-
Unused Error Correction (UEC)	○	○	-
Format Information Damage (FID)	○	○	-
Version Information Damage (VID)	○	○	-
Print Growth Horizontal (PGH)	○	○	-
Print Growth Vertical (PGV)	○	○	-



For [Format Information Damage] and [Version Information Damage], when the code type is not QR or Micro QR, judgment processing is not performed even if the judgment value has been set. Even if the check box on the [Overall Symbol Grade Condition] screen is selected, it is not included in the judgment of the overall symbol grade.

Decode(DEC)

Evaluates if decoding can be performed.

Quiet Zone(QZ)

Evaluates if the quiet zone of 1 cell or more is available around the code.

Symbol Contrast(SC)

- **ISO/IEC 15415:** Evaluates the difference between the maximum brightness value (Rmax) and the minimum brightness value (Rmin) in the code area.
- **SAE AS9132:** Evaluates the difference between the dark cell maximum brightness value and the bright cell minimum brightness value in the code area.

Cell Contrast(CC)

Evaluates the difference between the average (ML) of the bright cell brightness value and the average (MD) of the dark cell brightness value.

Modulation(MOD)

Evaluates the degree of variation of the cell brightness.

Cell Modulation(CM)

Evaluates the degree of variation of the cell brightness.

Angular Distortion(AD)

Evaluates the distortion level from a 90-degree angle of the angle of the L-shape part formed with a straight line.

Module Fill(MF)

Evaluates the deviation of the cell size from the correct size.

Reflectance Margin(RM)

Evaluates the degree of variation of the cell brightness considering the correct black and white of the cell.

Fixed Pattern Damage(FPD)

Evaluates the damage level of the fixed pattern that depends on the code type.

Axial Nonuniformity(AN)

Evaluates the distortion level of the code vertical and horizontal size.

Grid Nonuniformity(GN)

Evaluates the maximum deviation of each cell position.

Unused Error Correction(UEC)

Evaluates the percentage of error correction not used in decoding.

Format Information Damage(FID)

Evaluates the damage level of the QR code format information.

2D Code Reader

Version Information Damage(VID)

Evaluates the damage level of the QR code version information (version 2 or later of model 2).

Print Growth Horizontal(PGH)

Evaluates the extension/shrinkage of the mark cell in the horizontal direction.

Print Growth Vertical(PGV)

Evaluates the extension/shrinkage of the mark cell in the vertical direction.

Precautions When Using PDF417/MicroPDF417

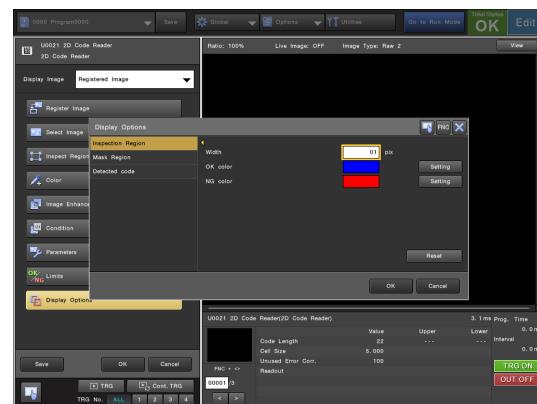
The tolerance of the quality verification result that can be specified when using PDF417/MicroPDF417 are as follows.

- Overall Symbol Grade
- Decode (DEC): Evaluates whether it can be decoded.
- Edge Determination (EDGE): Determines whether the number of read edges is equivalent to the anticipated number of edges.
- Symbol Contrast (SC): Evaluates the difference between the maximum (Rmax) and minimum (Rmin) brightness value in the code area.
- Minimum Reflectance (MINR): Evaluates the minimum reflectance in the scan wave form.
- Minimum Edge Contrast (MINE): Evaluates the minimum value of the reflectance difference between the space (including the quiet zone) and the neighboring bar.
- Modulation (MOD): Evaluates the ratio of the minimum edge contrast to the symbol contrast.
- Minimum Quiet Zone (QZ): Evaluates whether the quiet zone width complies with the standard.
- Decodability (DCD): Evaluates the defined decode margin (the size of the error between the ideal line width pattern and the actual line width pattern) for each code type.
- Defects (DEF): Evaluates the color irregularity inside the element.
- Codeword Yield (CY): Evaluates the read success rate of codewords.
- Codeword Print Quality (CPQ): Evaluates the print quality of the codewords.
- Unused Error Correction (UEC): Evaluates the ratio of error corrections that were not used during decoding.

Display Options

Specify the display methods for things such as the inspection region and mask region.

You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection region

Specify the line thickness and display color of the inspection region.

Mask region

Specify the line thickness and display color of the mask region.

Detected Code

Specify the thickness and display color of the region and detected point (center) of the detected code.

Reset

Restore the display options to their default settings.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



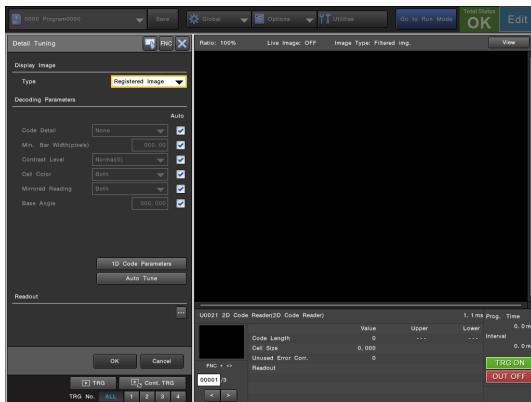
- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

Using Composite Code

To use composite code, you need to configure settings on the screens below.

Specifying the Code Type ([Condition] screen)

In the [Code Type] field, select [Composite Code] - [Detail], and then change the settings.



- 2D Code and Common Areas:**

- As the code type for the 2D code area in the composite code, in the [Code Detail] field you can select from [CC-A], [CC-B], and [CC-C].
- You can also change the other code detection condition settings for composite codes.

- 1D Code Area:**

- Select [1D Code Parameters] and as the 1D code type for the 1D code area in composite code, select from [EAN/JAN/UPC], [GS1 Databar], and [GS1 128].
- You can also specify [Code Detail] and [Code Length] if necessary.

Symbology Identifier ([Parameters] Screen)

- If you selected [GS1 Databar] or [GS1 128] in the 1D code area:
]e0 (barcode data) (2D code data)
- If you selected [EAN/JAN/UPC] in the 1D code area:
 -]E0 (barcode data)]e0 (2D code data):
Standard data for all EAN formats (EAN-13/JAN-13/UPC-A/UPC-E (excluding add-ons))
 -]E3 (barcode data)]e0 (2D code data):
Composite data made up of EAN-13/JAN-13/UPC-A/UPC-E + add-ons
 -]E4 (barcode data)]e0 (2D code data):
EAN-8/JAN-8 data (independent of existence of add-ons)

Verification ([Parameters] Screen)

The only evaluation method that you can specify is [ISO/IEC 15415].

Quality Verification ([Limits] screen)

The tolerance of the print quality verification result that can be specified are as follows.

By specifying the target code in the [Target] field, you can specify the items to be evaluated for each of the 2D and 1D code areas.

- Overall Symbol Grade
- Decode (DEC): Evaluates whether it can be decoded.
- Edge Determination (EDGE): Determines whether the number of read edges is equivalent to the anticipated number of edges.
- Symbol Contrast (SC): Evaluates the difference between the maximum (Rmax) and minimum (Rmin) brightness value in the code area.
- Minimum Reflectance (MINR): Evaluates the minimum reflectance in the scan wave form.
- Minimum Edge Contrast (MINE): Evaluates the minimum value of the reflectance difference between the space (including the quiet zone) and the neighboring bar.
- Modulation (MOD): Evaluates the ratio of the minimum edge contrast to the symbol contrast.
- Minimum Quiet Zone (QZ): Evaluates whether the quiet zone width complies with the standard.
- Decodability (DCD): Evaluates the defined decode margin (the size of the error between the ideal line width pattern and the actual line width pattern) for each code type.
- Defects (DEF): Evaluates the color irregularity inside the element.
- Codeword Yield (CY): Evaluates the read success rate of codewords.
- Codeword Print Quality (CPQ): Evaluates the print quality of the codewords.
- Unused Error Correction (UEC): Evaluates the ratio of error corrections that were not used during decoding.



Codeword Yield (CY), Codeword Print Quality (CPQ), and Unused Error Correction (UEC) can only be specified for the 2D code area.

When Codes Cannot be Read Correctly

If code tuning and reading are not possible, check whether any of the following problems exists.

Code resolution is low

Increase the CCD area for the 2D code as much as possible by adjusting the lens or using a higher resolution camera using 4 pixels per cell as a minimum guideline.

Poor contrast

Try using contrast conversion or another image enhancement filter (Page 2-278) to improve the contrast. If [Grayscale] is selected for color extraction (Page 2-278) with a color camera, using [RGB Grayscale] may improve the contrast.

Code is out of focus

Check the lens focus adjustment and shutter speed.

Printing of the code itself is either distorted or there is deviation/collapse of the cell

Check the code printing / marking conditions.

Gaps between cells or holes in cells

Use a combination of expand, shrink, and other image enhancement filters (Page 2-278) and attempt to connect the cells and or fill the holes.

Small quiet zone (less than 2 cells)

Check that there is sufficient blank space (minimum space equivalent to the size of 2 cells) around the code within the inspection region. If the code position is displaced toward the edge of the inspection region, consider position adjustment using the position adjustment unit (Page 2-306).

When Using [Position Adjustment], [Use Interpolation] Is [OFF]

Turn [Use Interpolation] to [ON] in the Position Adjustment Unit (Page 2-306).

[Condition] screen settings are not suitable

Try setting [Linear] for [Distortion Correction] and setting [Extended Search] (DataMatrix only) to [ON] to increase the probability of detecting the code.

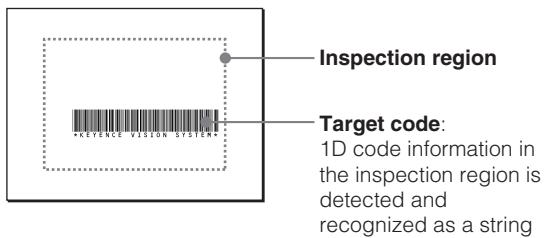
1D Code Reader

1D Code Reader

The 1D code information in the inspection region is detected and texts included in the 1D code in the captured image are read.

In addition to external output of the string that was read, the reader can also verify and judge the data against pre-registered contents as well as dynamically changing contents such as dates, times, and serial codes. When multiple reference patterns are registered in advance, this tool can also be conveniently used for sorting and other purposes.

Measurement Overview



1D Code Reader Unit: Supported Codes

Codes in the following formats are supported.

Code39

The unit can read CODE39.



KEYENCE VISION SYSTEM



Full ASCII conversion is not supported.

Code128

The unit can read CODE128.



test123



The "FNC2" character used to link messages is not supported.

EAN/JAN/UPC

The unit can read EAN(JAN) and UPC. The unit can read EAN(JAN)-8, EAN(JAN)-13, UPC-A, and UPC-E.



5 963423 133425

The unit can also read barcodes with added two character or five character add-on codes.



0 023424 424320



2 3 4 2 3

GS1 Databar

The unit can read GS1 Databar. The unit can read Databar, Databar Stacked, Databar Limited, and Databar Expanded.



0112345678901231



GS1 Databar Expanded Stacked is not supported.

1D Code Reader**ITF**

The unit can read ITF.

**Codabar/NW-7**

The unit can read Codabar/NW-7.

**Pharmacode**

The unit can read Pharmacode.

**Main measurement results**

The standard results and data returned by 1D Code Reader tool are as follows:

Code Length	The length of the read data is output in bytes. [Tolerance inspection target]
Readout	Outputs the decoded data as a string. [Tolerance inspection target]
Position X	Outputs the center X coordinate (pixels) of the detected 1D code [Tolerance inspection target]
Position Y	Outputs the center Y coordinate (pixels) of the detected 1D code. [Tolerance inspection target]
Position XY	Outputs the center XY coordinates (pixels) of the detected 1D code.
Deviation angle	Outputs the angle difference of the detected 1D code from the base angle. [Tolerance inspection target]
Pos. XY / Deviation Angle	Outputs the center XY coordinates and deviation angle (pixels and angle) of the detected 1D code.
Split 1 Length to Split 8 Length	Outputs the length of the read split data No. 1 to No. 8 in bytes.
Split 1 Readout to Split 8 Readout	Outputs the character strings of split data No. 1 to No. 8. [Tolerance inspection target]
Min. Bar Width	Outputs the resolution of the detected 1D code as the number of pixels per module.
Bar Color	Outputs the marking color of the detected 1D code. (0: Not detected, 1: Black on white background, 2: White on black background)
Code angle	Outputs the detection angle of the detected 1D code, using the base angle as 0°.
Code data length	Outputs the length of all code data contained in the detected 1D code as a number of bytes.
Stability	Outputs the read stability (5: high to 1: low, 0: read failure)
Read error	Outputs whether or not a reading error occurred. (0: Reading successful, 1: Reading failed)
Read error reason	Outputs the cause of a reading error. (0: Reading successful, 1: Decoding failed, 2: Timeout)
Multi Reference No.	Outputs the lowest number of the reference setting that was matched.
Reference 1 to Reference 16	Outputs the characters strings of reference patterns No. 1 to No. 16.
Reference Result	Outputs an overall judgment result for all reference settings.
Reference Result1 to Reference Result16	Outputs reference results No. 1 to No. 16. (-1: Matching impossible, 0: Matched, 1 or higher: No. of the digit where mismatch occurred).
Code Area: Point 1X	Outputs the region information (first coordinate X) (pixels) of the detected 1D code.
Code Area: Point 1Y	Outputs the region information (first coordinate Y) (pixels) of the detected 1D code.
Code Area: Point 1XY	Outputs the region information (first coordinate XY) (pixels) of the detected 1D code.
Code Area: Point 2X	Outputs the region information (second coordinate X) (pixels) of the detected 1D code.
Code Area: Point 2Y	Outputs the region information (second coordinate Y) (pixels) of the detected 1D code.
Code Area: Point 2XY	Outputs the region information (second coordinate XY) (pixels) of the detected 1D code.
Code Area: Point 3X	Outputs the region information (third coordinate X) (pixels) of the detected 1D code.

Code Area: Point 3Y	Outputs the region information (third coordinate Y) (pixels) of the detected 1D code.
Code Area: Point 3XY	Outputs the region information (third coordinate XY) (pixels) of the detected 1D code.
Code Area: Point 4X	Outputs the region information (fourth coordinate X) (pixels) of the detected 1D code.
Code Area: Point 4Y	Outputs the region information (fourth coordinate Y) (pixels) of the detected 1D code.
Code Area: Point 4XY	Outputs the region information (fourth coordinate XY) (pixels) of the detected 1D code.
Unit judgment value	When the measurement result of the tolerance judgment target is outside the specified tolerance (upper limit and lower limit), or when the read string does not match the reference setting string, it is judged as [NG] (binary 1). When the result is within the tolerance and the detected string matches the reference setting string, it is judged as [OK] (binary 0).

- Point**
- For the measurement results where a character string is output (Readout, Split Data 1 - 8, Reference Pattern 1 - 16), the character string result is acquired when no array element is specified (example: ID_DATA[]), and the numeric value result is acquired when an array element is specified (example: ID_DATA[0]).
 - If [PC Program] was set as the destination for results output, then for measurement results where a character string is output (Readout, Split Data 1 - 8, Reference Pattern 1 - 16), the maximum number of characters which can be output for 1 item is limited to 80. Use "Data Split" (Page 2-298) as necessary.

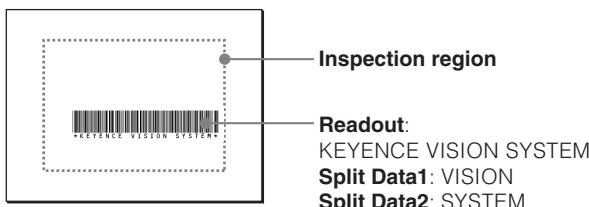
Reference

For the lists of available measurement output values and setting parameters, see "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

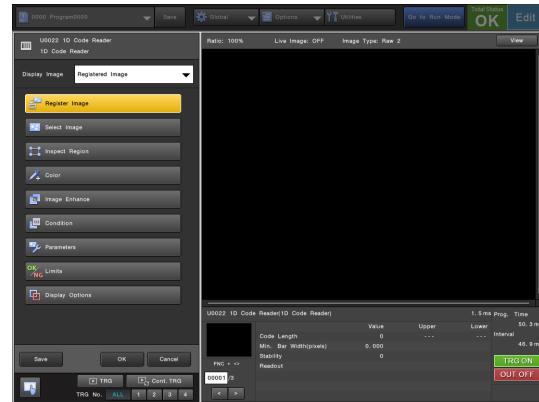
Example showing the results of a measurement performed under the following conditions:

- Code Type: Code39
- Start Digit: 1
- Data Length: 100
- Data Split: ON
- DATA1: Start Digit 9, Data Length 6
- DATA2: Start Digit 16, Data Length 6



Top Menu

The top menu of the 1D Code Reader tool consists of the following options. Configure settings under each option as required for the inspection.

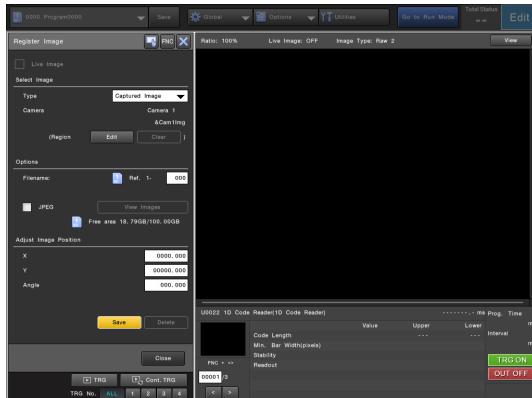


Register Image (Page 2-294)	Register an image to be used as a template for settings.
Select Image (Page 2-294)	Specify the captured image and registered image to use for measurement.
Inspect Region (Page 2-294)	Define the region to be used for unit processing.
Color (Page 2-295)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.
Image Enhance (Page 2-295)	Specify the filter processing to apply to the image.
Condition (Page 2-295)	Specify the conditions to detect 1D Code during measurement.
Parameters (Page 2-298)	Specify other conditions for the 1D Code Reader tool as required.
Limits (Page 2-300)	Set the reference pattern for the read code and the tolerance (upper limit and lower limit) for the detection results measured value.
Display Options (Page 2-304)	Specify the display methods for things such as the inspection region and mask region.
Save (Page 2-305)	Save the current state to the program file.

1D Code Reader

Register Image

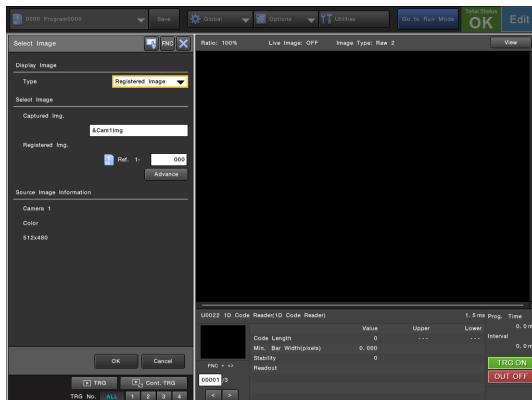
Register an image to be used as a template for settings.



For more details, see "Register Image" (Page 2-468).

Select Image

Specify the captured image and registered image to use for measurement.



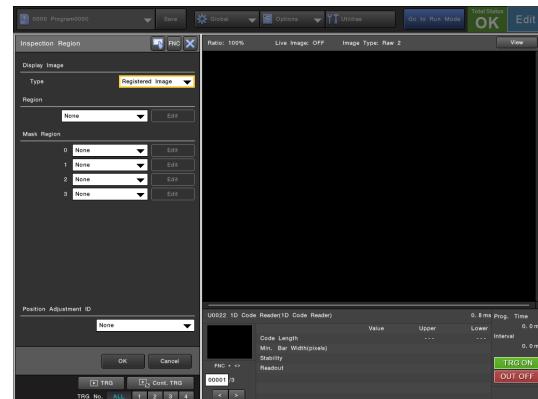
For more details, see "Select Image" (Page 2-471).

Inspect Region

Define the region to be used for unit processing.



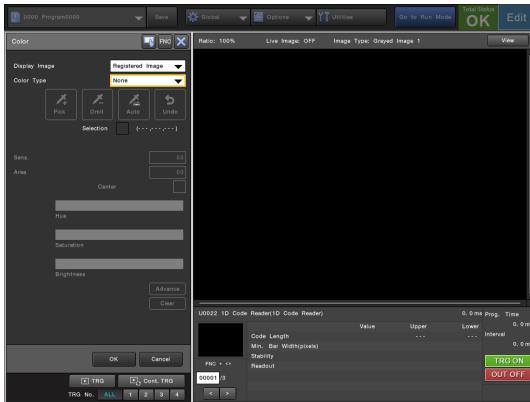
- The smaller the inspection region, the shorter the processing time.
- When there is a background other than the 1D code in the inspection region, there may be a large increase in the processing time and automatic tuning time. Set the region as necessary.
- It is not possible to specify which code to detect when there are 2 or more codes in the inspection region that match the detection conditions (the behavior is uncertain).



For more details, see "Region Settings" (Page 2-473).

Color

When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.

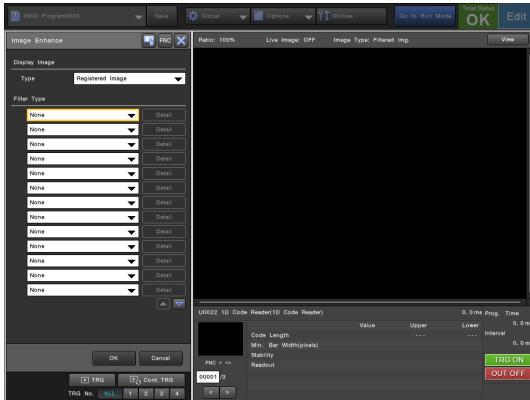


For more details, see "Color Extraction" (Page 2-483).

Image Enhance

Specify the filter processing to apply to the image.

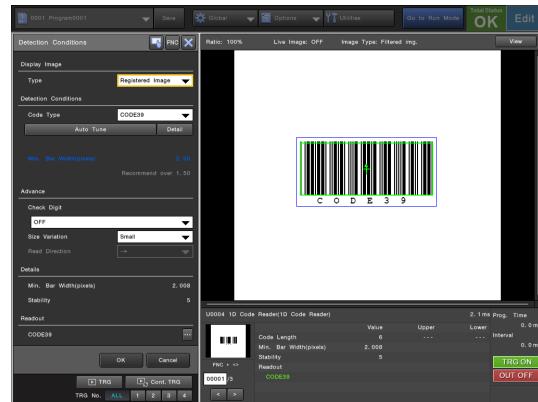
- Point** You cannot select the Subtract filter for 1D Code Reader measurement.



For more details, see "Image Enhance" (Page 2-489).

Condition

Specify the conditions to detect 1D Code during measurement.



Display Image

Type

Switch the image displayed on the screen.

- **Captured image:** Displays the latest image from the specified camera (image variable).
- **Registered image:** Displays the registered image specified under [Select Image].

Code Type

Select the type of 1D code to inspect for.

- **CODE39** (default setting): Inspects for Code39 type codes.
- **CODE128**: Inspects for Code 128 type codes.
- **EAN/JAN/UPC**: Inspects for EAN/JAN/UPC type codes.
- **GS1 Databar**: Inspects for GS1 Databar type codes.
- **ITF**: Inspects for ITF type codes.
- **Codabar/NW-7**: Inspects for Codabar/NW-7 type codes.
- **Pharmacode**: Inspects for Pharmacode type codes.

- Point**

- If you change the code type, some settings on the screen are reset.
- When reading a UPC-A code, the read string is output as 13 digits.
- When reading a UPC-E code, the read string is output as 7 digits.

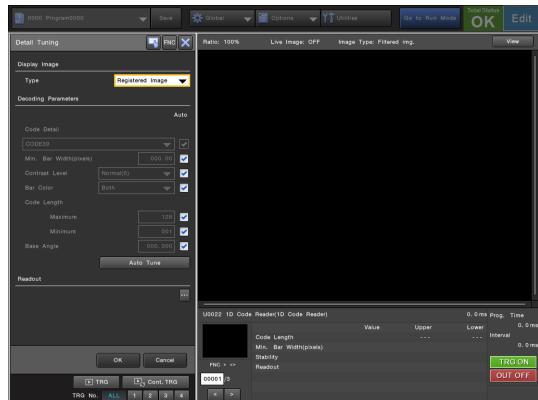
Auto Tune

Use automatic tuning to automatically adjust settings to that which is best suited for the detection of the code.

- Reference** The AT command can be used in order to execute automatic tuning from an external device or menu. For more information about AT command, see the XG-X2000 Series Communications Control Manual.
- Point**
- Automatic tuning will fail when a settings error is present or when the state is such that even normal detection is not successful (timeout value is too small, and so on).
 - If the inspection region is large, the influence of background noise may cause automatic tuning to fail or may increase the amount of time required for automatic tuning. Reduce the size of the inspection region as necessary.
 - It is not possible to specify which code to detect when there are two or more codes in the inspection region (the behavior is uncertain). Make sure that one code is shown in the inspection region when capturing images.
 - For Pharmacode, the codes with a code length of three or more are the targets of auto tuning.

Detail

When the optimal settings cannot be acquired by automatic tuning, or to change the settings that were created by automatic tuning, select [Detail] and manually specify the detection parameters in the [Detail Tuning] screen that appears.



For items to be set by automatic tuning, select the [Auto] check box. If the check box is cleared, change the setting for each item accordingly based on the code to inspect.

Code Detail

- When EAN/JAN/UPC is selected:** Specify the code type details for EAN/JAN/UPC.

- None
- EAN-13,UPC-A
- EAN-13,UPC-A & 2-digit
- EAN-13,UPC-A & 5-digit
- EAN-8
- EAN-8 & 2-digit
- EAN-8 & 5-digit
- UPC-E
- UPC-E & 2-digit
- UPC-E & 5-digit

- When GS1 Databar is selected:** Specify the code type detail for GS1 Databar.

- None
- Databar
- Databar Stacked
- Databar Limited
- Databar Expanded

- Point** When [None] is specified, a parameter error occurs and code detection will not be performed.

Min. Bar Width (pixels)

Specify the module width resolution (number of pixels per module) for the barcode which will be read (default: 0.00). Setting a value that is close to the barcode that will actually be read will allow more stable detection.

- Reference** The recommended module size values are listed below.
- (1) Position adjustment off: 1.5 or higher
 - (2) Position adjustment on, position adjustment setting Use Interpolation is [ON]: 1.5 or higher
 - (3) Position adjustment on, position adjustment setting Use Interpolation is [OFF]: 3.2 or higher
 - (4) Conditions in (2), captured image is color: 3.2 or higher

- Point** If the module size is a size as shown below, it cannot be read.
- (1) Position adjustment off: Less than 1.2
 - (2) Position adjustment on, position adjustment setting Use Interpolation is [ON]: Less than 1.2
 - (3) Position adjustment on, position adjustment setting Use Interpolation is [OFF]: Less than 3.0
 - (4) Conditions in (2), captured image is color: Less than 3.0

Contrast Level

Select the contrast level which will be used as a reference when extracting code features from the following: Highest (2) / High (1) / Normal (0) / Low (-1) / Lowest (-2) (default: Normal (0)).

Setting a lower value will increase the possibility of detecting the code even when the contrast is poor, however, if the value is set too low the detection will be susceptible to the influence of noise and detection may become unstable. When automatic tuning is used, a value slightly lower than the maximum detectable value is used based on the image used during the tuning.

Bar Color

Select the color of the code to be detected relative to the background.

- **Both** (default setting) (0): Detection of both black codes on white backgrounds and white codes on black backgrounds are possible. However, the processing time will be longer than when [Black] or [White] is selected.
- **Black** (1): Detection of black codes on white backgrounds only.
- **White** (2): Detection of white codes on black backgrounds only.

Code Length (Only when Code39, Code128, ITF, Codabar/NW-7, Pharmacode, or GS1 Databar Expanded is selected)

Specify the maximum number of digits of the code to read (default setting: 128) and the minimum number of digits (default setting: 1).

During auto tuning, the detected code length is set as the minimum and maximum.

Base Angle

Specify the base angle for code detection (default setting: 0.000).

Reference The base angle 0° state for each code is the state shown in "1D Code Reader Unit: Supported Codes" (Page 2-291).

Advance

Check Digit (Only when Code39, ITF, Codabar/NW-7 is selected)

Select whether or not to inspect the check digit (check character) in the decoded string.

- **ON**: Inspect the check digit.
- **OFF** (default setting): Do not inspect the check digit.

Reference When Codabar/NW-7 is selected, select the check digit from the following seven types.

- Modulus 16
- Modulus 11
- Modulus 10/Weight 2
- Modulus 10/Weight 3
- 7 Check DR
- Modulus 11-A
- Lunes

Size Variation

Specify the level of variation to allow when the size of the code changes. The smaller the allowed variation, the less chance for false detection.

- **Small** (default setting): Detects codes with a ±10% size variation.
- **Medium**: Detects codes with a ±20% size variation.
- **Large**: Detects codes with a ±30% size variation.
- **Unlimited**: Allows detection of all size variations.

Point When [Unlimited] is selected, the read stability may decrease.

Read Direction (Only when Pharmacode is selected)

Select the read direction of Pharmacode.

- → (default setting): Reads the code from left to right of the screen.
- ←: Reads the code from right to left of the screen (180° inversion).
- ↑: Reads the code from bottom to top of the screen (counterclockwise 90° rotation).
- ↓: Reads the code from top to bottom of the screen (clockwise 90° rotation).

Point Pharmacode shows different results depending on the read direction.

Details

Min. Bar Width(pixels)

Displays the module size for the currently read data.

Stability

Displays the read stability for the currently read data (Six levels: 0: read failure, 1: low to 5: high).

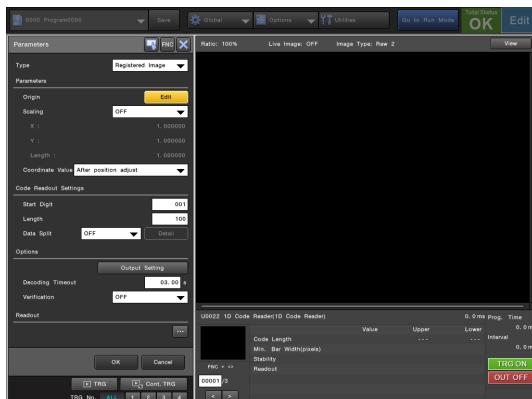
Readout

Displays the data read using the current settings.

1D Code Reader

Parameters

Specify other conditions for the 1D Code Reader tool as required.



Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified under [Select Image].

Parameters

Origin

By default, the origin is set to the top left corner of the camera but its location can be moved as required. To specify the origin, select [Edit] and then specify the coordinates.

Reference The origin can be set outside the process region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels internally. However, you can convert the result data and setting parameters used for on-screen display, judgment, and calculation to the desired units, such as actual dimension values. (This process is called "scaling".)

- OFF** (default setting): Do not use scaling.
- ON:** Use scaling.

Reference

- The scaling value can be changed in the [Options] menu (Page 4-18).
- For a summary list of the result data for which scaling can be used, see "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Coordinate Value

Select the coordinate axes to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- After position adjust** (default setting): The inspection uses the adjusted coordinate axes determined after position adjustment.
- Before position adjust:** The distance from the position specified for the [Origin] of the inspection is used.

Code Readout Settings

Start Digit

Specify which digit (1 - 128) of the detected code to begin reading data from.

Length

Specify the number of characters to read (1 to 128 characters, in bytes) beginning from the starting digit.

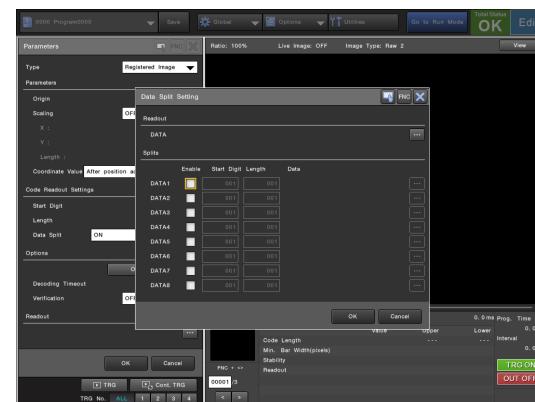


Point Because this forcibly divides the data at the designated points, if the starting or ending digit is in the middle of a kanji, kana, or other 2-byte character, the character may become garbled.

Data Split

Select whether or not to split the data into segments when reading it. The data which is divided and read, can be referenced individually and output externally as a reference pattern.

- OFF** (default): The read data is not divided.
- ON:** The read data is split into a maximum of eight segments for output and judgment. When [Detail] is selected, the [Data Split Setting] menu is displayed; specify Enable/Disable, the starting digit, and data length for each split data.

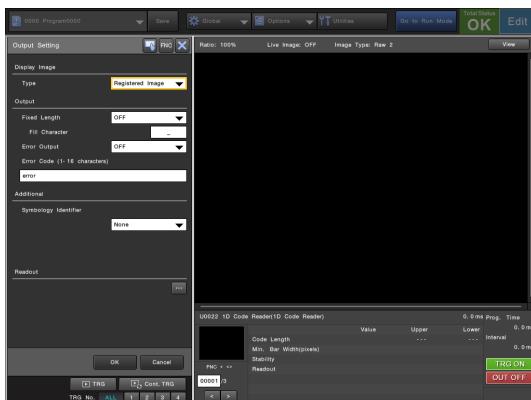


Point Because this forcibly divides the data at the designated points, if the starting digit or data length is in the middle of a kanji, kana, or other 2-byte character, the character may become garbled.

Options

Output Setting

Displays the [Output Setting] screen for setting the parameters for output of the read data.



- Fixed Length:** Select whether to fix the data output length.
 - **OFF** (default setting): Outputs the data for the number of read characters up to a maximum of the value that was set for [Length]. (The data output length varies according to the number of characters that were read.)
 - **ON:** Outputs only the data for the predetermined number of characters that was set in [Length]. If the number of read characters is less than this number, the character data specified in [Fill Character] is added.
- Fill Character:** Specify the supplemental character to complete the data if the number of read characters is insufficient with [Fixed Length] set to [ON] (default setting: _ (underscore)).
- Error Output:** Select whether to output errors that occurred during data reading.
 - **OFF** (default setting): Do not output.
 - **ON:** Outputs the specified character string.
- Error Code (1-16 characters):** Specify the character string to output if an error occurs with [Error Output] set to [ON]; up to 16 characters can be specified (default setting: error).
- Symbology Identifier:** Select whether to add an identifier (three characters: 3 bytes) to identify a symbol.
 - **None** (default setting): Do not add a symbol identifier.
 - **Output:** Add the symbol identifier (3 bytes) that is defined in JIS X 0530 "Data carrier identifiers (including symbology identifiers)" to the start of the read data.



The symbol identifiers to be added are as follows.

Code type	Added data	Condition
Code39]A0	Check character verification, full ASCII processing both off.
]A1	Check character is checked and sent.
Code128]C0	Standard case. FNC1 does not come in the first or second symbol character position following the start character.
]C1	EAN/UCC-128. When the first symbol character is FNC1.
]C2	When the second symbol character is FNC1.
EAN/UPC]E0	Entirely EAN format standard data. EAN-13, UPC-A, UPC-E (excluding add-ons)
]E3	Compound data composed of EAN-13/UPC-A/UPC-E + add-on
]E4	EAN-8 data (Not dependent on presence of add-on)
GS1 Databar]e0	No option rule ("]e0" is always output).
ITF]I0	No check character verification.
]I1	Check character is checked and sent.
Codabar/ NW-7]F0	Standard codabar symbol. No special processing.
]F2	The reader has already finished check character verification.
Pharmacode]X0	No option rule ("]X0" is always output).

Decoding Timeout

Set the maximum processing time. When the processing time at a unit exceeds the set value (0.01 s to 60 s; default setting: 3 s) due to the conditions of the captured image, it is determined that there is an error in the unit processing and timeout occurs.



The set value is approximate. There may be some difference in the time when actual timeout occurs.

1D Code Reader

Verification

Verification is performed on the captured 1D code in accordance with the print quality evaluation defined by a third party organization. In addition to outputting the verification result, the level of the overall symbol grade is judged against the set threshold value. The verification results can be used as judgment conditions.

- **OFF** (default setting): The verification function is not used.
- **ISO/IEC 15416:** Print quality is verified with the ISO/IEC 15416 standard. It is the 1D code print quality evaluation standard specified by the International Organization for Standardization (ISO). It is mainly used for evaluation of 1D codes printed on labels.



- The verification function of the controller is just a function to evaluate the 1D code print quality for the captured image according to the standard. It cannot be used as an official 1D code verification unit.
- If you change the verification setting, the quality verification settings in the [Limits] screen will be reset.

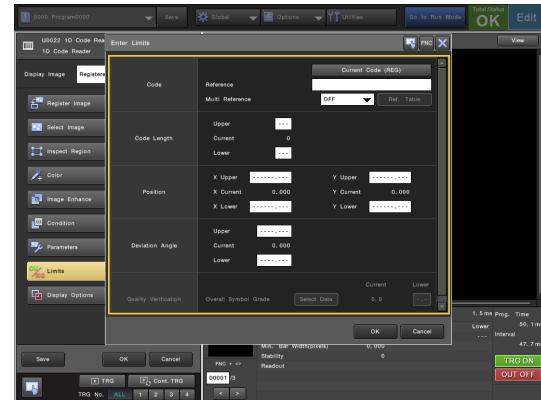
Readout

Displays the data read using the current settings.

Limits

Set the reference pattern for the read code and the tolerance (upper limit and lower limit) for the detection results measured value.

"NG" is output when the code reading results do not match the reference settings, or when the measured value exceeds the designated tolerances. "OK" is output when the results match the reference settings and the measured value is within the tolerances.



Select the tolerances you wish to configure and enter the tolerances.

- If no limits or tolerances are set, judgment is not performed even when a measurement is executed.
- The unit of the tolerance varies depending on the type of the measured value.

Code

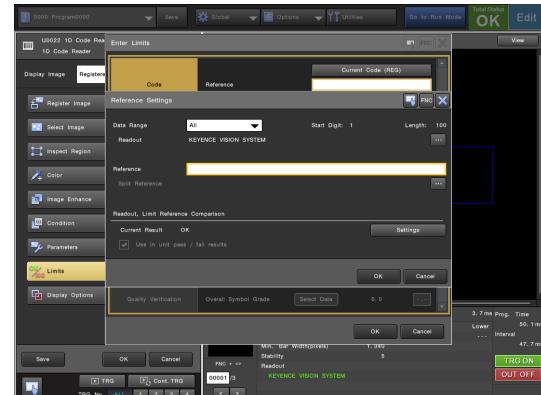
Current Code (REG)

Register up to 128 characters (128 bytes) from the data that was read with the current settings as a REG reference pattern.

- If the reference pattern field is blank and the Multi Reference (Page 2-302) is set to [OFF], REG is automatically input; the read result for the currently displayed image is registered.
- For more details about REG, see "REG (registered string)" (Page 2-301).

Reference Settings

When [Reference] is selected, the [Reference Settings] menu appears where a matching pattern, a matching method, or other matching criteria can be specified.



- Point**
- When the [Multi Reference] (Page 2-302) is set to [ON], [Reference] cannot be selected.
 - To set multiple references, select [Ref. Table] (Page 2-303) to display the [Multi Reference Table Settings] screen; select [Edit] to display the reference setting menu for the desired reference.

- Data Range:** Select the data range to check against the reference pattern (default setting: [All]). If [Data Split] (Page 2-298) on the [Parameters] screen is set to [ON], the split (1 through 8) can be specified and checked against any area of the read data.

- Point** When [Data Split] is not set to [ON] on the [Parameters] screen, [All] is fixed.

- Readout:** Displays the data read using the current settings.
 - Reference:** When the input field is selected, the software keyboard appears; enter up to 32 characters or symbols (32 bytes) as a reference pattern.
 - You can combine fixed characters with reference tolerances that automatically change the content together with external information such as date and time, and the Calculation tolerance which references a variable.
 - Readout: Specify the current read data as the reference pattern.
 - Special characters: The following control characters can be used in the string.
 - *, #:** Checks only the presence of data corresponding to one character (one byte) and ignores the reference.
 - !:** Ignores the reference of arbitrary characters from the point where ! is used and onwards.
- Example: Differences in results when using "*" ("#") versus "!"

Reading results	Reference pattern	
	AB* (AB#)	AB!
AB →	NG	OK
ABC →	OK	OK
ABCD →	NG	OK

REG (registered string): The reading result from the currently displayed image is used as the reference pattern. When [OK] is selected on the confirmation screen, the read result from the currently displayed image is registered as a reference pattern (In a normal reference pattern, up to 32 characters (32 bytes) can be entered. In the case of REG, however, up to 128 characters (128 bytes) can be registered).

Furthermore, selecting [Current Code (REG)] on the [Limits] screen also allows the reading result to be registered again.

Reference The CW command can be used to rewrite the REG data on the controller. For more details, see the XG-X2000 Series Communications Control Manual.

- Point**
- It is not possible to use two or more of the special character "!" in the reference pattern. If two or more are used, matching is not possible.
 - The REG (registered string) cannot be used in combination with other fixed characters or other tolerance types. It also cannot be used with multiple reference patterns.
 - When the captured image is selected for the display image and there is no previous result, REG is cleared (a blank field is registered). Be sure that a code has been detected before registering the reading results.

- Date & time tolerances: The following date time functions from the internal calendar can be used in the string.

Year4: Four digit calendar year

Year2: Two digit calendar year

Month: Two digit month

Day: Two digit day

Hour: Two digit hour

Example: Verifying the current year/month/day (January 1, 2017) using the date tolerances which are linked to the internal calendar.

String	Registered pattern
Year4/Month/Day →	2017/01/01

This example uses both the calendar tolerance and the fixed character "/".

Reference

- A user specified offset and allowable error can be set for the date time functions of the calendar tolerance.
- Zero suppression can be set for the Month, Day, and Hour.

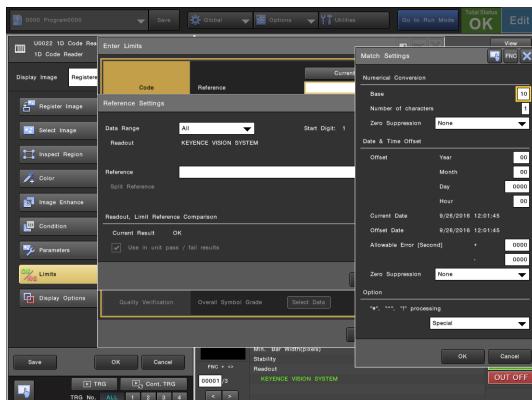
- **Variable:** Variable values are converted into string tolerances. The conversion method follows the Numerical Conversion settings.

Example: For a 7-character string composed of text ("TEST") plus a 3-digit serial number (#Count01) to which 1 is added at each inspection in the Calculation unit (Numerical Conversion: base 10 / 3 digits, zero suppression: None.)

String	Registered string
TEST#Count01 →	TEST000 to 999 (After 999, the count returns to 000.)

1D Code Reader

- Match Settings:** On the [Match Settings] screen, the detailed matching method can be specified.



- **Numerical Conversion:** Specify the number base and number of recognized characters used for conversion of numerical variables to string tolerances used in the limit settings.

Base: Set the base (10 to 36) used for converting the value of the reference variable into the calculation tolerance (default setting: base 10).

Example: Numerical conversion when base is set to base 36.

Calculation result	0	to	9	10	to	35
Calculation tolerance	0	to	9	A	to	Z

Number of characters: Specify the number of characters to use after conversion of the calculation tolerance (1 to 6, default setting: 1).

Point Converted numerical values that result in the number of characters being exceeded are excluded (Example of when the Base is 10 and the Number of characters is 2: the Calculation result 350 results in the Calculation tolerance being 50).

Zero Suppression: Judgment is done with the zeros at the start of the Calculation tolerance removed. For more details, see the description of "Zero suppression" in "Date & Time Offset" (Page 2-302).

- **Date & Time Offset**

Offset: Add an offset to the values of the date and time tolerances which are used in the string for judgment. The offset result is displayed as the offset data in the [Setup Calendar] screen. The range of offset values that can be specified are: Year: ±10, Month: ±12, Day: ±1999, Hour: ±24 (By default, all of the offset values are set to 0).

Allowable Error [Second]: Specify the allowable error in time difference between the internal calendar and the external device (target character string) at the turn of the day or hour. This error is used for judgment of the calendar tolerance. Enter absolute values up to 3599 seconds on both + and - sides (default setting: 0).

Example: Judgment results when the allowable error is set to ±60 seconds at the turn of the day

Current internal calendar time	2016.12.31		2017.1.1	
	~23:58:59	23:59:00 ~23:59:59	0:00:00 ~0:01:00	0:01:01~
Printing 2016/12/31	OK		OK	NG
Printing 2017/1/1	NG	OK	OK	

Allowable error -60 seconds Allowable error +60 seconds

Zero Suppression: Judgment is done with the zeros at the start of the Date & time tolerances and Calculation tolerance removed.

None (Default) (0): Do not suppress zeros.

Space forward (1): Replace leading zeros with a space placed at the front of the number.

Space backward (2): Replace leading zeros with a space placed at the back of the number.

Remove zeros (3): Remove all leading zeros.

Point Zeros in both digits of the 2-digit year are exempt from zero suppression regardless of the setting.

Example: Conversion result of the registered character strings using zero suppression

Zero suppression setting	Date & time tolerance	Calculation tolerance
None	08/08/25	00350
Space forward	08/_8/25	_350
Space backward	08/8/_25	350_
Remove zeros	08/8/25	350

Underscore "_" is used to symbolize a space.

- **"#", "*", "!" processing:** Select whether "#", "*", and "!" are used as special characters (default setting) (0) for reference pattern judgment or used as ordinary characters (1) as they are.

- **Use in unit pass / fail results:** Select this box to use the matching result for unit judgment (default setting: enabled). Remove the check in order to execute reference only without affecting judgment when using multiple reference settings.

Point If [Multi Reference] (Page 2-302) is set to [OFF], this option is fixed to enabled state.

Multi Reference

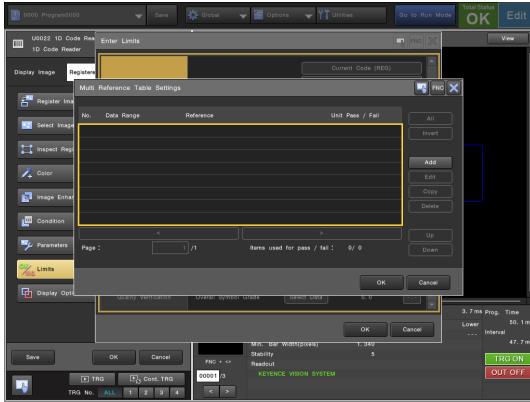
Select [ON] when setting multiple reference settings (default setting: [OFF]).

Point When this setting is changed from [ON] to [OFF], the second and later reference settings are cleared.

Ref. Table

When multiple reference conditions are made, they can be checked in a table display. Select to display the [Multi Reference Table Settings] screen on which multiple reference conditions can be displayed and/or edited.

- Point** When [Multi Reference] is set to [OFF], [Ref. Table] cannot be selected.



- All:** Selects all the reference settings displayed in the list.
- Invert:** Inverts the current selection.
- Add:** Add reference settings (up to 16 conditions). Select this to display the [Reference Settings] screen (Page 2-300) on which reference settings such as the reference pattern and match settings can be specified; specify various conditions such as the reference pattern, and so on.
- Edit:** Edit the currently selected reference setting. The setting details are the same as with Reference when [OFF] is selected for [Multi Reference].
- Copy:** Copy the currently selected reference settings.
- Delete:** Delete the currently selected reference settings.
- Up/Down:** Change the order of the currently selected reference settings.

- Reference**
- A maximum of 16 reference settings can be added.
 - When multiple reference settings are made, it is possible to reference a combination of ranges from the read data, and to perform sorting based on the results data according to which of the reference setting numbers was matched.
 - When used for sorting, remove the check from [Use in unit pass / fail results] on the Reference Settings screen (default: enabled) in order to execute reference only without the mismatch results affecting the judgment.

Code length

Set the tolerance for the number of characters read from the code.

The measured value is the number of characters (byte units) which was read at the inspection.

- Point**
- The number of characters applies to the read range specified in the Code Readout Settings on the [Parameters] screen.
 - Alphanumeric and other half-size characters are handled as 1 byte per character, while kanji, kana, and other full-size characters are handled as 2 bytes per character.

Position

Specify the tolerance for the coordinates of the detected position of the code.

The measured value is the number of pixels indicating position.

Deviation Angle

Specify the tolerance for the tilt angle of the code.

The measured value is an angle in degrees.

- Point** The deviation angle is the angle difference from the [Base Angle] on the [Condition] screen.

Quality Verification

Specify the tolerance for the print quality verification result for the code.

Overall Symbol Grade

Specify the overall symbol grade tolerance of the print quality. If you select [Select Data], you can specify the items to include in the overall symbol grade judgment on the [Overall Symbol Grade Condition] screen.

- The overall symbol grade is the lowest value of the items selected.
- For each print quality item, numerical data (4 (A) to 0 (F)) can be output from the data output unit. (If evaluation is not performed, -1 is output.)

Decode(DEC)

Evaluates if decoding can be performed.

Edge Determination (EDGE)

Determines whether the number of read edges is equivalent to the anticipated number of edges.

Symbol Contrast (SC)

Evaluates the difference between the maximum (Rmax) and minimum (Rmin) brightness value in the code area.

Minimum Reflectance (MINR)

Evaluates the minimum reflectance in the scan wave form.

Minimum Edge Contrast (MINE)

Evaluates the minimum value of the reflectance difference between the space (including the quiet zone) and the neighboring bar.

Modulation (MOD)

Evaluates the ratio of the minimum edge contrast to the symbol contrast.

Minimum Quiet Zone (QZ)

Evaluates whether the quiet zone width complies with the standard.

1D Code Reader

Decodability (DCD)

Evaluates the defined decode margin (the size of the error between the ideal line width pattern and the actual line width pattern) for each code type.

Defects (DEF)

Evaluates the color irregularity inside the element.

Wide to Narrow Ratio (WNR)

It evaluates whether the fine to thick element ratio complies with the standards (for Code39 and ITF only).

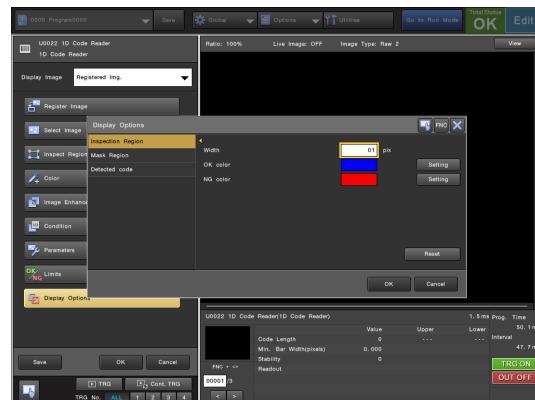
Intercharacter Gap (CGAP)

Evaluates whether the intercharacter gap is too wide (for Code39 only).

Display Options

Specify the display methods for things such as the inspection and mask regions.

You can change the display color based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select color] - [None].



Inspection region

Specify the line thickness and display color of the inspection region.

Mask region

Specify the line thickness and display color of the mask region.

Detected code

Specify the thickness and display color of the region and detected point (center) of the detected code.

Reset

Restores the display options to their default settings.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

When Codes Cannot Be Read Correctly

If code tuning and reading are not possible, check whether any of the following problems exists.

Code resolution is low

Either increase the size of the capture as much as possible, using a module size of 1.5 pixels or more as a guideline, or use a higher resolution camera.



When using position adjustment for color images, set the module size to 3.2 or higher as a guideline.

Code contrast is low

Try using contrast conversion or another image enhancement filter (Page 2-295) to improve the contrast.

If [Grayscale] is selected for color extraction (Page 2-295) with a color camera, using [RGB Grayscale] may improve the contrast.

Code is out of focus

Check the lens focus adjustment and shutter speed.

Little blank space (quiet zone) around code

Check that there is sufficient blank space around the code within the inspection region. If the position of the code is shifted to the end of the inspection region, consider correcting the position with the position adjustment unit.

Interpolation is OFF when using position adjustment

Turn interpolation ON for the Position Adjustment unit.

Position Adjustment

Measurement Condition Settings

Image Acquisition

Vision Tools

► Position Adjustment

Flowchart Functions

Operations

Timing

Display

Output

Commands

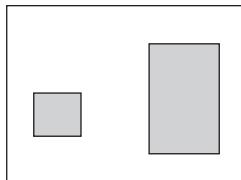
Common Setting Items

Position Adjustment Unit

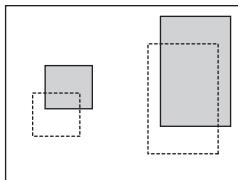
The position adjustment unit allows the configuration and allocation of settings relating to part tracking and region movement for correct inspection of a target that could be misaligned or is not repeatable when presented to the camera.

Position Adjustment

For situations where regions are fixed and target misalignment occurs, correct measurements and inspection results cannot be guaranteed.



Example:
Reference position setting



Example:
Image where the
positions shifted

The position adjustment unit is used to specify a reference position and have the deviation information automatically reflected (position adjustment function) to other units such that proper measurement and inspection can be done even in cases such as the above.

Main execution results

The standard results and data returned by the position adjustment unit are as follows:

Offset (X, Y)	Outputs the X and Y deviation in pixels between the registered base position and the current base position.
Rot. Center (X, Y)	Outputs the X Y center co-ordinates used for rotation angle deviation results.
Rotation angle	Outputs the rotation angle deviation between the registered reference angle and the current reference angle.
Reference Position (X, Y)	Outputs the registered reference position coordinates in pixels. In the 2-point correction mode, the position coordinates of points 1 and 2 are output individually in pixels.
1st point/ 2nd point	
Base Position Angle 1	Outputs the registered reference angle.

Reference For the lists of available measurement output values, refer to "List of Result Data" in the XG-X2000 Series Communications Control Manual.

Selectable reference units

The list below details the unit type and result data that can be used as the reference position in the position adjustment unit.

Unit type	Result data (item)	
Pattern Search	Position, angle	
ShapeTrax3, ShapeTrax2, PatternTrax	Position, angle	
Edge Position	Position, angle	
Edge Angle	Center, angle	
Defect	Grouping OFF	Position
	Grouping ON	Center of gravity
Blob		Center of gravity, major axis angle
Grayscale Blob		Center of gravity, major axis angle
Profile	Best Fit Circle/Line OFF	Position, angle
Position	Best Fit Circle ON	Circle center
	Best Fit Line ON	Line center, line angle
Profile Defect, Multi-Profile Defect		Defect position, defect angle
2D Code Reader		Position, code angle
1D Code Reader		Position, code angle
Calculation		Calculation result (ANS)

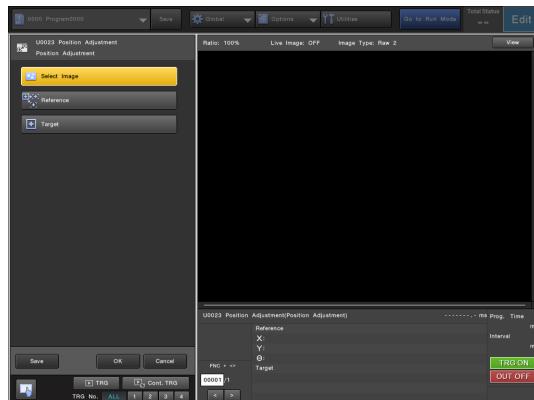


The calculation unit can only be specified through the Edit Unit menu, and the only data that is available is the result (ANS) data.

Position Adjustment Unit

Top Menu

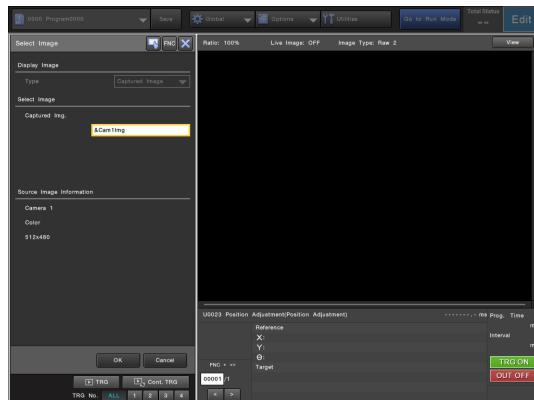
The top menu of the position adjustment unit consists of the following options. Configure settings under each option as required for the inspection.



Select Image (Page 2-308)	Specify the captured image to be used as a reference when configuring position adjustment.
Reference (Page 2-308)	Set the information, such as the units and coordinates that will serve as reference for position adjustment, needed for position adjustment.
Target (Page 2-309)	Specify the units for which the position adjustment will be reflected to.
Save (Page 2-309)	Save the current state to the program setting file.

Select Image

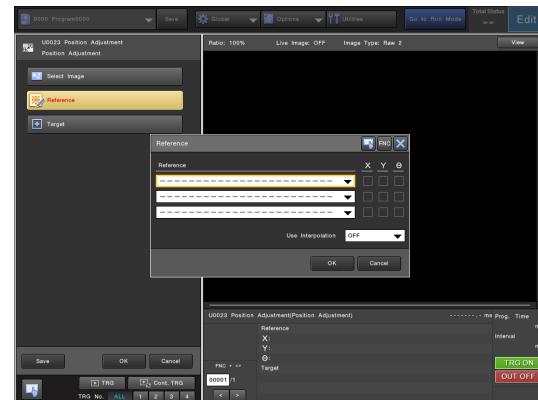
Specify the captured image to be used as a reference when configuring position adjustment.



For more details, see "Select Image" (Page 2-471).

Reference

Set the information, such as the units and coordinates that will serve as reference for position adjustment, needed for position adjustment.



Point

- Changes made here will only be reflected when OK is selected.
- Based on the items used in the reference menu the position adjustment information may be based on registered images when [OK] is selected.
- Variables and specific unit result data can not be directly specified in the reference menu. Nor can any variables or unit result data that have been specified elsewhere be displayed or edited either.

Reference

Select a unit containing X Y coordinates or angle information to be used as a reference for the position adjustment, and then specify the appropriate item (X, Y, or θ) individually.

Reference

- Units with different image variables can also be selected.
- Refer to "Selectable reference units" (Page 2-307) for more information on units and items which can be selected for the position adjustment reference.

Use Interpolation

Use interpolation on the target image.

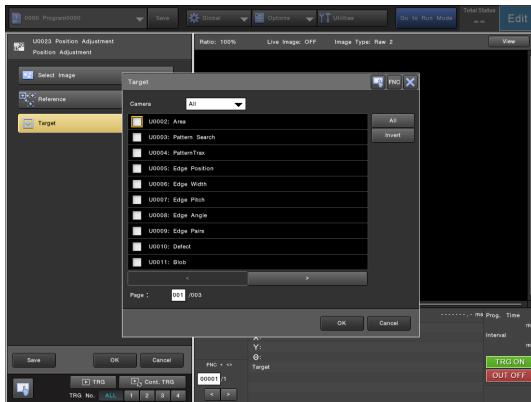
- ON:** Use interpolation.
- OFF** (default): Do not use interpolation.

Point

This setting is only valid when a monochrome image variable is used. Interpolation is disabled for a color image variable regardless of this setting.

Target

Specify the units for which the position adjustment will be reflected to.



Point

Changes made here will only be reflected when OK is selected.

Target

Select units for which the position adjustment will be applied to.

Reference

Units with different image variables can be filtered.

Save

Save the current unit changes to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

Point

- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

Flowchart Functions

Measurement Condition Setting

Image Acquisition

Vision Tools

Position Adjustment

► Flowchart Functions

Operations

Timing

Display

Output

Commands

Common Setting Items

Program Branch Unit

The flowchart can be branched off into different processes based on a specified condition. A branch can be used to control the processing flow based on the result of a vision unit, a calculation, a variable or external I/O.

Main execution results

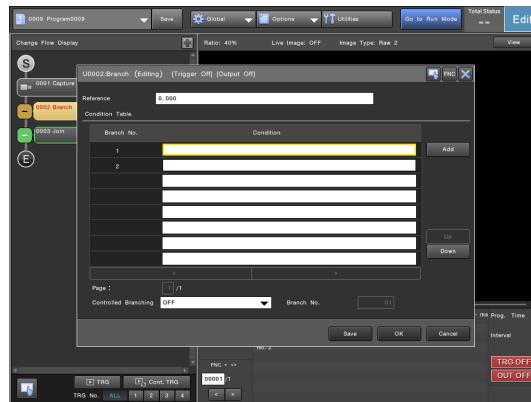
The standard results and data returned by the branch unit are as follows:

Reference value	The assigned reference value used in the evaluation of the branch processing.
Destination branch	The branch number that the process follows based on the evaluation of the reference and conditions. If no conditions are satisfied then 0 is returned.

Point The join unit has no specific result data.

Branch

Specify the parameters for branching the process.



Reference

Specify a numerical value, result data, variable or I/O to be used for evaluation.

Point A mathematical expression cannot be used here.

Branch No.

The available branches (1 to 64) in the branch unit are shown in a list indicating the order of comparison that occurs between the reference and condition values.

Comparison starts at No. 1 and carries on until the reference value equals the condition value unless ELSE is specified as one of the conditions. The unit then branches to that No.

Condition

Specify a numerical value, result data, variable or I/O to be compared to the reference value. [ELSE] can also be used as a condition value for instances where no condition values are satisfied.

Point A mathematical expression cannot be used here.

Reference

The order of the branch Nos. can be changed by holding down the No.1 (FUNCTION) button or No. 7 (BACK) button while moving up or down. If the reference value does not equal any of the condition values and [ELSE] is not set as a condition value, units in the branch area skipped and processing moves to the join unit.

Add

Specify the number of branches to be added. The specified number of branches are added below the current set of branches.

Controlled Branching

Select the branch method when using controlled branching.

- **ON (Loop):** When the process passes through this branch unit for the first time, it is branched to the destination that is specified as the starting branch number. Every time the process passes through this branch unit after that, it is branched to the branch number where the previous number has incremented by 1.
 - If the set maximum value of branch number has been exceeded, the process is branched to Branch No. 1.
 - If the program settings have been switched, the mode has been switched from Setup Mode to Run Mode, or the settings have been reset, the branch destination will return to the specified branch number from the next time.
- **ON (Fixed):** Regardless of the branch conditions, the process will always be branched to the destination set in [Branch No.].
- **ON (Fixed During Re-test Only):** Only during a re-test will the branch conditions be ignored and the process will be branched to the destination set in [Branch No.].
- **OFF:** Controlled branching will not be used and the process will be branched as per the branch conditions (default setting).

Save

Save the current unit changes the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

Other Operations

Adding additional branches

Additional branches can be added on to an existing branch from the flowchart. The number of branches that can be used in a branch unit is minimum 2 and maximum 64.

- 1 On the flowchart select the branch to add a branch to, and display the flowchart edit menu (Page 2-10).
- 2 Select [Edit] - [Edit Branch] - [Add Branch].
A branch is added.
- 3 From the branch menu set the condition value for the new branch.

Removing part of a branch

Selected branches can be removed from a branch without deleting the whole branch / joint unit.



- If other units exist under the branch being removed then they will be deleted when the branch is removed. Deleted units can not be restored.
- If the selected only has 2 branches the branch cannot be removed.
- To re-organize branches before moving branches expand and edit the branch unit.

- 1 On the flowchart, select the branch to remove, and display the flowchart edit menu (Page 2-10).

- 2 Select [Edit] - [Edit Branch] - [Remove Branch].
A Confirmation screen will appear.

- 3 Select [OK].
The branch is removed.

Moving branches

Branches can be moved left or right in the flowchart.



- To re-organize branches before moving branches expand and edit the branch unit.

- 1 On the flowchart select the branch to move, and display the flowchart edit menu (Page 2-10).

- 2 Select [Edit] - [Edit Branch] - [Move Branch Right] or [Move Branch Left].
The branch is moved accordingly.

Loop Function Unit

The loop function causes the units in between the loop function and loop end unit to be processed in order a set number of times.

Point

- When the loop function unit is added to the flowchart, the loop end unit is automatically added. When the loop function unit is deleted from the flowchart, the corresponding loop end unit is automatically deleted.
- When the loop function unit and loop end unit are deleted from the flowchart, all other units between the pair are also deleted.

Main execution results

The standard results and data returned by the loop function/end units are as follows:

No. of loops

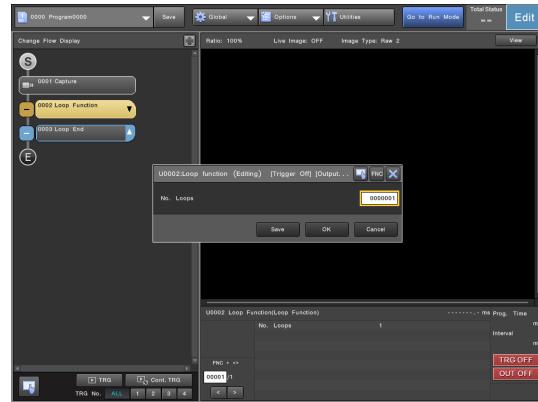
The current loop number being processed by the loop function.
This value is 0 when the flowchart starts and increases by +1 when the process returns to the loop function unit after reaching the loop end unit.

Point

- The loop end unit has no specific result data.
- The loop end unit cannot be edited.

Loop function

Specify the number of loops.



No. Loops

Specify the number of times (0 to 9999999, default: 1) to process units between the Loop Function unit and Loop End unit.

Point

When [Number of Loops] is set to [0], the units between the loop function unit and loop end unit are not executed, and the process moves to the unit immediately after the loop end unit.

Save

Save the current unit changes the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

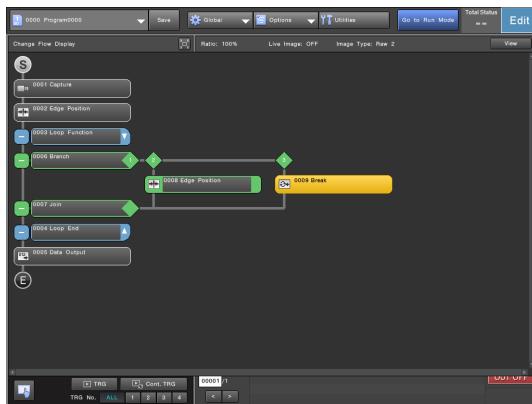
Point

- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

Break Unit

The break unit is placed between the loop function and loop end unit to force the loop operation to cancel.

This unit can be used in conjunction with the branch unit (Page 2-311) to force the process to go out of the loop when a specific condition is satisfied.



In the example above, the loop operation is canceled and the process moves to the data output unit.

- Point**
 - A break unit can only be used in-between the loop function and loop end units.
 - The break unit cannot be edited.

End Unit

The end unit terminates the flowcharts operation.

An end unit is automatically inserted at the bottom of the flowchart when a new program is created. Additional end units can also be placed at other points in the flowchart allowing for other circumstances to cause the flowchart to end.

Operations

Measurement Condition Setting

Image Acquisition

Vision Tools

Position Adjustment

Flowchart Functions

► Operations

Timing

Display

Output

Commands

Common Setting Items

Overview of Operation

This section explains the following operation units.

- Calculation (Page 2-317)
- Image Operation (Page 2-373)
- Defect Extraction Operation (Page 2-394)
- Contour Region Generator (Page 2-399)
- Calibration (Page 2-407)
- Image Stitching (Page 2-418)



Point

- The settings for a C Plugin unit cannot be changed from the controller side. For more details, see the XG-X VisionEditor Reference Manual.
- For more details on the Robot Coordinate Conversion Unit and Robot Coordinate Operation Unit, see the XG-X2000 Series User's Manual (Robot Vision Edition).

Calculation Unit

The calculation unit is used for processing multiple functions in as a calculation string with the results being used directly as the output of the calculation unit or for populating user specified variables. While complex mathematical calculations and scripts can be constructed and processed, upper and lower limits can also be set to act as pass / fail criteria for the units function in the rest of the program.

Main execution results

The standard results and data returned by the calculation unit are as follows:

Calculation result	The result of the calculation (default 0) if ANS is used as the result for a function processed in the script. Tolerance Judgment Target
Error Code	The reference error code (default 0) used when an error occurs in the processing of the script in the unit.
Error line	The line number of the error found in the calculation unit.



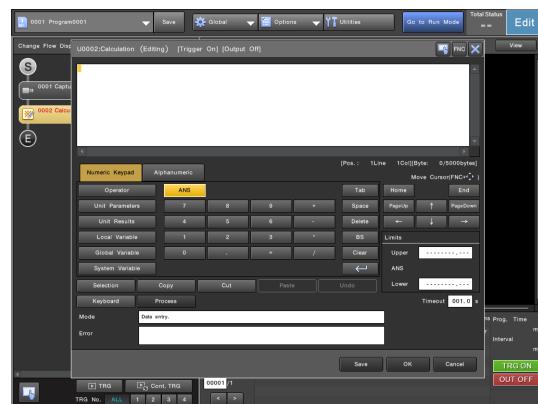
- The default value is used for other errors in the unit (such as judgment limits).
- These error codes and lines numbers are not displayed for setting errors.



For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Calculation setting

Specify the functions, parameters and results for a calculation script along with associated pass/ fail limits.



Operator

Enter the script to perform in calculation Unit. Up to 5000 characters can be used to write a function in a single calculation unit (including comments). Note that a line feed is counted as two characters, and a tab is counted as one character.

For more information about operators and functions available for an arithmetic expression, see "Troubleshooting" (Page 9-33).



- If the number of characters exceed the upper limit due to changes in variable name length the function will not be processed.
- The script in the calculation unit has to be less than 1000 characters per line and less than 2000 lines long.



- To use two or more functions in the calculation separate them with a blank line.
- To specify comments in the function precede the comment with '#'. English and Japanese characters can be used in the comments.

Unit Parameters

Use this option to select parameters from units already configured in the program.

When the [Select Unit Parameters] menu is displayed, select the appropriate unit and tab to the right to drill down to the desired parameter.

Unit Results

Use this option to select result data from units already configured in the program.

When the [Select Unit Results] menu is displayed, select the appropriate unit and tab to the right to drill down to the desired result.

Calculation Unit

Local Variable

Use this option to select from a list of local variables defined in the program.

When the [Select Local Variable] menu is displayed, select the variable and tab to the right to drill down to the desired option or variable value to be used.

Global Variable

Use this option to select from a list of global variables defined in the program.

When the [Select Global Variable] menu is displayed, select the variable and tab to the right to drill down to the desired option or variable value to be used.

System Variable

Use this option to select from a list of system variables.

When the [Select System Variable] menu is displayed, select the variable to be used.

Selection

Highlight characters to be edited by selecting the first and last characters.

Copy

Copy selected characters.

Cut

Cut selected characters.

Paste

Paste selected characters.

Undo

Undo the last operation.

Keyboard

[Hiragana], [Katakana], [Alphanumeric Characters], and [Kanji] can be entered.

Process

Calculate the entered script.

If an error is found in the calculation script, that error is displayed.



Point

If variables are used in the calculation script, updating such variables may affect their values during operation.

Errors

If an error occurs in the calculation script, the line, column and description of the error are displayed.

- If a syntax error is found, the cursor jumps to the location of the error.
- The [Error] field shows the line, column and description of the error.
- If several errors exist, the first error from the beginning of the script is displayed.
- When a calculation processing error occurs (such as dividing by 0), a unit error (UERR) is output as result data for the calculation unit together with the calculation error code (ERRC) and error line (ERRL). For the error codes, see the XG-X2000 Series Communications Control Manual.

Limits

To generate pass / fail results from the calculation unit upper and lower limits need to be set as judgment criteria for ANS.

- The calculation result ANS represents result data from the calculation unit and can be populated with a value directly in the calculation script.
- By associating ANS with a variable (which is processed in another calculation script) tolerances can be set for a variable and the calculation unit result can be used for processing in the rest of the program.
- Example of using ANS with a variable:
Using a calculation unit to judge the variable #AreaCount which contains a processed value.

`ANS=#Area_Count`



ANS is reset to 0 every time before the calculation unit is processed.

Upper

To set upper pass / fail criteria, input the upper limit. When the ANS value exceeds the specified upper limit, the unit is judged as NG.

Lower

To set lower pass / fail, input the lower limit. When the ANS value is below the specified lower limit, the unit is judged as NG.



- The current value of the calculation result ANS is shown next to [ANS] between the upper and lower limit values.
- Pass / fail judgment is performed regardless of the unit error or timeout.
- If a calculation unit is specified as a position adjustment reference ANS will be the value referenced.

Timeout

For time sensitive processing, a time-out can be used to specify a time (1.0 to 600.0 s) to wait for the conditions to be satisfied (default: 1.0).

Moreover, if a timeout is generated, this unit's response will be handled as an error.



Depending on the processing load of the controller the timeout value maybe longer than specified.

Save

Save the current unit changes the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

Calculation Notation

Follow the following rules when describing the calculation with the XG-X2000 series.

- "Programming" (Page 2-320)
- "Character Set" (Page 2-320)
- "Scripts" (Page 2-321)
- "Variables" (Page 2-321)
- "Expressions and Operators" (Page 2-322)
- "Statements" (Page 2-324)

Parts

Calculations and scripts can be made up of the following parts.

- Constants
- Variables (Page 2-321)
- Operators (Page 2-322)
- Expressions (Page 2-322)
- Statements (Page 2-324)
- Functions
 - Mathematical functions (Page 2-329)
 - Trigonometric functions (Page 2-336)
 - Geometric functions (Page 2-338)
 - Calendar functions (Page 2-359)
 - Bit functions (Page 2-360)

Programming

Statements and lines

- Calculations and scripts are made up of multiple lines.
- Each line can contain a set of elements for defining a single function.
- A function is the smallest unit of execution in a calculation / script.

Comments

- Comments are indicated by a single quotation ('') mark.
- Functions after a single quotation (') on the same line are ignored.

Example

```
@a = 100 'Set initial values
'Date created May 23
```

Line continuation

To separate a long line into several lines, use a space and an underscore ("space" + "_").

Example 1 (Correct)

```
IF (@a > 100) AND (@a < 200) THEN (1)
...
END IF
```

Example 2 (Correct)

```
IF (@a > 100) AND _ (2)
(@a < 200) THEN
...
END IF
```

Example 3 (Error)

```
IF (@a > 100) AND(3)
(@a < 200) THEN
...
END IF
```

Example 4 (Correct)

```
@max = Max(@a, @b, @c, _ (4)
@d, @e, @f)
```

Example explanation

- (1) Processed correctly because the function is written on a single line.
- (2) Processed correctly because the line continuation syntax is used.
- (3) Results in an error because the line continuation syntax is missing.
- (4) Example of separating function elements over two lines.

Character Set

Calculations and scripts can be created using the following characters.

Type	Character set
Space	<Space> <TAB>
Letters	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz
Numbers	0123456789
Symbols	.()[]+-*^/=<>_@#\$!%:

- Letters are case-sensitive.
-

Scripts

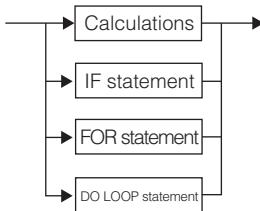
Scripts

Scripts are comprised of statements.



Statements

Statements are categorized into Functions, Calculations, IF, FOR, and DO LOOP statements.



Other

- The maximum number of characters that can be used is 5,000.
- The levels of nesting allowed for parentheses, IF, FOR, and DO LOOP statements is subject to the amount of free memory. If the available memory space is exceeded a programming error will occur when the calculation is applied, and the cursor moves to the beginning of the expression where the error occurs.

Variables

Temporary variables

- Temporary variables are defined with a @ sign.
- Temporary variables may only be used within the same calculation unit.
- Temporary variables may only be used for processing numbers.
- Temporary variables do not need to be defined in the variables menu.
- The default value for a temporary variable is 0.
- Temporary arrays cannot be defined or used.
- Variable names have to be 32 characters or less including the @ sign.

Example (Correct)

@a_10

Example (Error)

@a_10[10] ... (1)

Example explanation

- Arrays cannot be used.

Local variables

Local variables can be used anywhere in the calculation / script. Refer to "User variable" (Page 4-4) and "Defining and editing local variables" (Page 4-6) for other definitions.

Global variables

Global variables can be anywhere in the calculation / script. Refer to "User variable" (Page 4-4) and "Defining and editing global variables" (Page 4-7) for more information.

System variables

System variables can only be used as a reference in a calculation / script.

Unit settings, Unit results

Unit settings and unit results are read only (and can only be used as a reference in a calculation / script). For more information about unit settings and unit results, refer to the XG-X2000 Series Communications Control Manual.

ANS variables

- ANS is numerical variable that is associated as the result of the calculation unit.
- ANS has to be referenced in uppercase letters.
- ANS on its own can only be populated in a calculation.

Example

ANS=MAX(#a1,#a2,#a3,#a4,#a5)



ANS is used as the reference value for limits set in a calculation unit.

Expressions and Operators

Mathematical Operators

Mathematical operators can be used for processing numerical values. The following operators are available

Operator	Description	Syntax	Explanation
$^$	Power	A^B	Raises A to the power of B.
$+$	Positive	$+A$	A
$-$	Negative	$-A$	Inverts A.
$*$	Multiply	$A * B$	Multiplies A by B.
$/$	Divide	A / B	Divides A by B.
MOD	Modulo	$A \text{ MOD } B$	The remainder dividing A by B.
$+$	Add	$A + B$	Adds A and B.
$-$	Subtract	$A - B$	Subtracts B from A.

Comparative Operators

Comparative operators can be used for comparing numerical values and producing a Boolean logic (1 (true) or 0 (false)) result.

Operator	Description	Syntax	Explanation
$=$	Equal to	$A = B$	A is equal to B.
$<>$	Not equal to	$A <> B$	A is not equal to B.
$>$	Greater than	$A > B$	A is greater than B.
$<$	Less than	$A < B$	A is less than B.
\geq	Greater than or equal to	$A \geq B$	A is greater than or equal to B.
\leq	Less than or equal to	$A \leq B$	A is less than or equal to B.



Point

- Comparative operators are executed as 64-bit floating point decimal numbers.

Example

- If @a is equal to @b, the result of the statement is TRUE (1), otherwise it is FALSE (0):


```
IF @a = @b THEN
...
END IF
```
- If @a is not equal to @b, the result of the statement is TRUE (1), otherwise it is FALSE (0):


```
IF @a <> @b THEN
...
END IF
```
- If @a is greater than @b, the result of the statement is TRUE (1), otherwise it is FALSE (0):


```
IF @a > @b THEN
...
END IF
```
- If @a is less than @b, the result of the statement is TRUE (1), otherwise it is FALSE (0):


```
IF @a < @b THEN
...
END IF
```
- If @a is greater than or equal to @b, the result of the statement is TRUE (1), otherwise it is FALSE (0):


```
IF @a >= @b THEN
...
END IF
```
- If @a is less than or equal to @b, the result of the statement is TRUE (1), otherwise it is FALSE (0):


```
IF @a <= @b THEN
...
END IF
```
- Comparative operators can only be used in conditional statements (such as IF and WHILE) and can not be processed on their own. If a statement such as "@a = @b <> @c", a 0 or 1 is used for defining @a a programming error will occur.
To define @a the script must be written using the IF statement as script.


```
IF @b<>@c THEN
@a=1
ELSE
@a=0
END IF
```

Logic Operators

Logic operators can be used in conditional functions for performing true / false operations.

The following logic operators are available.

Operator	Description	Syntax	Explanation
NOT	Logical inverse	NOT A	Inverts A.
AND	Logical multiplication	A AND B	Multiplies A and B.
OR	Logical addition	A OR B	Adds A and B.
XOR	Exclusive OR	A XOR B	Exclusive OR of A and B.

Examples

- If @a is a value other than 1, the result of the statement is TRUE (1), and if it is 1, the expression is FALSE (0):

IF NOT (@a = 1) THEN

...

END IF

- If @a is greater than -1 and less than +1, the result of the statement is TRUE (1), otherwise it is FALSE (0):

IF (@a > -1) AND (@a < +1) THEN

...

END IF

- If @a is less than -1 or greater than +1, the result of the statement is TRUE (1), otherwise it is FALSE (0):

IF (@a < -1) OR (@a > +1) THEN

...

END IF

- If one of @a or @b are 0 and the other value is not 0 the expression is TRUE (1)

If both @a and @b are 0 or both not 0 the result of the statement is FALSE (0):

IF (@a = 0) XOR (@b = 0) THEN

...

END IF



- Logic operators can only be used in conditional statements (such as IF and WHILE).
- To process bit / binary data, refer "Bit Functions" (Page 2-360).

Processing Priority

If a statement contains more than one operator, the order of execution is based on the priority of the operators.

Operators are evaluated in the following order.

- (1) Mathematical operators
- (2) Comparative operators
- (3) Logic operators

The priority of operators is shown in the table below.

Operator	Description	Processing Priority
^	Power	1
+	Positive	2
-	Negative	
*	Multiply	3
/	Divide	
MOD	Modulo	4
+	Add	5
-	Subtract	
=	Equal to	
<>	Not equal to	
>	Greater than	6
<	Less than	
>=	Greater than or equal to	
<=	Less than or equal to	
NOT	Logical inverse	7
AND	Logical multiplication	8
OR	Logical addition	9
XOR	Exclusive OR	10

Examples

- IF @a > -1 AND @a < +1 THEN(1)

...

END IF

- IF (@a > -1) AND (@a < +1) THEN.....(2)

...

END IF

- @a = 1 + 2 * 3(3)

- @a = 1 + (2 * 3)(4)

- @a = (1 + 2) * 3(5)

Example explanation

- (1) and (2) result in being processed the same way.
- (3) and (4) result in being processed the same way.
- The result of (3) is 7.
- The result of (4) is 7.
- The result of (5) is 9.

Statements

Assign Values

An item (result, setting, value etc) can be defined to a variable.

- The item on the right of the expression is assigned to the variable on the left of the "=" sign
- Only items of the same type can be assigned to each other.
- It is not possible to assign an entire array at once.

Syntax

variable = expression

Structure



Example (Correct)

- Assignment of a numerical variable:
@a = @a + 1
- Assignment of the X component (numerical value) of a circle to a numerical variable:
@a = #circle.CX
- Assignment of the three numerical components of a circle (CX, CY, CR) to a circle type variable
#circl_A = #circle

Example (Error)

- Incorrect assignment of a circle value into a numerical variable:
@a = #circle
- Incorrect assignment of a scalar value into a circle variable.
#circle = @a
- Incorrect assignment of arrays:
#A[] = #B[]

IF THEN Statements

Process a single set of functions as a block from multiple blocks based on the result of a conditional expression.

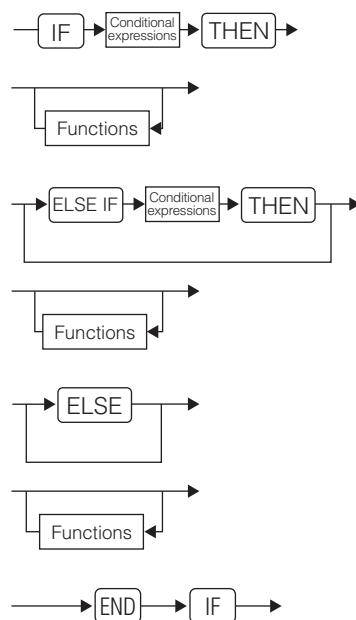
Syntax

```

If <conditional expressions> THEN
- functions-
[ELSE IF] <conditional expressions> THEN
- functions-
[ELSE]
- functions-
END IF
  
```

Reference The [and] brackets in the syntax shown above can be omitted.

Structure



Explanation

- If the condition in the IF statement is TRUE, the block after THEN are executed after which processing goes to END IF. If the condition is FALSE, processing goes to the next ELSE IF.
- If ELSE IF is not used and the condition is FALSE, processing goes to ELSE.
- If ELSE is not used and the condition is FALSE, processing goes to END IF.
- If the condition in the ELSE IF statement is TRUE, the block after the associated THEN is executed after which processing goes to the END IF.
- If the condition is FALSE, processing goes to the next ELSE IF.
- If ELSE IF is not used and the condition is FALSE, processing goes to ELSE.
- If ELSE is not used and the condition is FALSE, processing goes to END IF.
- The ELSE IF statement can be used as many times as necessary.
- The ELSE statement can only be used as the last ELSE term before the END IF.

Examples

```

@a = 4
IF @a < 3 THEN
  @b = 333
ELSE IF @a < 4 THEN
  @b = 444
ELSE IF @a < 5 THEN
  @b = 555
ELSE
  @b = 999
END IF

```

Example Explanation

In the above example, @b is assigned the value of 555.

FOR NEXT Statements

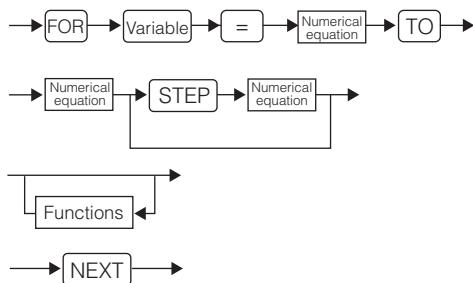
Processing a set of functions multiple times in a loop fashion for a specified number of iterations.

Syntax

```

FOR <variable> = <initial value> TO <final value> [STEP
<increment>]
- functions-
NEXT

```

Structure**Explanation**

- Before the loop is processed, an initial value is assigned to a variable, which is then incremented each time through the loop. This loop is repeated until the variable value exceeds the final value.
- STEP can be omitted (in which case the incremental value defaulted to 1).
- A loop can be exited using the EXIT FOR statement. Processing resumes at the line following the NEXT statement.

Examples

```

@a = 0
FOR @i = 1 TO 10
  @a = @a + @i
  IF @a > 11 THEN
    EXIT FOR
  END IF
NEXT

```

Example explanation

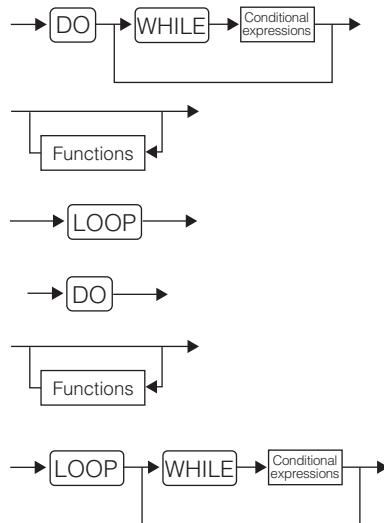
In the above example, @a is assigned the value of 15.

DO LOOP statement

Processing a set of functions multiple times in a loop fashion while a conditional statement is true.

Syntax

- Pre-loop evaluation:
DO WHILE <conditional expressions> - functions- LOOP
- Post loop evaluation:
DO - functions- LOOP WHILE <conditional expressions>

Structure**Explanation**

The DO statement uses pre-loop evaluation when the condition is written after the DO statement and post-loop evaluation when the condition is written after the LOOP statement.

- In the pre-loop evaluation, the loop condition must be true in order to process the functions below. When processing reaches the LOOP statement, it returns to the DO statement. If the conditional expression is false, the loop is finished and processing resumes on the line after the LOOP statement.
- In the post loop evaluation, the functions in the loop are processed first and then the loop condition is checked. If true, Processing returns to the DO statement, otherwise the loop is finished and processing resumes on the next line.
- The loop condition can be omitted (resulting in an endless loop).
- A DO... LOOP can be exited using the EXIT DO statement in the loop after the desired condition.

Processing resumes f on the next line after the LOOP statement LOOP. If WHILE is omitted the loop function must include EXIT DO.

Calculation Notation

Examples

(Pre-loop evaluation)

@a = 0

@i = 0

DO WHILE @i < 10

 @i = @i +10

 @a = @a + @i

LOOP(1)

(Post loop evaluation)

@a = 0

@i = 10

DO

 @i = @i + 1

 @a = @a + @i

LOOP WHILE @i < 10(2)

Example explanation

(1) In the above example @a is assigned the value of 10.

(2) In the above example @a is assigned the value of 11.

Operation Function List

The following functions can be used in the operations on the XG-X2000 Series.

Mathematical Functions

Function	Description	Reference page
Abs()	Absolute value	2-329
Atoi()	Convert ASCII code into integer	2-329
Ave()	Average value in a set range	2-329
Ave2()	Average value in a range of arrays	2-329
AveR()	Average value in a set range (set Max, Min)	2-330
AveR2()	Average value in a range of arrays (set Max, Min)	2-330
Ceil()	Round up	2-330
Deg()	Convert radians to degrees	2-331
Exp()	Exponential	2-331
Floor()	Round down	2-331
Itoa()	Convert integer into ASCII code	2-331
Int()	Convert to integer	2-332
Ln()	Natural logarithm	2-332
Log()	Common logarithm	2-332
Max()	Maximum value in range	2-332
Max2()	Maximum value in a range of arrays	2-332
MaxN()	Location of Maximum value in range	2-333
MaxN2()	Location of Maximum value in a range of arrays	2-333
Min()	Minimum value in range	2-333
Min2()	Minimum value in a range of arrays	2-333
MinN()	Location of minimum value in range	2-334
MinN2()	Location of minimum value in a range of arrays	2-334
Pi()	Circle ratio	2-334
Rad()	Convert degrees to radians	2-334
Round()	Round to the nearest integer	2-334
Sort()	Sort array values	2-335
Sqr()	Square	2-335
Sqrt()	Square root	2-335
Stdev()	Standard Deviation of a Range of Values	2-335
Stdev2()	Standard Deviation of a Range of Arrays	2-336
Sum()	Sum of an array	2-336

Trigonometric Functions

Function	Description	Reference page
Acos()	Angle formed by adjacent & hypotenuse	2-336
Asin()	Angle formed by opposite & hypotenuse	2-336
Atan()	Angle formed by opposite & adjacent	2-336
Atan2()	Angle formed by opposite (P1) & adjacent (P2)	2-337
Cos()	Adjacent/Hypotenuse: Cosine	2-337
Sin()	Opposite/Hypotenuse: Sine	2-337
Tan()	Opposite/Adjacent: Tangent	2-337

2D Geometric Functions

Function	Description	Reference page
AddVector()	Add vectors	2-338
AngC()	Center angle	2-338
Angle()	Segment angle	2-338
AngleTrans()	Angle range conversion	2-338
AngW()	Angular width	2-339
AsCircle()	Define circle from single X,Y and radius values	2-339
AsLine()	Define line from rho and angle values	2-339
AsPoint()	Define point from single X and Y values	2-339
CalibInfo()	Acquire calibration information	2-340
Circle3()	Create circle from 3 points	2-340
CircleLs()	Create circle from array points	2-340
CircleTangent()	Tangent to circle	2-341
ConvCrd()	Coordinate conversion (single magnitude)	2-341
ConvCrd2()	Coordinate conversion (dual magnitude)	2-342
ConvPixToWld (Q, CALIB[])	Convert pixel to unit	2-342
ConvWldToPix (Q, CALIB[])	Convert unit to pixel	2-343
Dist()	Distance between 2 points	2-343
I2Circle()	Intersection of 2 circles	2-343
I4XY()	Intersection of Four Points	2-344
I4Line()	Intersection of a Quadrilateral's Diagonal Lines	2-344
ILineCircle()	Intersection of line and circle	2-344
InnerProd()	Inner product of 2 vectors	2-344
ISect()	Intersection of 2 lines	2-345
Line()	Create line from 2 points	2-345
LineLs()	Create line from array points	2-345
LLAngle()	Angle between 2 lines	2-345
LnAngle()	Angle of line to horizontal	2-346
LnDist()	Perpendicular distance from point to line	2-346

Operation Function List

Function	Description	Reference page
LnDistP()	Perpendicular vector distance from point to line	2-346
LnDistXY()	Intersection of line and perpendicular from point to line	2-346
MidLine()	Bisector between 2 lines	2-347
MidXY()	Midpoint of 2 points	2-347
MultiPtCalib()	Calibration (CALIB:No.elem.>=28)	2-347
MultiPtCalib2()	Calibration (Transform Method)	2-349
OuterProd()	Outer product of vectors	2-349
Rotate()	Rotate	2-349
RotCenter()	Center of rotation	2-350
SortPos()	Sort position array values	2-350
SubVector()	Subtract vectors	2-351
UVWTrans()	Convert XYT to UVW	2-351
VMidLine()	Bisector between 2 points	2-352

3D Geometric Functions

Function	Description	Reference page
AddVector3D()	Add 3D Vectors	2-352
As3DPoint()	Define 3D Position from Single X, Y, Z Values	2-352
AsPlane()	Define Plane from A, B and C Values	2-353
Dist3D()	Distance Between Two 3D-Coordinate Points	2-353
I2Plane()	Line of Intersection of 2 Planes	2-353
ILine3DPlane()	Intersection of a 3D Line and a Plane	2-353
Line3DDist()	Perpendicular distance from point to 3D Line	2-354
Line3DDistXYZ()	Intersection of line and Perpendicular from Point to 3D Line	2-354
Line3DLs()	Create 3D line from 3D-coordinate points	2-355
LnLn3DDist()	Distance Between Two 3D Lines	2-355
Plane2Angle()	Angle Between Two Planes	2-355
PlaneContact()	Create contact plane	2-356
PlanePassPt()	Move plane parallel to pass specified point	2-356
PIDist()	3D point to plane perpendicular distance	2-356
PIDistN()	3D point to plane perpendicular distance (Max.)	2-356
PIDistP()	3D point to plane perpendicular vector distance	2-357
PIDistPN()	3D point to plane perpendicular vector distance (Max.)	2-357
PIDistXYZ()	Intersection of plane and perpendicular from 3D point to plane	2-357
PlaneLs()	Create plane from 3D-coordinate points	2-358
Sort3DPos()	Sort 3D position array values	2-358
SphereLs()	Create spherical surface from 3D-coordinate points	2-359
SubVector3D()	Subtract 3D Vectors	2-359

Calendar Functions

Function	Description	Reference page
ShiftDay()	No. Day(s) offset	2-359
ShiftMonth()	No. Month(s) offset	2-359
ShiftYear()	No. Year(s) offset	2-359

Bit Functions

Function	Description	Reference page
B_And()	Multiplication	2-360
B_Not()	Inverse	2-360
B_Or()	Addition	2-360
B_Xor()	Exclusive Addition	2-360
Bind()	Bind Bits	2-361

Others

Function	Description	Reference page
ClearVariableArrayC()	Clear circle array variable with 0	2-361
ClearVariableArrayL()	Clear line array variable with 0	2-362
ClearVariableArrayP()	Clear position array variable with 0	2-362
ClearVariableArrayPL()	Clear plane array variable with 0	2-363
ClearVariableArrayS()	Clear numerical array variable with 0	2-363
ClearVariableArrayT()	Clear 3D position array variable with 0	2-364
ClearVariableC()	Clear circle variable with 0	2-364
ClearVariableL()	Clear line variable with 0	2-364
ClearVariableP()	Clear position variable with 0	2-364
ClearVariablePL()	Clear plane variable with 0	2-365
ClearVariableS()	Clear numerical variable with 0	2-365
ClearVariableT()	Clear 3D position variable with 0	2-365
CopyVariableArrayC()	Copy circle array variable	2-365
CopyVariableArrayL()	Copy line array variable	2-366
CopyVariableArrayP()	Copy position array variable	2-366
CopyVariableArrayPL()	Copy plane array variable	2-367
CopyVariableArrayS()	Copy numerical array variable	2-367
CopyVariableArrayT()	Copy 3D position array variable	2-368
ResetVariableArrayC()	Reset circle array variable	2-368
ResetVariableArrayL()	Reset line array variable	2-369
ResetVariableArrayP()	Reset position array variable	2-369
ResetVariableArrayPL()	Reset plane array variable	2-370
ResetVariableArrayS()	Reset numerical array variable	2-370
ResetVariableArrayT()	Reset 3D position array variable	2-371
ResetVariableC()	Reset circle variable	2-371
ResetVariableL()	Reset line variable	2-371
ResetVariableP()	Reset position variable	2-371
ResetVariablePL()	Reset plane variable	2-371
ResetVariableS()	Reset numerical variable	2-372
ResetVariableT()	Reset 3D position variable	2-372

Mathematical Functions



The sample calculations given in the following explanations may not be precise due to computational errors inherent with processors.

Abs (P)

Calculates the absolute value of P.

Parameters

P: constant, numerical variable, or a function that results in a numerical value

Result type

Numerical value

Examples

`@a = -128`

`@a = Abs(@a)`

Example explanation

`@a` is set to a value of 128.

Atoi (N, P[])

Converts each value in the scalar array P[] from ASCII decimal code (numbers only) to its correct integer.

- The conversion is carried out until a non-numerical ASCII code is reached or the number of variables (N) is processed).
- No error occurs if the array contains a non-numerical ASCII code.

Parameters

- N: number of variables (a constant that represents the number of digits in a number, numerical variable, or a function that results in a numerical value)
- P[]: scalar array variable

Return value

Numerical value

Causes of Errors

- An error occurs if N is set to a value less than 1.
- An error occurs if there are fewer elements in the array than specified by N.

Examples

`#P[0] = 50.....(1)`

`#P[1] = 48.....(2)`

`#P[2] = 48.....(3)`

`#P[3] = 54.....(4)`

`@YEAR = Atoi(4,#P[]).....(5)`

`#Q[0] = 50.....(6)`

`#Q[1] = 48.....(7)`

`#Q[2] = 65.....(8)`

`#Q[3] = 54.....(9)`

`@a = Atoi(4,#Q[])`(10)

`#P[0] = 50.....(11)`

`#P[1] = 48.....(12)`

`#P[2] = 48.....(13)`

`#P[3] = 54.....(14)`

`@a = Atoi(10,#P[]).....(15)`

Explanation of examples

- (1) ASCII '2'
- (2) ASCII '0'
- (3) ASCII '0'
- (4) ASCII '6'
- (5) @YEAR=2006.
- (6) ASCII '2'
- (7) ASCII '0'
- (8) ASCII 'A'
- (9) ASCII '6'
- (10) @a is set to a value of 20 (no error generated).
- (11) ASCII '2'
- (12) ASCII '0'
- (13) ASCII '0'
- (14) ASCII '6'
- (15) Generates an error.

Ave(P0, P1, ..., Pn)

Calculates the average value of P0-Pn (Maximum of 40 items).

Parameters

P0 - Pn: constant, numerical variable, or a function that results in a numerical value

Return value

Numerical value

Error conditions

- An error occurs if none of the terms P0 - Pn are specified.
- An error occurs if P0 - Pn is more than 40 terms.

Examples

`@a = 8`

`@b = 9`

`@c = 2`

`@d = 3`

`@ave = Ave(@a, @b, @c, @d)`

Explanation of examples

`@ave` is set to a value of 5.5.

Ave2(N, P[])

Calculates the average of an array P[0] - P[N-1].

Parameters

- N: constant, numerical variable, or a function that results in a numerical value.
- P[]:numerical array variable

Return value

Numerical value

Error conditions

- An error occurs if N is set to a value of less than 1.
- An error occurs if there are fewer elements in the P[] array than N.

Examples

`#a[0] = 8`

`#a[1] = 9`

`#a[2] = 2`

`#a[3] = 3`

`@ave2 = Ave2(4, #a[])`

Explanation of examples

`@ave2` is set to a value of 5.5.

Operation Function List

AveR(Max, Min, P0, P1, ..., Pn)

Calculates the average value of terms that fall between a specified Min-to-Max range from P0-Pn (Maximum of 40 terms).

- The function will still calculate the average if Min and Max are reversed.
- Results in 0 if none of terms P0 to Pn fall between the Min-to-Max range.

Parameters

- Max: maximum value. Constant, numerical variable, or a function that results in a numerical value
- Min: minimum value. Constant, numerical variable, or a function that results in a numerical value
- P0 - Pn: constant, scalar numerical, or a function that results in a numerical value

Return value

Numerical value

Error conditions

- An error occurs if none of the terms P0 - Pn are specified.
- An error occurs if P0 - Pn h is more than 40 terms.

Examples

```
@max = 25
@min = 20
@a = 21
@b = 26
@c = 23
@aver = AveR(@max, @min, @a, @b, @c)
```

Explanation of examples

- @aver is set to a value of 22.

AveR2(Max, Min, N, P[])

Calculates the average value of terms that fall between a specified Min-to-Max range from array P[0]-P[N-1].

- The function will still calculate the average if the Min and Max are reversed.
- Results in 0 if all the terms in P[] are outside the range.

Parameters

- Max: maximum value. Constant, numerical variable, or a function that results in a numerical value
- Min: minimum value. Constant, numerical variable, or a function that results in a numerical value
- N: constant, numerical variable, or a function that results in a numerical value
- P[]:numerical array variable

Return value

Numerical value

Error conditions

- An error occurs if N is set to a value of less than 1.
- An error occurs if there are fewer elements in the P[] array than N.

Examples

```
@max = 25
@min = 20
#a[0] = 21
#a[1] = 26
#a[2] = 23
@aver2 = AveR2(@max, @min, 3, #a[])
```

Explanation of examples

@aver2 is set to a value of 22.

Ceil (P)

Rounds P up to the nearest integer.

Parameters

P: constant, numerical variable, or a function that that results in a numerical value

Return value

Numerical value

Comparison between rounding functions (Int, Floor, Round, and Ceil)

Value of P	Int (P)	Floor (P)	Round (P)	Ceil (P)
1.5	1	1	2	2
1.4	1	1	1	2
-1.4	-1	-2	-1	-1
-1.5	-1	-2	-2	-1

Deg(P)

Converts the angle P from radians into degrees..

Parameters

P: constant, scalar variable, or function that returns a scalar value in radians

Return value

Numerical value (units: degrees ($^{\circ}$))

Examples

`@a = Deg(3.14)`

Explanation of examples

`@a` is set to a value of 179.909.

Exp()

Returns the exponential base value e (2.71828183...).

Parameters

None

Return value

Numerical value

Examples

`@a = Exp()`

Explanation of examples

`@a` is set to a value of 2.718....

Floor(P)

Rounds P down to the closest integer.

Parameters

P: constant, numerical variable, or a function that results in a numerical value

Return value

Scalar value



Refer to "Comparison between rounding functions (Int, Floor, Round, and Ceil)" (Page 2-330) for more details about the differences between Floor and Int.

Itoa(D[],P)

Converts the integer P to ASCII code and stores it in a numerical array variable.

Parameters

- D[]: ASCII code, numerical array variable
- P: Numerical constant, variable, or a function that returns a numerical value

Return value

The number of characters after conversion

Error conditions

- If the number of D[] elements is fewer than the number of characters after conversion, the function terminates abnormally.

Examples

`@a = Itoa(#P[],12)`(1)

`@a = Itoa(#Q[],-12)`(2)

`@a = Itoa(#R[],12.3)`(3)

`@a = Itoa(#S[],1234)`(4)

#P[], #Q[], #R[], #S[]: Any numerical array variable defined with 3 elements.

Explanation of examples

(1)

`#P[0] = 49` ... ASCII '1'

`#P[1] = 50` ... ASCII '2'

`#P[2] = *` ... Will not be updated via this function

`@a` is set to a value of 2.

(2)

`#Q[0] = 45` ... ASCII '-'

`#Q[1] = 49` ... ASCII '1'

`#Q[2] = 50` ... ASCII '2'

`@a` is set to a value of 3.

(3)

`#R[0] = 49` ... ASCII '1'

`#R[1] = 50` ... ASCII '2'

`#R[2] = *` ... Will not be updated via this function
(rounded off after the decimal point)

`@a` is set to a value of 2.

(4)

`#S[0] = *` ... Will not be updated via this function

`#S[1] = *` ... Will not be updated via this function

`#S[2] = *` ... Will not be updated via this function

`@a` is set to a value of 0.



- The maximum value is 2147483647 (maximum of INT), and the minimum value is -2147483648 (minimum of INT).
- Unlike the Atoi function, negative values can also be used.
- The integer -123 is converted to the character string {"-", "1", "2", "3"}. If decimals are included, the values after the decimal point are discarded and only the integers are converted (for example, the value 456.789 is converted to the character string {"4", "5", "6"}).
- This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

Operation Function List

Int(P)

Returns the integer of P.

Parameters

P: constant, numerical variable, or a function that results in a numerical value

Return value

Numerical value



Point Refer to "Comparison between rounding functions (Int, Floor, Round, and Ceil)" (Page 2-330) for more details about the differences between Floor and Int.

Ln(P)

Calculates the natural logarithm of P.

Parameters

P: constant, numerical variable, or a function that results in a numerical value

Return value

Numerical value

Error conditions

An error occurs if the value of P is less than 0.

Examples

```
@e = Exp( )
@a = Ln(@e)
```

Explanation of examples

@a is set to a value of 1.

Log(P)

Calculates the common logarithm (base 10) of P.

Parameters

P: constant, numerical variable, or a function that results in a numerical value

Return value

Numerical value

Error conditions

An error occurs if the value of P is less than 0.

Examples

```
@a = Log(10)
```

Explanation of examples

@a is set to a value of 1.

Max(P0, P1, ..., Pn)

Calculates the largest value in P0 - Pn (Maximum of 40 items)

Parameters

P0 - Pn: constant, numerical variable, or function that results in a numerical value

Return value

Numerical value

Error conditions

- An error occurs if none of the parameters from P0 - Pn are specified.
- An error occurs if P0 - Pn is more than 40 terms.

Examples

```
@a = 8
@b = 9
@c = 2
@d = 3
@max = Max(@a, @b, @c, @d)
```

Explanation of examples

@max is set to a value of 9.

Max2(N, P[])

Calculates the largest value of an array P[0] - P[N-1].

Parameters

- N: constant, numerical variable, or a function that results in a numerical value
- P[]: numerical array variable

Return value

Numerical value

Error conditions

- An error occurs if N is set to a value of less than 1.
- An error occurs if there are fewer elements in the P[] array than N.

Examples

```
#a[0] = 8
#a[1] = 9
#a[2] = 2
#a[3] = 3
@max2 = Max2(4, #a[])
```

Explanation of examples

@max2 is set to a value of 9.

MaxN(P0, P1, ..., Pn)

Returns the location (from 0 to n) of the largest value in P0 - Pn (maximum of 40 terms).

Parameters

- P0 - Pn: constant, numerical variable, or a function that results in a numerical value

Return value

Numerical value

Error conditions

- An error occurs if none of the parameters from P0 - Pn are specified.
- An error occurs if P0 - Pn is more than 40 terms.

Examples

```
@a = 8
@b = 9
@c = 2
@d = 3
@maxn = MaxN(@a, @b, @c, @d)
```

Explanation of examples

@maxn is set to a value of 1.

MaxN2(N, P[])

Returns the location (from 0 to N-1) of the largest value in an array P[0] - P[N-1].

Parameters

- N: constant, numerical variable, or a function that results in a numerical value
- P[]: numerical array variable

Return value

Numerical value

Error conditions

- An error occurs if N is set to a value of less than 1.
- An error occurs if there are fewer elements in the P[] array than N.

Examples

```
#a[0] = 8
#a[1] = 9
#a[2] = 2
#a[3] = 3
@maxn2 = MaxN2(4, #a[])
```

Explanation of examples

@maxn2 is set to a value of 1.

Min(P0, P1, ..., Pn)

Calculates the smallest value in P0 - Pn (maximum of 40 terms).

Parameters

- P0 - Pn: constant, numerical variable, or a function that results in a numerical value

Return value

Numerical value

Error conditions

- An error occurs if none of the parameters from P0 - Pn are specified.
- An error occurs if P0 - Pn is more than 40 terms.

Examples

```
@a = 8
@b = 9
@c = 2
@d = 3
@min = Min (@a, @b, @c, @d)
```

Explanation of examples

@min is set to a value of 2.

Min2(N, P[])

Calculates the smallest value of an array P[0] - P[N-1].

Parameters

- N: constant, numerical variable, or a function that results in a numerical value
- P[]: numerical array variable

Return value

Numerical value

Error conditions

- An error occurs if N is set to a value of less than 1.
- An error occurs if there are fewer elements in the P[] array than N.

Examples

```
#a[0] = 8
#a[1] = 9
#a[2] = 2
#a[3] = 3
@min2 = Min2(4, #a[])
```

Explanation of examples

@min is set to a value of 2.

Operation Function List

MinN(P0, P1, ..., Pn)

Returns the location (from 0 to n) of the smallest value in P0-Pn (maximum of 40 terms).

Parameters

P0 - Pn: constant, numerical variable, or function that results in a numerical value

Return value

Numerical value

Error conditions

- An error occurs if none of the parameters from P0 - Pn are specified.
- An error occurs if P0 - Pn is more than 40 terms.

Examples

```
@a = 8
@b = 9
@c = 2
@d = 3
@minn = MinN(@a, @b, @c, @d)
```

Explanation of examples

@minn is set to a value of 2.

MinN2(N, P[])

Returns the location (from 0 to N-1) of the smallest value in an array P[0] - P[N-1].

Parameters

- N: constant, numerical variable, or a function t that results in a numerical value
- P[]: numerical array variable

Return value

Numerical value

Error conditions

- An error occurs if N is set to a value of less than 1.
- An error occurs if there are fewer elements in the P[] array than N.

Examples

```
#a[0] = 8
#a[1] = 9
#a[2] = 2
#a[3] = 3
@minn2 = MinN2(4, #a[])
```

Explanation of examples

@minn2 is set with a value of 2.

Pi()

Returns the value of π (3.141592654).

Parameters

None

Return value

Numerical value

 Point 180 (deg) = π (radian).

Rad(D)

Converts the angle P from degrees to radians.

Parameters

D: constant, numerical variable, or a function that results in a numerical value in degrees ($^{\circ}$)

Return value

Numerical value in radians

Examples

```
@a = Rad(30)
```

Explanation of examples

@a is set to a value of 0.523.

Round(P)

Rounds P up or down to the nearest integer.

Parameters

P: constant, numerical variable, or a function that results in a numerical value

Return value

Numerical value

Sort(N,P[],P1)

Sorts an array P[0] - P[N-1] in descending order. Then returns the value at location P1 from the newly sorted array P[0] - P[N-1].

Parameters

- N: number of variables
- P[]: numerical array variable
- P1: location (0- n in descending order)

Return value

Scalar value

Error conditions

- An error occurs if N is set to a value of less than 1.
- An error occurs if there are fewer elements in the P[] array than N.
- If !%InDataFieldbus[] is used as the array variable P[] t an error occurs as the system variable cannot be rewritten.
- An error occurs if the value of P1 is less than 0 or greater than or equal to N.
- An error occurs if there is not enough memory to processing the function.

Examples

```
#P[0] = 5
#P[1] = 10
#P[2] = 0
#P[3] = 9
#P[4] = 1
@a = Sort(5,#P[],2)
```

Explanation of examples

Sorting the elements in #P[] produces [10, 9, 5, 1, 0]. An index location of 2 returns the 3rd element from the largest value, so @a is set to a value of 5.



- Point**
- To produce the value at position Q when the elements are sorted in ascending order, code as follows:
Sort(N, P[], N-Q-1).
 - This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

Sqr(P)

Calculates P to the power of 2.

Parameters

P: constant, numerical variable, or a function that results in a numerical value

Return value

Numerical value

Examples

```
@a = 2
@a = Sqr(@a)
```

Explanation of examples

@a is set to a value of 4.

Sqrt(P)

Calculates the square root of P.

Parameters

P: constant, numerical variable, or a function that results in a numerical value

Return value

Numerical value

Error conditions

An error occurs if the value of P is negative.

Examples

```
@a = 256
@a = Sqrt(@a)
```

Explanation of examples

@a is set to a value of 16.

Stdev(P0, P1, ..., Pn)

Calculates the standard deviations from P0 to Pn (maximum of 40).

Parameters

P0 - Pn: constant, numerical variable, or a function that results in a numerical value

Return value

Numerical value

Error conditions

- An error occurs if none of the deviations from P0 to Pn are specified.
- An error occurs if the number of deviations from P0 to Pn is more than 40.

Examples

```
@a = 8
@b = 9
@c = 2
@d = 3
@stdev = Stdev(@a, @b, @c, @d)
```

Example explanation

@stdev is set to a value of 3.041.

Operation Function List

Stdev2(N,P[])

Calculates the standard deviations of array from P[0] to P[N-1].

Parameters

- N: constant, numerical variable, or a function that results in a numerical value
- P[]: numerical array variable

Return value

Numerical value

Error conditions

- If N is set to a value less than 1, the function terminates abnormally.
- If there are fewer elements in the P[] array than N, the function terminates abnormally.

Examples

```
#a[0] = 20
#a[1] = 9
#a[2] = 5
#a[3] = 3
@stdev2 = Stdev2(4, #a[])
```

Example explanation

@stdev2 is set to a value of 6.572.

Sum(N,P[])

Calculates the total sum of items in a numerical array P[0] - P[N-1].

Parameters

- N: number of variables
- P[]: numerical array variable

Return value

Numerical value

Error conditions

- An error occurs if N is set to a value of less than 1.
- An error occurs if there are fewer elements in the P[] array than N.

Examples

```
#P[0] = 1
#P[1] = 2
#P[2] = 3
#P[3] = 4
#P[4] = 5
@a = Sum(5,#P[])
```

Explanation of examples

@a is set to a value of 15.

Trigonometric Functions

Acos(P)

Calculates angle of an arc of a right angled triangle based on (P) (adjacent / hypotenuse).

Parameters

P: constant, numerical variable, or a function that results in a numerical value in the range of -1 to 1

Return value

Numerical value (0 to 180) (units: degrees (°))

Error conditions

An error occurs if the value of P1 falls outside of - 1.0 to +1.0.

Examples

```
@d = Acos(0.5)
```

Explanation of examples

@d is set to a value of 60(°).

Asin(P)

Calculates the angle of an arc of a right angled triangle based on (P) (opposite / hypotenuse).

Parameters

P: constant, numerical variable, or a function that results in a numerical value within the range of -1 to 1

Return value

Numerical value (-90 to 90) (units: degrees (°))

Error conditions

An error occurs if the value of P1 falls outside of - 1.0 to +1.0.

Examples

```
@d = Asin (0.5)
```

Explanation of examples

@d is set with a value of 30(°).

Atan(P)

Calculates the angle of an arc for a right angled triangle based on (P) (opposite / adjacent).

Parameters

P: constant, numerical variable, or a function that results in a numerical value

Return value

Numerical value (-90 to 90) (units: degrees (°))

Examples

```
@d = Atan(1)
```

Explanation of examples

@d is set to a value of 45(°).

Atan2(P1, P2)

Calculates the angle of an arc of a right angled triangle based of off two values (P1, P2) representing opposite and adjacent.

- $P1 > 0 \rightarrow 90$
- $P1 < 0 \rightarrow -90$
- $P1 = 0 \rightarrow \text{error}$

Parameters

P1, P2: constant, numerical variable, or function t that results in a numerical value in

Return value

Numerical value (-180 to 180) (units: degrees ($^{\circ}$))

Error conditions

An error if both P1 and P2 are 0.

Examples

`@d = Atan2 (1, 1)`

Explanation of examples

`@d` is set to a value of 45 ($^{\circ}$).

Cos(D)

Calculates adjacent, hypotenuse ratio for a right angled triangle based on an arc (D) ($^{\circ}$)

Parameters

D: constant, numerical variable, or function that results in a numerical value in degrees ($^{\circ}$)

Return value

Numerical value

Examples

`@a = Cos (60)`

Explanation of examples

`@a` is set with a value of 0.5.

Sin(D)

Calculates opposite, hypotenuse ratio for a right angled triangle based on an arc (D) ($^{\circ}$).

Parameters

D: constant, numerical variable, or function that results in a numerical value in degrees ($^{\circ}$)

Return value

Numerical value

Examples

`@a = Sin (30)`

Explanation of examples

`@a` is set to a value of 0.5.

Tan(D)

Calculates opposite, adjacent ratio for a right angled triangle based on an arc (D) ($^{\circ}$)

Parameters

D: constant, numerical variable, or a function that returns a scalar value in degrees ($^{\circ}$)

Return value

Numerical value

Examples

`@d = Tan(45)`

Explanation of examples

`@a` is set to a value of 1.

2D Geometric Functions

AddVector(Q1, Q2)

Calculates the sum of two two-dimensional vectors.

Parameters

Q1, Q2: position type variable or a function that results in position data

Return value

Position data

Examples

```
#P1=(1,1)
#P2=(2,2)
#p = AddVector(#P1, #P2)
```

Explanation of examples

#p is set to a value of (3,3).

AngC(D1, D2)

Calculates the center angle between D1 ($^{\circ}$) and D2 ($^{\circ}$) as calculated from the angle D1 in the clockwise direction.

Parameters

D1, D2: constant, numerical variable, or a function that results in numerical value in degrees ($^{\circ}$)

Return value

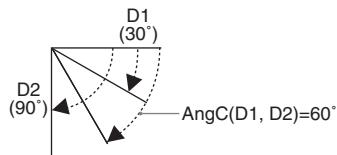
Numerical value (units: degrees ($^{\circ}$))

Examples

```
@a = AngC(30, 90)
```

Explanation of examples

@a is set to a value of 60($^{\circ}$).



Angle(Q1, Q2)

Calculates the angle formed by the horizontal axis and the line line through positions Q1 to Q2.

- Calculates the angle with Q1 as the point of rotation.
- The angle is calculated in a clockwise direction.

Parameters

Q1, Q2: position variable or a function that results in position data

Return value

Scalar numerical (units: degrees ($^{\circ}$))

Error conditions

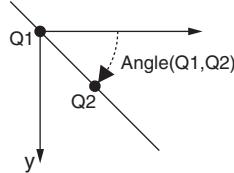
An error occurs if Q1 and Q2 are the same value.

Examples

```
#Q1.X = 0
#Q1.Y = 0
#Q2.X = 1
#Q2.Y = 1
#ang = Angle(#Q1, #Q2)
```

Explanation of examples

#ang is set to a value of 45($^{\circ}$).



AngleTrans(D, P)

This function finds the value of an angle that was converted to a value within a specified angle range.

Parameters

- D: Constant, scalar variable, or function that returns a scalar value, the unit is degrees ($^{\circ}$)
- P: Constant, scalar variable, or function that returns a scalar value
 - 0: Converts from -179.999 $^{\circ}$ or up to 180 $^{\circ}$ (-180 $^{\circ}$ is interpreted as 180 $^{\circ}$)
 - 1: Converts from 0 $^{\circ}$ or up to 359.999 $^{\circ}$ (360 $^{\circ}$ is interpreted as 0 $^{\circ}$)

Return value

Scalar value (unit: degrees ($^{\circ}$))

When the error conditions are fulfilled, the function abnormally terminates, so the return value is not returned.

Error conditions

When the value of P is not 0 or 1, the function abnormally terminates.

Example

```
#ANGLE=AngleTrance( 300, 0 )
```

Example explanation

#ANGLE is -60($^{\circ}$).

AngW(D1, D2)

Calculates the arc between D1 ($^{\circ}$) and D2 ($^{\circ}$) as calculated from the angle D1 in the clockwise direction.

Parameters

- D1, D2: constant, numerical variable, or a function that results in a numerical value in degrees ($^{\circ}$)

Return value

Scalar numerical (units: degrees ($^{\circ}$))

Example 1

```
@a = AngW(30, 90)
```

Explanation of example 1

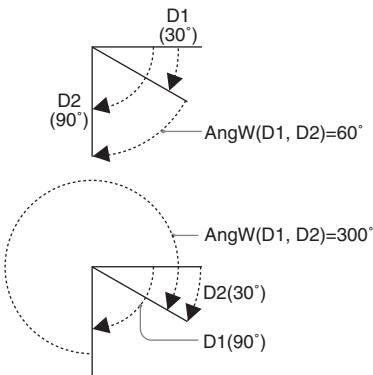
@a is set to a value of 60($^{\circ}$).

Example 2

```
@a = AngW(90, 30)
```

Explanation of example 2

@a is set to a value of 300($^{\circ}$).



AsCircle (P1, P2, P3)

Assigns P1 as the X center coordinate of a circle, P2 to as Y center coordinate, and P3 as the radius R.

Parameters

- P1: X center coordinate (constant, numerical variable, or a function that results in a numerical value)
- P2: Y-coordinate value of center (constant, numerical variable, or a function that results in a numerical value)
- P3: radius value (constant, scalar variable, or function that a function that results in a numerical value)

Return value

Circle data

Examples

```
#C[0] = AsCircle(10, 20, 30)
```

Explanation of examples

This example produces the same results as these operations.

```
#C[0].CX = 10
```

```
#C[0].CY = 20
```

```
#C[0].CR = 30
```

AsLine (P,D)

Assigns P to ρ of a line, and D to θ .

Parameters

- P: value of ρ (constant, numerical variable, or a function that results in a numerical value)
- D: value of θ (expressed in degrees) (constant, numerical variable, or a function that results in a numerical value)

Return value

Line data

Examples

```
#L[0] = AsLine(10, 45)
```

Explanation of examples

This example produces the same results as these operations.

```
L[0].RH = 10
```

```
L[0].T = 45
```

AsPoint (P1, P2)

Assigns P1 as the X coordinate of a position and P2 as the Y coordinate.

Parameters

- P1: X-coordinate (constant, numerical variable, or a function that results in a numerical value)
- P2: Y-coordinate (constant, scalar variable, or a function that results in a numerical value)

Return value

Position data

Examples

```
#P[0] = AsPoint(10, 20)
```

Explanation of examples

This example produces the same results as these operations.

```
#P[0].X = 10
```

```
#P[0].Y = 20
```

Operation Function List

CalibInfo(P1, P2, CALIB[], CINFO[])

This function finds the camera field of view, pixel resolution, camera rotation angle, and if the handedness was converted from the calibration information and camera pixel size.

Parameters

- P1, P2: Constant, scalar variable, or function that returns a scalar value
- P1: Camera pixel size in the X direction
- P2: Camera pixel size in the Y direction
- CALIB[]: 28 element scalar array variable or calibration unit results data "Calibration Model Parameters" (RSLT.CALIB[]))
- CINFO[]: 6 element scalar array variable (stores pixel resolution, camera field of view, camera rotation angle, and if the handedness was converted)
 - CINFO[0]: Camera field of view X (mm)
 - CINFO[1]: Camera field of view Y (mm)
 - CINFO[2]: Pixel resolution X (mm/pixel)
 - CINFO[3]: Pixel resolution Y (mm/pixel)
 - CINFO[4]: Camera rotation angle on the XY plane (°)
 - CINFO[5]: Righthand conversion from lefthand
 - 1: Not converted
 - 1: Converted

Return value

Scalar value (0=Success, -1=Failure)

- -1 is returned when a CINFO[] value cannot be correctly found.
- When the error conditions are fulfilled, the function abnormally terminates, so it cannot be checked with the return value.
- When the error conditions are fulfilled, the unit error code (RSLT.UEID) is 36005.

Error conditions

- When the CALIB[] array length is not 28, the function abnormally terminates.
- When the CINFO[] array length is not 6, the function abnormally terminates.

Example 1

```
@a=CalibInfo(640, 480, #CALIB[],#CINFO[] )
```

Example 1 explanation

This example finds the pixel resolution, camera field of view, camera rotation angle, and if the handedness was converted for a 0.3 megapixel camera (640x480 pixels) using #CALIB[] obtained with MultiPtCalib.

Example 2

```
@a=CalibInfo(640, 480, !U[0002].RSLT.CALIB[], #CINFO[])
```

Example 2 explanation

This example finds the pixel resolution, camera field of view, camera rotation angle, and if the handedness was converted for a 0.3 megapixel camera (640x480 pixels) using the calibration model parameters obtained with the calibration unit.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

Circle3(Q1,Q2,Q3)

Calculates the circle that passes through three X,Y positions (Q1, Q2, Q3).

Parameters

Q1, Q2, Q3: position variable or a function that results in position data

Return value

Circle data

Error conditions

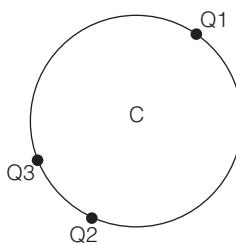
An error occurs two or more points are the same coordinate, or if all three points are in a single line.

Examples

```
#P[0].X = 10  
#P[0].Y = 0  
#P[1].X = 0  
#P[1].Y = 10  
#P[2].X = 10  
#P[2].Y = 20  
#c = Circle3(#P[0], #P[1], #P[2])
```

Explanation of examples

The values are set as follows: #c.CX = 10, #c.CY = 10, and #c.CR = 10.



CircleLs(N,Q[],P)

Calculates a circle based on a group of X,Y positions Q[0] to Q[N-1] using the least-squares method.

Parameters

- N: number of points
- Q[]:position array
- P: Use correction (0: no correction, 1: correction).

Return value

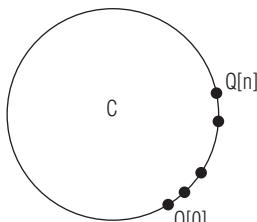
Circle data

Error conditions

- An error occurs if the number of points N exceeds 10,000.
- An error occurs if there are fewer than 3 points N.
- An error occurs if the value of P is neither 0 nor 1.
- An error occurs if there are fewer elements in the Q[] array than N.
- An error occurs if the function cannot find a circle from the group of points.

Examples

```
#C = CircleLs(5, #Q[], 1)
```



CircleTangent(C, Q, P)

Calculates two points on circle (C) based on tangent lines connecting position (Q) and circle (C).

Parameters

- C: circle variable or a function that results in circle data
 - Q: position variable or a function that results in position data
 - P: constant, numerical variable, or a function that returns results in a numerical value
- 0: returns the left intersect point (Q0) on the circle (C) when looking at position (Q) from the circle (C)
 1: returns the right intersect point (Q1) on the circle (C) when looking at position (Q) from the circle (C)

Return value

Position data

Error conditions

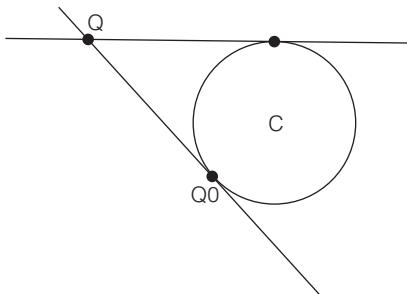
- An error occurs if point Q is inside the circle.
- An error occurs if the value of P is neither 0 nor 1.

Examples

```
#circle.CX = 10
#circle.CY = 10
#circle.CR = 10
#P[0].X = -10
#P[0].Y = 10
#p0 = CircleTangent(#circle, #P[0], 0)....(1)
#p1 = CircleTangent(#circle, #P[0], 1)....(2)
```

Explanation of examples

- (1) Intersect position is (5, 18.660).
- (2) Intersect position is (5, 1.329).



ConvCrd(Q1, Q2, D, P)

Converts the X,Y position Q1 in terms of the origin set at Q2, rotated D degrees and scaled by P (coordinate conversion).

Parameters

- Q1, Q2: position variable or a function that results in position data
- D: constant, numerical variable, or a function that results in a numerical value in degrees ($^{\circ}$)
- P: constant, numerical variable, or a numerical value

Return value

Position data (units: pixels)

Error conditions

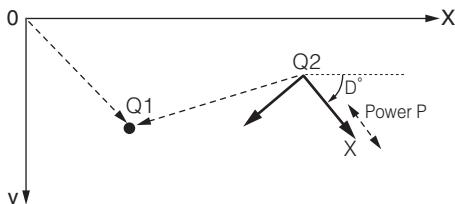
An error occurs if the value of P is zero.

Examples

```
#P[1].X = 10
#P[1].Y = 10 + 10 * Sqrt(2)
#P[2].X = 10
#P[2].Y = 10
#p = ConvCrd(#P[1], #P[2], 45, 1)
```

Explanation of examples

#p is set with a value of (10, 10).



Operation Function List

ConvCrd2(Q1, Q2, D, P1, P2)

Converts the X,Y position of Q1 in terms of the origin set at Q2, rotated D degrees, scaled by P1 and axis system P2.

Parameters

- Q1, Q2: position variable or a function that results in position data
- D: constant, numerical variable, or a function that results in a numerical value in degrees ($^{\circ}$)
- P1: constant, numerical variable, or a numerical value
- P2: constant, numerical variable, or a numerical value
 - 0: if the positive side of the Y axis faces the same way in the source and destination
 - 1: If the positive side of the Y axis faces in the opposite direction between the source and destination

Return value

Position data

Error conditions

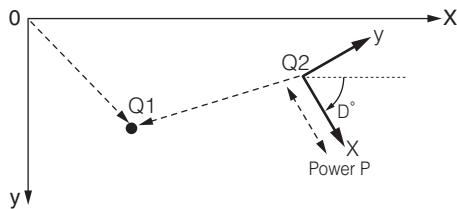
- An error occurs if the value of P is zero.
- An error occurs if the value of P2 is neither 0 nor 1.

Examples

```
#Q1.X = 10
#Q1.Y = 10 + 10 * Sqrt(2)
#Q2.X = 10
#Q2.Y = 10
#Q3 = ConvCrd2(#Q1, #Q2, 45, 1, 0) ..... (1)
#Q3 = ConvCrd2(#Q1, #Q2, 45, 1, 1) ..... (2)
```

Explanation of examples

- (1) #Q3 is set with a value of (10, 10).
- (2) #Q3 is set with a value of (10, -10).



ConvPixToWld(Q, CALIB[])

Converts an X,Y position on a pixel coordinate system to an X,Y position on a world coordinate system.

Parameters

- Q: position variable or a function that results in position data
- CALIB[]: numerical array variable with 28 elements, or result data from a calibration unit [Calibration Model Parameters] (RSLT.CALIB[])

Return value

Position data

Error conditions

- An error occurs if CALIB[] has more or fewer than 28 elements.
- An error occurs if the values in the CALIB[] cannot be converted, i.e., when the elements contain illegal values.

Examples

```
#P=ConvPixToWld(#p, #CALIB[])
```

Explanation of examples

Pixel coordinates #p are converted to world coordinates #P using the calibration model parameters (#CALIB[]).



Point

- When using the calibration model parameters (RSLT.CALIB[]) where the calibration unit is configured to generate a calibrated image, the conversion is done between the pixel and world coordinates of the calibrated image. If the calibration unit is not configured to generate a calibrated image, the conversion is done between the pixel and world coordinates of the current image.
- Positions converted using ConvPixToWld may not match exactly with the original positions when converted back (or vice versa) using ConvWldToPix.
- Positions that have been adjusted using position adjustment or scaling may not convert properly. Positions should be specified using an absolute value (AB).

ConvWldToPix(Q, CALIB[])

Converts an X,Y position on a world coordinate system to an X,Y position on a pixel coordinate system.

Parameters

- Q: position type variable or function that results in position data
- CALIB[]:numerical array variable with 28 elements, or result data from a calibration unit [Calibration Model Parameters] (RSLT.CALIB[]))

Return value

Position data

Error conditions

- An error occurs if CALIB[] has more or fewer than 28 elements.
- An error occurs if the values in the CALIB[] cannot be converted, i.e., when the elements contain illegal values.

Examples

```
#P=ConvWldToPix(#p, #CALIB[])
```

Explanation of examples

World coordinates #p are converted to pixel coordinates #P using the calibration model parameters (#CALIB[]).



- When using the calibration model parameters (RSLT.CALIB[]) where the calibration unit is configured to generate a calibrated image, the conversion is done between the pixel and world coordinates of the calibrated image. If the calibration unit is not configured to generate a calibrated image, the conversion is done between the pixel and world coordinates of the current image.
- Positions converted using ConvWldToPix may not match exactly with the original positions when converted back (or vice versa) using ConvPixToWld.

Dist(Q1, Q2)

Calculates the distance between two X,Y positions Q1 and Q2.

Parameters

Q1, Q2: position variable or a function that results in position data value

Return value

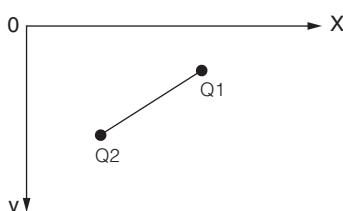
Numerical value (units: pixels)

Examples

```
#Q1.X = 70  
#Q1.Y = 20  
#Q2.X = 30  
#Q2.Y = 50  
#distance = Dist(#Q1, #Q2)
```

Explanation of examples

#distance is set to a value of 50.



I2Circle(C1,C2,P)

Calculates two intersecting points of two circles (C1 and C2). The points will be the same value if the circles are touching but not passing through each other.

Parameters

- C1, C2: circle variable or a function that results in circle data
 - P: constant, numerical variable, or a function that results in a numerical value
- 0: returns the left intersect point when looking at the line passing through the intersecting points (Q0, Q1) from the center of circle (C1)
1: returns the right intersect point when looking at the line passing through the intersecting points (Q0, Q1) from the center of circle (C1)

Return value

Position data (units: pixels)

Error conditions

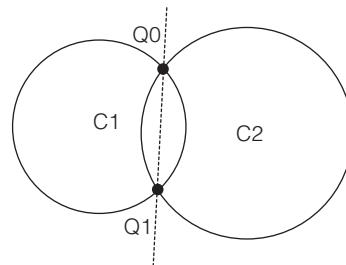
- An error occurs if the circles do not intersect.
- An error occurs if the value of P is neither 0 nor 1.

Examples

```
#Circle[0].CX = 10  
#Circle[0].CY = 10  
#Circle[0].CR = 10  
#Circle[1].CX = 20  
#Circle[1].CY = 20  
#Circle[1].CR = 10  
#point0 = I2Circle(#Circle[0], #Circle[1], 0)...(1)  
#point1 = I2Circle(#Circle[0], #Circle[1], 1)...(2)
```

Explanation of examples

- (1) Intersect position is (20,10)
- (2) Intersect position is (10,20)



Operation Function List

I4XY(Q1,Q2,Q3,Q4)

Calculates the intersecting point of diagonal lines based on four points.

Parameters

Q1, Q2, Q3, Q4: position variables or a function that results in a position value

Return value

Position data

Error conditions

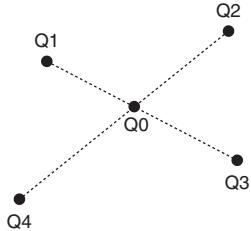
- When Q1 and Q3, and Q2 and Q4 are the same coordinates, the function terminates abnormally.
- When line Q1Q3 and line Q2Q4 are parallel to each other, the intersection line cannot be calculated: thus the function terminates abnormally.

Examples

```
#p0 = I4XY(#Q1, #Q2, #Q3, #Q4)
```

Example explanation

The coordinate of intersecting point Q0 is returned to #p0.



I4Line(L1,L2,L3,L4)

Calculates the intersecting point of diagonal lines based on four intersecting points formed by four lines.

Parameters

L1, L2, L3, L4: line type variables or a function that results in line data

Return value

Position data

Error conditions

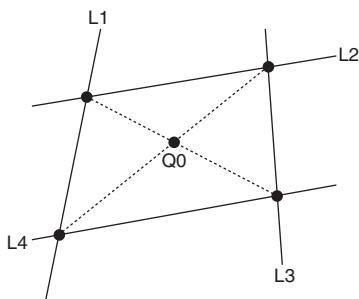
- When any of the four intersecting points cannot be calculated, the function terminates abnormally.
- When the diagonal line cannot be calculated from the intersecting points of four lines, the function terminates abnormally.

Examples

```
#p0 = I4Line(#L1, #L2, #L3, #L4)
```

Example explanation

The coordinate of intersecting point Q0 is returned to #p0.



ILineCircle(C,L,P)

Calculates the two intersecting points of a circle (C) and a line (L). The points will be the same value if the circles and line are touching but not passing through each other.

Parameters

- C: circle variable or a function that results in circle data
 - L: line type variable or a function that results in line data
 - P: constant, numerical variable, or a function that results in a numerical value
- 0: returns the left intersect point when looking at the line (L) from the center of circle (C)
1: returns the right intersect point when looking at the line (L) from the center of circle (C)

Return value

Position data (units: pixels)

Error conditions

- An error occurs if the circle and line do not intersect.
- An error occurs if the value of P is neither 0 nor 1.

Examples

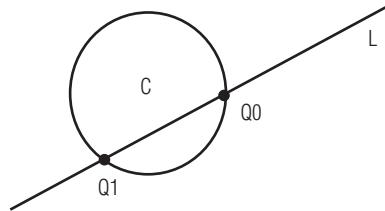
```
#circle.CX = 10  
#circle.CY = 10  
#circle.CR = 10  
#line.RH = 15 * Sqrt(2).....(1)  
#line.T = 45  
#point0 = ILineCircle(#circle, #line, 0).....(2)  
#point1 = ILineCircle(#circle, #line, 1).....(3)
```

Explanation of examples

(1) Represents line $y = -x + 30$.

(2) Intersect position is (20,10)

(3) Intersect position is (10,20)



InnerProd(Q1, Q2)

Calculates the inner product of two X,Y positions Q1 and Q2.

Parameters

Q1, Q2: position type variable or a function that results in position data

Return value

Numerical value

Examples

```
#P1=(1,1)  
#P2=(2,2)  
@a = InnerProd( #P1, #P2 )
```

Explanation of examples

@a is set to a value of 4 ($\#P1.X * \#P2.X + \#P1.Y * \#P2.Y$).

ISect(L1, L2)

Calculates the intersecting point of line L1 and line L2.

Parameters

L1, L2: line variable or a function that results in line data

Return value

Position data (units: pixels)

Error conditions

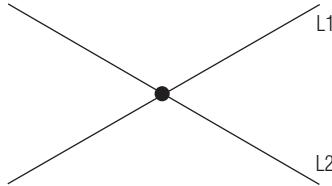
An error occurs if L1 and L2 are parallel.

Examples

```
#Point[0].X = 20
#Point[0].Y = 0
#Point[1].X = 0
#Point[1].Y = 10
#Point[2].X = 0
#Point[2].Y = 0
#Point[3].X = 20
#Point[3].Y = 10
#point = ISect(Line(#Point[0],#Point[1]), Line_(#Point[2],#Point[3]))
```

Explanation of examples

Intersecting position is (5,5)



Line(Q1, Q2)

Calculates the line between X,Y positions Q1 and Q2.

Parameters

Q1, Q2: position variable or a function that results in position data

Return value

Line data

Error conditions

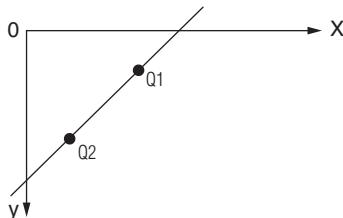
An error occurs if Q1 and Q2 are the same value.

Examples

```
#Q1.X = 50
#Q1.Y = 20
#Q2.X = 20
#Q2.Y = 50
#line = Line(#Q1, #Q2)
```

Explanation of examples

#line.T is set to a value of 45°, #line.RH to 49.497



LineLs(N,Q[],P)

Calculates a line based on a group of X,Y positions Q[0] to Q[N-1] using the least-squares method.

Parameters

- N: number of points
- Q[]:Position array
- P: Use correction (0: no correction, 1: correction)

Return value

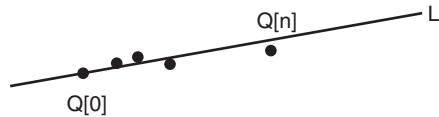
Line data

Error conditions

- An error occurs if the number of points N exceeds 10,000.
- An error occurs if there are fewer than 2 points N.
- An error occurs if the value of P is neither 0 nor 1.
- An error occurs if there are fewer elements in the Q[] array than N.
- An error occurs if the function cannot find a line from the group of points.

Examples

```
#L=LineLs(6, #Q[], 1)
```



LLAngle(L1, L2)

Calculates the angle formed by lines L1 and L2 where the angle is the absolute difference ($0^\circ \leq \theta < 180^\circ$) of the angle ($-90^\circ < \theta \leq 90^\circ$) formed by L1 and L2 with the horizontal line.



A line perpendicular to the horizontal line will have a 90° angle.

Parameters

L1, L2: line variable or a function that results in line data

Return value

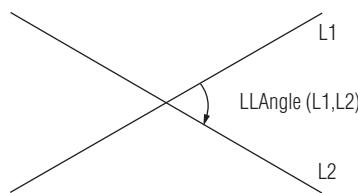
Numerical value (units: degrees ($^\circ$))

Examples

```
#Line[0].T = 60
#Line[0].RH = Sqrt(3) / 2
#Line[1].T = 120
#Line[1].RH = 0
#angle = LLAngle(#Line[0], #Line[1])
```

Explanation of examples

#ang is set to a value of 60° .



Operation Function List

LnAngle(L)

Calculates the angle ($-90^\circ < \theta \leq 90^\circ$) formed by line L and the horizontal line.

Point A line perpendicular to the horizontal line will have a 90° angle.

Parameters

L: line type variable or a function that results in line data

Return value

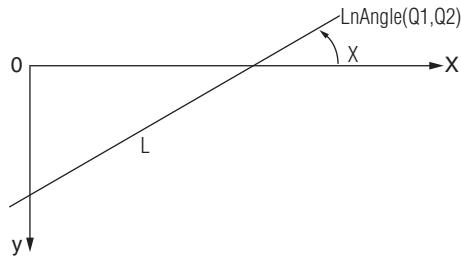
Numerical value (units: degrees ($^\circ$))

Examples

```
#line.T = 60
#line.RH = Sqrt(3) / 2
#ang = LnAngle(#line)
```

Explanation of examples

#ang is set to a value of -30° .



LnDist(L, Q)

Calculates the perpendicular distance between line L and X,Y position Q.

Parameters

- L: line variable or a function that results in line data
- Q: position variable or a function that results in position data

Return value

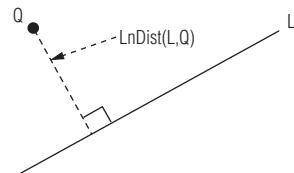
Numerical value (units: pixels)

Examples

```
#P[0].X = 0
#P[0].Y = 0
#line.T = 60
#line.RH = 1.5
#distance = LnDist(#line, #P[0])
```

Explanation of examples

#distance is set to a value of 1.5.



LnDistP(L, Q)

Outputs signed LnDist. If point Q is lower than line L, the value is positive; if it is higher, the value is negative.

Parameters

- L: line variable or a function that results in line data
- Q: position variable or function that results in position data

Return value

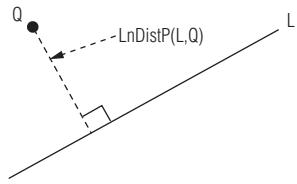
Numerical value (units: pixels)

Examples

```
#p0.X = 0
#p0.Y = 0
#line.T = 60
#line.RH = 1.5
#distance = LnDistP(#line, #p0)
```

Explanation of examples

#distance is set to a value of -1.5.



LnDistXY(L, Q)

Calculates the intersecting point between the line L and the perpendicular line from X,Y position Q.

Parameters

- L: line variable or a function that results in line data
- Q: position variable or a function that results in position data

Return value

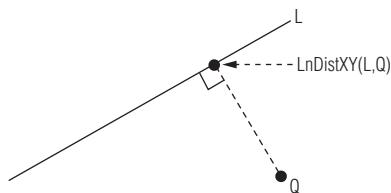
Position data (units: pixels)

Examples

```
#P[0].X = 10
#P[0].Y = 10
#line.T = 45
#line.RH = 5 * Sqrt(2)
#pointXY = LnDistXY(#line, #P[0])
```

Explanation of examples

Intersect position is (5,5)



MidLine(L1,L2,P)

Calculates two bisecting lines based on the intersection of two straight lines L1 and L2.

Parameters

- L1, L2: line variable or a function that results in line data
- P: constant, numerical variable, or a function that results in a numerical value
 - 0: returns the line bisecting the angle between L1 and L2
 - 1: returns the line perpendicular to the line bisecting the angle between L1 and L2

Return value

Line data

Error conditions

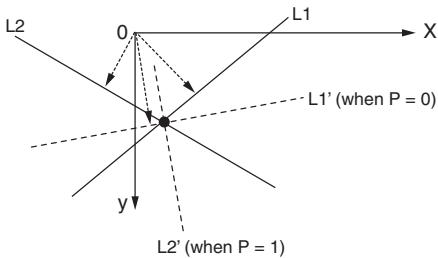
- An error occurs if L1 and L2 are parallel.
- An error occurs if the value of P is neither 0 nor 1.

Examples

```
#Line[0].T = 60
#Line[0].RH = 10
#Line[1].T = 120
#Line[1].RH = 0
#line = MidLine(#Line[0], #Line[1], 0) .....(1)
#line = MidLine(#Line[0], #Line[1], 1) .....(2)
```

Explanation of examples

- (1) $\theta = 90^\circ$, $p = 5.7735 (10/\sqrt{3})$.
- (2) $\theta = 0^\circ$, $p = 10$.



MidXY(Q1, Q2)

Calculates the point Q halfway between X,Y positions Q1 and Q2.

Parameters

Q1, Q2: position variable or a function that results in position data

Return value

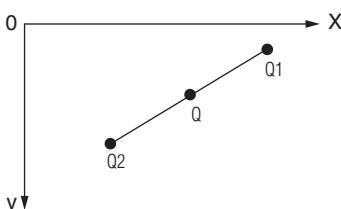
Position data (units: pixels)

Examples

```
#P[0].X = 90
#P[0].Y = 20
#P[1].X = 10
#P[1].Y = 80
#p = MidXY(#P[0], #P[1])
```

Explanation of examples

#p is set to a value of (50, 50).



MultiPtCalib(N,Q1[], Q2[], CALIB[])

Calculates calibration model (CALIB[]) from multiple pixel X,Y positions (Q1[]) and world X,Y positions (Q2[]).

The CALIB[] model obtained from this function can be used in ConvPixToWld and ConvWldToPix as a parameter for the following conversions.

- ConvPixToWld (Q, CALIB[]): converts X,Y position Q from pixel coordinates (Q1 coordinates) to world coordinates (Q2 coordinates).
- ConvWldToPix (Q, CALIB[]): converts X,Y position Q from world coordinates (Q2 coordinates) to pixel coordinates (Q1 coordinates)

Parameters

- N: number of points (1 - 16)
- Q1[]: position array (coordinates in a pixel coordinate system)
- Q2[]: position array (coordinates in a world coordinate system)
- CALIB[]: scalar array variable with 28 elements (where the calibration information is to be stored)

Return value

Numerical value (0 = success, -1 = fail)

The function returns -1 if it fails to find the calibration information.
(If the error conditions are met, the function ends on an error and the return value cannot be confirmed.)

Error conditions

- The function terminates abnormally if the number of elements is outside the range of 1 to 16.
- The function terminates abnormally if there are fewer elements in the Q1[] array than N.
- The function terminates abnormally if there are fewer elements in the Q2[] array than N.
- The function terminates abnormally if CALIB[] has more or fewer than 28 elements.

Example 1

Single point calibration

```
@a = MultiPtCalib(1, #P1[], #P2[], #CALIB[])
```

P1[0]



P2[1]



Explanation of example 1

@a = 0 (success) or @a = -1 (fail)

This function creates the calibration model (#CALIB[]) based on #P1 (pixel coordinates) being #P2 (world coordinates).



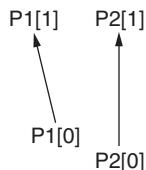
- Used in this manner the function cannot change the axis direction.
- This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

Operation Function List

Example 2

Two-point calibration

`@a = MultiPtCalib(2, #P1[], #P2[], #CALIB[])`



Explanation of example 2

`@a = 0` (success) or `@a = -1` (fail)

This function creates the calibration model (`#CALIB[]`) based on conversion (X/Y translation, rotation, and shrink & expand) of vector `#P1` (pixel coordinates) so that it correctly superimposes on vector `#P2` (world coordinates).

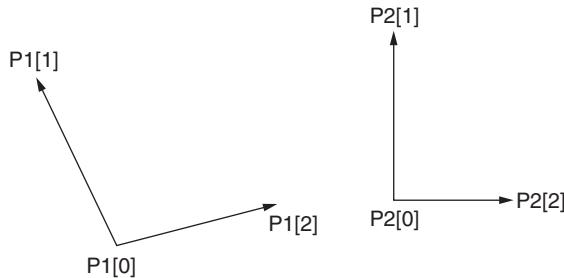


Used in this manner the function cannot change the axis direction.

Example 3

Three-point calibration

`@a = MultiPtCalib(3, #P1[], #P2[], #CALIB[])`



Explanation of example 3

`@a = 0` (success) or `@a = -1` (fail)

This function creates the calibration model (`#CALIB[]`) based on (X/Y translation, rotation, shrink & expand, aspect ratio, and shearing) on axis `#P1` (pixel coordinates) so that it superimposes on axis `#P2` (world coordinates).

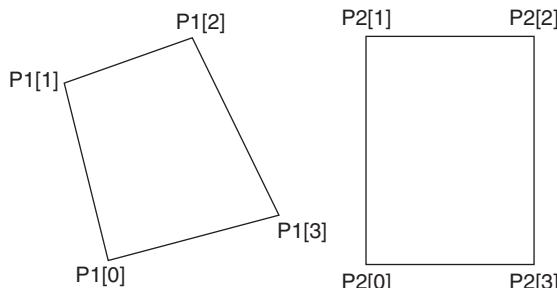


Used in this manner the function can be used to change the axis direction.

Example 4

Four-point calibration

`@a = MultiPtCalib(4, #P1[], #P2[], #CALIB[])`



Explanation of example 4

`@a = 0` (success) or `@a = -1` (fail)

This function creates the calibration model (`#CALIB[]`) based on projection conversion of square `#P1` (pixel coordinates) so that it superimposes on the square `#P2` (world coordinates) (eg trapezoid correction).

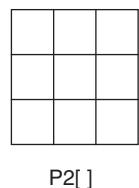
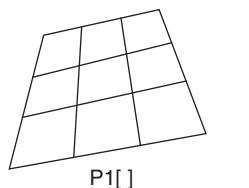


Used in this manner the function can be used to change the axis direction.

Example 5

Five-point calibration

`@a = MultiPtCalib(#N, #P1[], #P2[], #CALIB[])`



Explanation of example 5

`@a = 0` (success) or `@a = -1` (fail)

This function creates the calibration model (`#CALIB[]`) based on projection conversion of multiple points `#P1` (pixel coordinates) so that they superimpose as closely as possible (using the least-squares method) on the multiple points `#P2` (world coordinates).



- Used in this manner the function can be used to change the axis direction.
- Points need not exist on the same line.
- This cannot be used to correct lens distortion.

MultiPtCalib2(N, Q1[], Q2[], CALIB[], P)

This function finds the calibration information (CALIB[]) from multi-point position coordinates (Q1[] and Q2[]).

By giving CALIB[] (calibration information) obtained from this function to an argument of the function ConvPixToWld or ConvWldToPix, the following conversions become possible.

- ConvPixToWld(Q, CALIB[]): Converts the position coordinates of Q from the pixel coordinate system (Q1 coordinate system) to the world coordinate system (Q2 coordinate system).
- ConvWldToPix(Q, CALIB[]): Converts the position coordinates of Q from the world coordinate system (Q2 coordinate system) to the pixel coordinate system (Q1 coordinate system).

Parameters

- N: Number of points (1 to 10000)
- Q1[]: Position type array (coordinates on the pixel coordinate system)
- Q2[]: Position type array (coordinates on the world coordinate system)
- CALIB[]: 28 element scalar array variable (stores the calibration information)
- P: Selection option of transformation formula (0 to 3)
 - 0: Helmert transformation + No hand transformation (World coordinate: Left-hand)
 - 1: Helmert transformation + Hand transformation (World coordinate: Right-hand)
 - 2: Affine transformation
 - 3: Projective transformation

Return value

Numerical value (0=Success, -1=Failure)

If calibration information is not correctly obtained, -1 is returned.
(When error conditions are satisfied, the function terminates abnormally. It cannot be checked by the return value.)

Error conditions

- When N (Number of points) exceeds 10000, the function abnormally terminates.
- When the number of elements of the Q1[] array is less than N, the function abnormally terminates.
- When the number of elements of the Q2[] array is less than N, the function abnormally terminates.
- When the number of elements of the CALIB[] array is not 28, the function abnormally terminates.
- When P is not 0 to 3, the function abnormally terminates.



Point This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

OuterProd(Q1, Q2)

Calculates the outer product of two X,Y positions Q1 and Q2.

Parameters

Q1, Q2: position variable or a function that results in position data

Return value

Numerical value

Examples

```
#P1=(2,1)  
#P2=(1,2)  
@a = OuterProd(#P1, #P2)
```

Explanation of examples

@a is set to a value of 3 (#P1.X * #P2.Y - #P1.Y * #P2.X).

Rotate(Q1,Q2,D,P)

Rotates X,Y position Q1 about center Q2 for D degrees and scaled by P.

Parameters

- Q1, Q2: position variable or a function that results in position data
- D: constant, numerical variable, or a function that results in a numerical value in degrees (°).
- P: power. Constant, nu variable, or a function that results in a numerical value

Return value

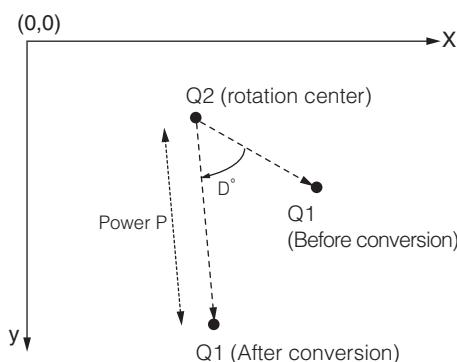
Position data (units: pixels)

Examples

```
#Q1.X = 15  
#Q1.Y = 15  
#Q2.X = 10  
#Q2.Y = 10  
#Q3 = Rotate(#Q1, #Q2, 90, 2)
```

Explanation of examples

Q3 is set to a value of (0, 20).



Operation Function List

RotCenter(Q1,Q2,D)

Calculates the X,Y position rotation center when Q1 is rotated to Q2 by D degrees.

Parameters

- Q1, Q2: position variable or a function that results in position data
- D: constant, numerical variable, or a function that results in a numerical value in degrees ($^{\circ}$)

Return value

Position data

Error conditions

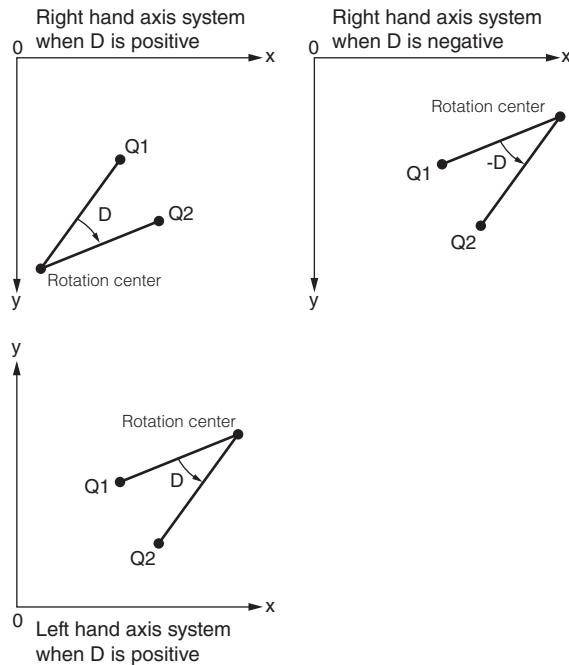
- An error occurs if Q1 and Q2 are the same value.
- An error occurs if D is a multiple of 360 degrees (-360, 0, 360, 720, ..., etc.).

Examples

```
#P=RotCenter(#Q1, #Q2, 30)
```

Explanation of examples

This function calculates the rotation center when point Q1 is rotated 30 degrees to point Q2.



Point

When using the right hand axis system and a positive angle the rotation will be clockwise with the rotation center being nearer the Y axis. For a negative angle the rotation will be counterclockwise and the rotation center nearer the X axis.

SortPos(N,P[],P1,P2,P3)

Sorts N elements starting from the variable in the P2 place among position array variables P[], using the element in the P1 place as the key, and then stores the data again (sort). The sort order is specified in P3. Then the index position data that is specified in P2 is returned from the array P[] after restoring.

Parameters

- N: number of variables
- P[]: position type array variable
- P1: number of element that is used as the key for sorting (0:X, 1:Y)
- P2: start point index where sorting starts
- P3: sorting order (0: descending order, 1: ascending order)

Return value

Position data

Error conditions

- If N is set to a value less than 1, the function terminates abnormally.
- If the value of P1 is other than 0 or 1, the function terminates abnormally.
- If the value of P2 is less than 0, the function terminates abnormally.
- If the value of P3 is other than 0 or 1, the function terminates abnormally.
- An error occurs if the number of N+P2 exceeds 10,000.
- If there are fewer elements in the P[] array than N+P2, the function terminates abnormally.
- If there is not enough memory for processing the function, the function terminates abnormally.

Examples

```
#P[0] = AsPoint(1, 5)
#P[1] = AsPoint(2, 4)
#P[2] = AsPoint(3, 3)
#P[3] = AsPoint(4, 2)
#P[4] = AsPoint(5, 1)
#p0 = SortPos(3, #P[], 1, 2, 1)
```

Example explanation

Sorts three variables with #P[2] being the first, using Y as the key in ascending order. Then returns the value of #P[2].

The value of each variable after sorting is as follows:

	X	Y
#P[0]	1	5
#P[1]	2	4
#P[2]	5	1
#P[3]	4	2
#P[4]	3	3
#p0	5	1

Point

This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

SubVector(Q1, Q2)

Calculates the difference between two X,Y positions Q1 and Q2.

Parameters

Q1, Q2: position variable or a function that results in position data

Return value

Position data

Examples

```
#P1=(1,1)
#P2=(2,2)
#p = SubVector(#P1, #P2)
```

Explanation of examples

#p is set to a value of (1,1).

UVWTrans(P1, P2, P3, P4[], P5[], UVW[])

This function converts the relative feed amount for a stage used for alignment from the XYθ coordinate system to the UVW coordinate system.

Parameters

- P1, P2, P3: Constant, scalar variable, or function that returns a scalar value
 - P1: Relative displacement in the X direction (mm)
 - P2: Relative displacement in the Y direction (mm)
 - P3: Angular relative displacement (°)
- P4[]: 9 element scalar array variable
 - P4[0]: U-axis ball screw position X mm
 - P4[1]: U-axis ball screw position Y mm
 - P4[2]: U-axis positive direction (0: ←, 1: →, 2: ↑, 3: ↓)
 - P4[3]: V-axis ball screw position X mm
 - P4[4]: V-axis ball screw position Y mm
 - P4[5]: V-axis positive direction (0: ←, 1: →, 2: ↑, 3: ↓)
 - P4[6]: W-axis ball screw position X mm
 - P4[7]: W-axis ball screw position Y mm
 - P4[8]: W-axis positive direction (0: ←, 1: →, 2: ↑, 3: ↓)
- P5[]: 3 element scalar array variable
 - P5[0]: U-axis current position mm
 - P5[1]: V-axis current position mm
 - P5[2]: W-axis current position mm
- UVW[]: 3 element scalar array variable (stores the UVW coordinate system values)
 - UVW[0]: U-axis displacement mm
 - UVW[1]: V-axis displacement mm
 - UVW[2]: W-axis displacement mm

Return value

Scalar value (0=Success)

- When the error conditions are fulfilled, the function abnormally terminates, so the return value is not returned.
- When the error conditions are fulfilled, the unit error code (RSLT.UEID) is 36005.

Error conditions

- When the P4[] array length is not 9, the function abnormally terminates.
- When the P5[] array length is not 3, the function abnormally terminates.
- When the UVW[] array length is not 3, the function abnormally terminates.
- When P4[2], P4[5], P4[8] (U-/V-/W-axis positive direction) values are not between 0 and 3, the function abnormally terminates.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

Operation Function List

Example

```

For relative displacement X: 1 mm, Y: 2 mm, θ: 0.5°
( Current position U-axis 0.1 mm, V-axis 0.1 mm, W-axis 0 mm)
#P1=1
#P2=2
#P3=0.5
#P4[0]=-100
#P4[1]=100
#P4[2]=1
#P4[3]=-100
#P4[4]=-100
#P4[5]=1
#P4[6]=100
#P4[7]=100
#P4[8]=2
#P5[0]=0.1
#P5[1]=0.1
#P5[2]=0
@a=UVWTrans(#P1, #P2, #P3, #P4[], #P5[] ,#UVW[])

```

Example explanation

@a=0 (Success)
 #UVW[] values are #UVW[0]: 0.131, #UVW[1]: 1.876, and
 #UVW[2]: 2.869.



You may not be able to use this function depending on the stage specifications. Contact a sales representative for details.

VMidLine(Q1, Q2)

Calculates the vertical line that bisects the line passing through X,Y positions Q1 and Q2.

Parameters

Q1, Q2: position type variable or a function that results in position data

Return value

Line data

Error conditions

An error occurs if Q1 and Q2 are the same coordinates.

Examples

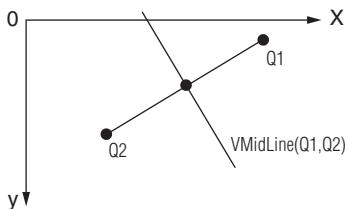
```

#P[0].X =10*Sqrt(3)
#P[0].Y = 0
#P[1].X = 0
#P[1].Y = 10
#I =VMidLine(#P[0], #P[1])

```

Explanation of examples

#1.T is set to -30°, #1.RH is set to 5.



3D Geometric Functions

AddVector3D(Q1, Q2)

Calculates the sum of two three-dimensional vectors.

Parameters

Q1, Q2: 3D position type variable or a function that results in 3D position data

Return value

3D position data

Examples

```

#P1 = As3DPoint(10, 10, 10)
#P2 = As3DPoint(20, 20, 20)
#P = AddVector3D(#P1, #P2)

```

Example explanation

#P is set to a value of (30, 30, 30).

As3DPoint (P1, P2, P3)

Assigns P1, P2, and P3 to TX, TY, and TZ of 3D position type.

Parameters

- P1: Value of TX (constant, numerical variable, or a function that results in a numerical value)
- P2: Value of TY (constant, numerical variable, or a function that results in a numerical value)
- P3: Value of TZ (constant, numerical variable, or a function that results in a numerical value)

Return value

Position data

Examples

```
#P[0] = As3DPoint(10, 20, 30)
```

Example explanation

This example produces the same results as these operations.

```

#P[0].TX = 10
#P[0].TY = 20
#P[0].TZ = 30

```

AsPlane (P1, P2, P3)

Assigns P1, P2, and P3 to A, B, and C of the plane type.

Parameters

- P1: Value of A (constant, numerical variable, or a function that results in a numerical value)
- P2: Value of B (constant, numerical variable, or a function that results in a numerical value)
- P3: Value of C (constant, numerical variable, or a function that results in a numerical value)

Return value

Plane data

Examples

```
#P[0] = AsPlane(10, 20, 30)
```

Example explanation

This example produces the same results as these operations.

```
#P[0].PPA = 10
```

```
#P[0].PPB = 20
```

```
#P[0].PPC = 30
```

Dist3D(Q1, Q2)

Calculates the distance between two 3D coordinates Q1 and Q2.

Parameters

Q1, Q2: 3D position type variable or a function that results in 3D position data

Return value

Numerical value (units: pixels)

Examples

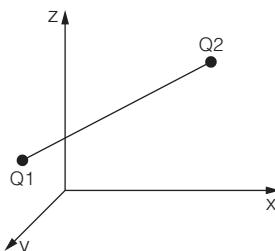
```
#Q1 = As3DPoint(TX1, TY1, TZ1)
```

```
#Q2 = As3DPoint(TX2, TY2, TZ2)
```

```
#distance = Dist3D(#Q1, #Q2)
```

Example explanation

Distance between two points is returned to #distance.



I2Plane(A1,A2,P,V)

Calculates the intersection line between two planes.

Parameters

- A1, A2: plane type variable or a function that results in plane data
- P: 3D plane variable (stores the points on the obtained intersection line)
- V: 3D plane variable (stores the direction vector of the obtained intersection line)

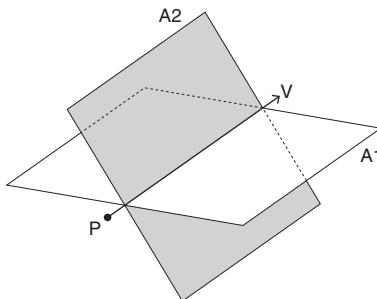
Return value

Numerical value (0 = Success)

When the error conditions are fulfilled, the function terminates abnormally, so the return value is not returned.

Error conditions

When the normal vectors of two planes are parallel to each other, the function terminates abnormally.



Point

- Since the plane is expressed as $z=ax+by+c$, a plane that has normal vector perpendicular to Z-axis cannot be calculated.
- The direction vector V is sought from the SubVector3D and Line3DLs.

ILine3DPlane(P,V,A)

Calculates the intersecting point of 3D line and plane. The 3D line is expressed as the line of direction vector V, passing through 3D position P.

Parameters

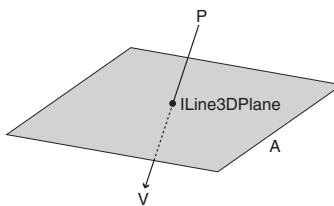
- P: 3D position type variable or a function that results in 3D position data
- V: 3D position type variable or a function that results in 3D position data
- A: plane type variable or a function that results in plane data

Return value

3D position data

Error conditions

- When the direction vector of 3D line is perpendicular to the normal vector of plane, the function terminates abnormally.
- When direction vector V is (0, 0, 0), the function terminates abnormally.



Point

- Since the plane is expressed as $z=ax+by+c$, a plane which has normal vector perpendicular to Z-axis cannot be calculated.
- The direction vector V is sought from the SubVector3D and Line3DLs

Operation Function List

Line3DDist(P,V,Q)

Calculates the distance between the point and 3D line (line of direction vector V, passing through 3D position P).

Parameters

- P: 3D position type variable or a function that results in 3D position data
- V: 3D position type variable or a function that results in 3D position data
- Q: 3D position type variable or a function that results in 3D position data

Return value

Numerical value (units: pixels)

Error conditions

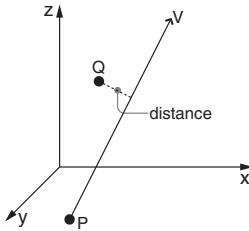
When direction vector V is (0, 0, 0), the function terminates abnormally.

Examples

```
#P = As3DPoint1(TX1, TY1, TZ1)
#V = As3DPoint(TX2, TY2, TZ2)
#Q = As3DPoint(TX3, TY3, TZ3)
#distance = Line3DDist(#P, #V, #Q)
```

Example explanation

The distance between the point Q and 3D line is returned to #distance.



The direction vector V is sought from the SubVector3D and Line3DLs

Line3DDistXYZ(P,V,Q)

Calculates the perpendicular intersecting point of the point and 3D line (line of direction vector V, passing through 3D position P).

Parameters

- P: 3D position type variable or a function that results in 3D position data
- V: 3D position type variable or a function that results in 3D position data
- Q: 3D position type variable or a function that results in 3D position data

Return value

3D position data

Error conditions

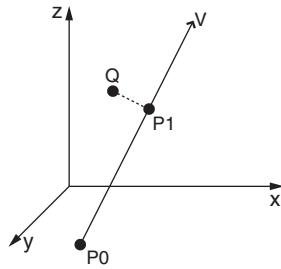
When direction vector V is (0, 0, 0), the function terminates abnormally.

Examples

```
#P0 = As3DPoint1(TX1, TY1, TZ1)
#V = As3DPoint(TX2, TY2, TZ2)
#Q = As3DPoint(TX3, TY3, TZ3)
#p1 = Line3DDistXYZ(#P, #V, #Q)
```

Example explanation

The coordinate of point-line intersecting point P1 is returned to #p1.



The direction vector V is sought from the SubVector3D and Line3DLs

Line3DLs(N,Q[],S,P,V)

Calculates a 3D line based on a group of 3D points, Q[0] to Q[N-1], using the least-squares method.

Parameters

- N: number of points
- Q[]: 3D position type array variable
- S: Specifies whether to perform Correction (0: No Correction, 1: Correction)
- P: 3D position type variable (stores a point on the obtained 3D line)
- V: 3D position type variable (stores the unit directional vector of the obtained 3D line)

Return value

Numerical type value (0=Success, -1=Fail)

-1 is returned when a 3D line was not able to be obtained from the group of points (when the error conditions are fulfilled, the function terminates abnormally, so the return value is not returned.)

Error conditions

- An error occurs if the number of points N exceeds 10,000.
- If the number of points N is less than 2, the function terminates abnormally.
- If S is something other than 0 or 1, the function terminates abnormally.
- If there are fewer elements in the Q[] array than N, the function terminates abnormally.

Examples

```
@a = Line3DLs(10, #T[], 0, #P, #V)
```

Example explanation

A 3D line is calculated based on the 3D positional array variable #T[0] - #T[9], and the point where the line passes is stored in #P and the unit directional vector is stored in #V.



The result (directional vector) sought via this function can be used in the other functions which take directional vectors as arguments.

LnLn3DDist(P1, V1, P2, V2)

Calculates the distance between two 3D lines (line of direction vector V, passing through 3D position P).

Parameters

- P1: 3D position type variable or a function that results in 3D position data
- V1: 3D position type variable or a function that results in 3D position data
- P2: 3D position type variable or a function that results in 3D position data
- V2: 3D position type variable or a function that results in 3D position data

Return value

Numerical value (units: pixels)

Error conditions

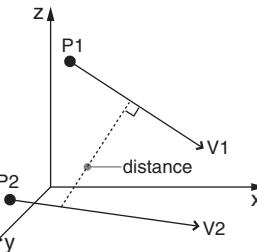
When direction vector V1 or V2 is (0, 0, 0), the function terminates abnormally.

Examples

```
#P1 = As3DPoint1(TX1, TY1, TZ1)
#V1 = As3DPoint(TX3, TY3, TZ3)
#P2 = As3DPoint(TX2, TY2, TZ2)
#V2 = As3DPoint(TX4, TY4, TZ4)
#distance = LnLn3DDist(#P1, #V1, #P2, #V2)
```

Example explanation

The distance between two lines is returned to #distance.



The direction vector V is sought from the SubVector3D and Line3DLs

Plane2Angle(A1, A2)

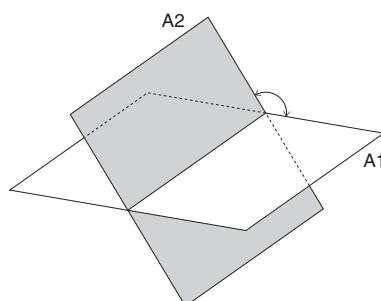
Calculates the angle formed by two planes.

Parameters

A1, A2: plane type variable or a function that results in plane data

Return value

Numerical value (units: degrees (°))



Operation Function List

PlaneContact(N, Q[], D)

Calculates a plane touching a group of 3D points from the upper or lower part of Q[0] to Q[N-1].

Parameters

- N: number of points
- Q[]: 3D position type array variable
- D: whether the plane to calculate from 3 of the points is at the top or bottom (in terms of the Z axis) of the remaining group of points that it does not come into contact with (0: Upper part, 1: Lower part)

Return value

Plane type value

Error conditions

- An error occurs if the number of points N exceeds 10,000.
- If the number of points N is less than 1, the function terminates abnormally.
- If D is something other than 0 or 1, the function terminates abnormally.
- If there are fewer elements in the Q[] array than N, the function terminates abnormally.
- When a plane cannot be calculated based on the group of points, the function terminates abnormally.

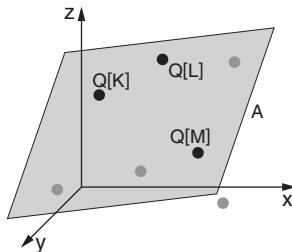
Example

```
#A = PlaneContact(10, #T[], 0)
```

Example explanation

A plane which contacts 3 of the points in a 3D position type array variable #T[0] - #T[9] and is located above the remaining points of the 3D position type array in terms of the Z axis is calculated.

The plane is stored in #A.



PlanePassPt(A, Q)

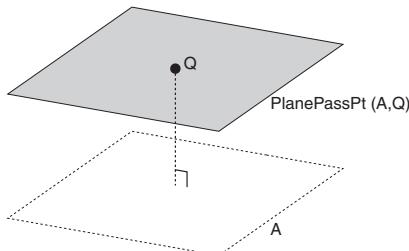
Calculates a plane that is obtained by translating the plane and passing a specified point.

Parameters

- A: plane type variable or a function that results in plane data
- Q: 3D position type variable or a function that results in 3D position data

Return value

Plane data



PIDist(A, Q)

Calculates the distance between plane A and 3D coordinate Q.

Parameters

- A: plane type variable or a function that results in plane data
- Q: 3D position type variable or a function that results in 3D position data

Return value

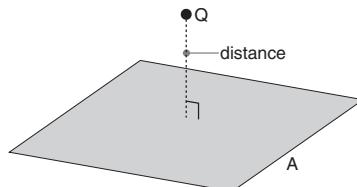
Numerical value (units: pixels)

Examples

```
#Q = As3DPoint(TX, TY, TZ)
#A = PlaneLs(10, #T[], 0)
#distance = PIDist(#A, #Q)
```

Example explanation

The distance from plane A to point Q, obtained by using the least-squares method based on 3D point group T, is returned to distance.



PIDistN(A, N, Q[], D[])

Calculates the distance between plane A and 3D coordinate group Q, and stores the result to array D.

Parameters

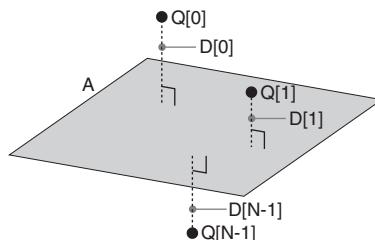
- A: plane type variable or a function that results in plane data
- N: number of points
- Q[]: 3D position type array variable
- D[]: numerical array variable

Return value

A numerical value (returns the index of point with D being the maximum)

Error conditions

- An error occurs if the number of points N exceeds 10,000.
- If the number of points N is less than 1, the function terminates abnormally.
- If there are fewer elements in the Q[] array than N, the function terminates abnormally.
- If there are fewer elements in the D[] array than N, the function terminates abnormally.



PIDistP(A, Q)

Calculates the distance between plane A and 3D coordinate Q, and obtains a signed result (signed output of PIDist, with the direction of normal vector being positive).

Parameters

- A: plane type variable or a function that results in plane data
- Q: 3D position type variable or a function that results in 3D position data

Return value

Numerical value (units: pixels)

PIDistPN(A, N, Q[], D[])

Calculates the distance between plane A and 3D coordinate Q, and stores the signed result into array D (signed output of PIDistN, with the direction of normal vector being positive).

Parameters

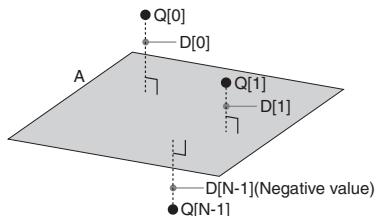
- A: plane type variable or a function that results in plane data
- N: number of points
- Q[]: 3D position type array variable
- D[]: numerical array variable

Return value

A numerical value (returns the index of point with the absolute value of D being the maximum)

Error conditions

- An error occurs if the number of points N exceeds 10,000.
- If the number of points N is less than 1, the function terminates abnormally.
- If there are fewer elements in the Q[] array than N, the function terminates abnormally.
- If there are fewer elements in the D[] array than N, the function terminates abnormally.



PIDistXYZ(A, Q)

Calculates the coordinates (XYZ) of intersecting point between the 3D position coordinate and the perpendicular line drawn to the plane.

Parameters

- A: plane type variable or a function that results in plane data
- Q: 3D position type variable or a function that results in 3D position data

Return value

3D position data

Examples

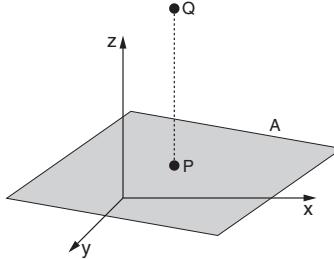
```
#Q = As3DPoint(TX, TY, TZ)
```

```
#A = PlaneLs(10, #T[], 0)
```

```
#p = PIDistXYZ(#A, #Q)
```

Example explanation

3D coordinate of perpendicular line from point Q drawn to plane A, which was obtained from 3D point group T by using the least-squares method, is returned to #p.



Since the plane is expressed as $z=ax+by+c$, a plane that has normal vector perpendicular to Z-axis cannot be calculated.

Operation Function List

PlaneLs(N, Q[], P)

Calculates a plane based on a group of 3D points from Q[0] to Q[N-1] using the least-squares method.

Parameters

- N: number of points
- Q[]: 3D position type array variable
- P: use correction (0: no correction, 1: correction).

Return value

Plane data

Error conditions

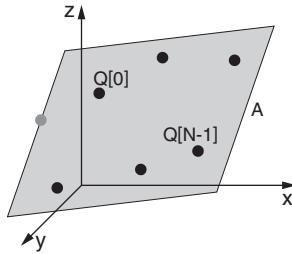
- An error occurs if the number of points N exceeds 10,000.
- If the number of points N is less than 3, the function terminates abnormally.
- If there are fewer elements in the Q[] array than N, the function terminates abnormally.
- When a plane cannot be calculated based on the group of points, the function terminates abnormally.

Examples

```
#A = PlaneLs(10, #T[], 0)
```

Example explanation

A plane is calculated from the 3D position type array variables from #T[0] to #T[9], and stored it to #A.



Sort3DPos(N,P[],P1,P2,P3)

Sorts N elements starting from the variable in the P2 place among 3D position array variables P[] using the element in the P1 place as the key, and then stores the data again (sort). The sort order is specified in P3. Then the index 3D position data that is specified in P2 is returned from the array P[] after restoring.

Parameters

- N: number of variables
- P[]: 3D position type array variable
- P1: number of element that is the key for sorting (0:TX, 1:TY, 2:TZ)
- P2: start point index where sorting starts
- P3: sorting order (0: descending order, 1: ascending order)

Return value

3D position data

Error conditions

- If N is set to a value less than 1, the function terminates abnormally.
- If the value of P1 is other than 0, 1, or 2, the function terminates abnormally.
- If the value of P2 is less than 0, the function terminates abnormally.
- If the value of P3 is other than 0 or 1, the function terminates abnormally.
- An error occurs if the number of N+P2 exceeds 10,000.
- If there are fewer elements in the P[] array than N+P2, the function terminates abnormally.
- If there is not enough memory for processing the function, the function terminates abnormally.

Examples

```
#P[0] = As3DPoint(10, 50, 10)
#P[1] = As3DPoint(20, 40, 10)
#P[2] = As3DPoint(30, 30, 10)
#P[3] = As3DPoint(40, 20, 10)
#P[4] = As3DPoint(50, 10, 10)
#p0 = Sort3DPos(3, #P[], 1, 2, 1)
```

Example explanation

Sorts three variables with #P[2] being the first, using TY as the key in ascending order. Then returns the value of #P[2].

The value of each variable after sorting is as follows:

	TX	TY	TZ
#P[0]	10	50	10
#P[1]	20	40	10
#P[2]	30	30	10
#P[3]	40	20	10
#P[4]	50	10	10
#p0	50	10	10



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

SphereLs(N,Q[],S,P,R)

Calculates a spherical surface based on a group of 3D points from Q[0] to Q[N-1] using the least-squares method.

Parameters

- N: number of points
- Q[]: 3D position type array variable
- S: Specify whether to perform Correction (0: No Correction, 1: Correction)
- P: 3D position type variable (stores the 3D position type coordinates of the center of the obtained sphere)
- R: Numerical variable (stores the radius of the obtained sphere)

Return value

Numerical type value (0=Success, -1=Fail)

-1 is returned when a sphere was not able to be obtained from the group of points (when the error conditions are fulfilled, the function terminates abnormally, so the return value is not returned.)

Error conditions

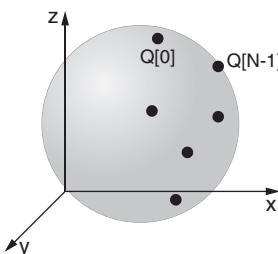
- An error occurs if the number of points N exceeds 10,000.
- If the number of points N is less than 4, the function terminates abnormally.
- If S is something other than 0 or 1, the function terminates abnormally.
- If there are fewer elements in the Q[] array than N, the function terminates abnormally.

Example

```
@a = SphereLs(10, #T[], 0, #P, #R)
```

Example explanation

A spherical surface is calculated from the 3D position type array variable from #T[0] to #T[9], and the sphere's center coordinates are stored in #P and the radius stored in #R.



SubVector3D(Q1, Q2)

Calculates the difference between two 3D vectors.

Parameters

Q1, Q2: 3D position type variable or a function that results in 3D position data

Return value

3D position data

Examples

```
#P1 = As3DPoint(20, 20, 20)
#P2 = As3DPoint(10, 10, 10)
#P = SubVector3D(#P1, #P2)
```

Example explanation

#P is set to a value of (10, 10, 10).



The results (direction vectors) sought via this function can be used in the other functions which turn direction vectors into arguments.

Calendar Functions

ShiftDay(P)

Adds or subtracts the number of days (P) to the current month, date, year, and returns the day.

Parameters

P: constant, numerical variable, or a function that results in a numerical value that returns a scalar value

Return value

Numerical value

Error conditions

An error occurs if the number of days P exceeds 9,999.

Examples

```
#day=ShiftDay(-1)
```

Explanation of examples

Returns the day one day prior to the current date set.

ShiftMonth(P)

Adds or subtracts the number of days (P) to the current month, date, year, and returns the month.

Parameters

P: constant, numerical variable, or a function that results in a numerical value

Return value

Numerical value

Error conditions

An error occurs if the number of days P exceeds 9,999.

Examples

```
#month = ShiftMonth(10)
```

Explanation of examples

Returns the month 10 days after the current date set.

ShiftYear(P)

Adds or subtracts the number of days (P) to the current month, date, year, and returns the year.

Parameters

P: constant, numerical variable, or a function that results in a numerical value

Return value

Numerical value

Error conditions

An error occurs if the number of days P exceeds 9,999.

Examples

```
#year = ShiftYear(-365)
```

Explanation of examples

Returns the year 365 days prior to the current set date.

Bit Functions

B_And(P1, P2)

Calculates the logical product of the BIT's of P1 and P2.

- The function converts P1 and P2 from a numerical value to a 4-byte integer (32 BIT's) and returns the calculated result as a numerical value.
- If the value specified exceeds the maximum for an unsigned 4-byte integer, the lower 4-bytes are used and all bits above that are ignored.

Parameters

P1, P2: constant, numerical variable, or a function that results in a numerical value

Return value

Numerical value

Examples

`@p1 = 10 (1010 in binary numeral notation)`

`@p2 = 3 (0011 in binary numeral notation)`

`@p3 = B_And (@p1, @p2)`

Explanation of examples

`@p3` is set to a value of 2 (0010 in binary numeral notation).

B_Not(P)

Calculates the logical inverse of the BIT's of P.

- The function converts P from a numerical value to a 4-byte integer (32 BIT's) and returns the calculated result as a numerical value.
- If the value specified exceeds the maximum for an unsigned 4-byte integer, the lower 4-bytes are used and all bits above that are ignored.

Parameters

P: constant, numerical variable, or function that results in a numerical value

Return value

Numerical value

Examples

`@p1 = 10 (1010 in binary numeral notation)`

`@p2 = B_And(B_Not(@p1), 15)`

Explanation of examples

`@p2` is set to a value of 5(0101 in binary numeral notation).

B_Or(P1, P2)

Calculates the logical sum of the BIT's of P1 and P2.

- The function converts P1 and P2 from a numerical value to a 4-byte integer (32 BIT's) and returns the calculated result as a numerical value.
- If the value specified exceeds the maximum for an unsigned 4-byte integer, the lower 4-bytes are used and all bits above that are ignored.

Parameters

P1, P2: constant, numerical variable, or a function that results in a numerical value

Return value

Numerical value

Examples

`@p1 = 10 (1010 in binary numeral notation)`

`@p2 = 3 (0011 in binary numeral notation)`

`@p3 = B_Or (@p1, @p2)`

Explanation of examples

`@p3` is set to a value of 11 (1011 in binary numeral notation).

B_Xor(P1, P2)

Calculates the exclusive logical OR of the BIT's of P1 and P2.

- The function converts P1 and P2 from a numerical value to a 4-byte integer (32 BIT's) and returns the calculated result as a numerical value.
- If the value specified exceeds the maximum for an unsigned 4-byte integer, the lower 4-bytes are used and all bits above that are ignored.

Parameters

P1, P2: constant, numerical variable, or function that returns a numerical value

Return value

Numerical value

Examples

`@p1 = 10 (1010 in binary numeral notation)`

`@p2 = 3 (0011 in binary numeral notation)`

`@p3 = B_Xor (@p1, @p2)`

Explanation of examples

`@p3` is set to a value of 9 (1001 in binary numeral notation).

Bind(P0, P1, P2, P3, P4, P5, P6, P7)

Binds the BIT's from P0 to P7 into an 8-bit value (P0: MSB, P7: LSB).

Parameters

P0 - P7: constant, numerical variable, or function that returns a numerical value

Return value

Numerical value

Error conditions

An error occurs if the value of P0 to P7 is neither a 0 nor a 1.

Examples

```
@p3 = Bind(0,1,0,1,0,1,0,1)
```

Explanation of examples

@p3 is set to a value of 85 (1010101 in binary numeral notation).

Others

ClearVariableArrayC(V[], P1, P2)

Clears (zeros out) a circle type array variable.

Parameters

- V[]: Circle type array variable
- P1, P2: Constant, scalar variable, or function that returns a scalar value
 - P1: The start index of the array elements to clear (all elements if -1)
 - P2: The stop index of the array elements to clear (P2 is not valid when P1=-1)

Return value

Scalar value (0=Success)

When the error conditions are fulfilled, the function abnormally terminates, so the return value is not returned.

Error conditions

- If P1 < -1, the function abnormally terminates.
- If P1 > P2 and P2 > (V[] array elements count - 1), the function abnormally terminates.

Example 1

```
@a=ClearVariableArrayC( #C[], 0, 9 )
```

Example 1 explanation

The current values of the circle type array variable #C[0] to #C[9] are set to (0,0,0).

Example 2

```
@a=ClearVariableArrayC( #C[], -1, -1 )
```

Example 2 explanation

The current values of all the elements of the circle type array variable #C[] are set to (0,0,0).



Point

This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

Operation Function List

ClearVariableArrayL(V[], P1, P2)

Clears (zeros out) a line type array variable.

Parameters

- V[]: Line type array variable
- P1, P2: Constant, scalar variable, or function that returns a scalar value
 - P1: The start index of the array elements to clear (all elements if -1)
 - P2: The stop index of the array elements to clear (P2 is not valid when P1=-1)

Return value

Scalar value (0=Success)

When the error conditions are fulfilled, the function abnormally terminates, so the return value is not returned.

Error conditions

- If P1 < -1, the function abnormally terminates.
- If P1 > P2 and P2 > (V[] array elements count - 1), the function abnormally terminates.

Example 1

```
@a=ClearVariableArrayL( #L[], 0, 9 )
```

Example 1 explanation

The current values of the line type array variable #L[0] to #L[9] are set to (0,0).

Example 2

```
@a=ClearVariableArrayL( #L[], -1, -1 )
```

Example 2 explanation

The current values of all the elements of the line type array variable #L[] are set to (0,0).



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ClearVariableArrayP(V[], P1, P2)

Clears (zeros out) a position type array variable.

Parameters

- V[]: Position type array variable
- P1, P2: Constant, scalar variable, or function that returns a scalar value
 - P1: The start index of the array elements to clear (all elements if -1)
 - P2: The stop index of the array elements to clear (P2 is not valid when P1=-1)

Return value

Scalar value (0=Success)

When the error conditions are fulfilled, the function abnormally terminates, so the return value is not returned.

Error conditions

- If P1 < -1, the function abnormally terminates.
- If P1 > P2 and P2 > (V[] array elements count - 1), the function abnormally terminates.

Example 1

```
@a=ClearVariableArrayP( #P[], 0, 9 )
```

Example 1 explanation

The current values of the position type array variable #P[0] to #P[9] are set to (0,0).

Example 2

```
@a=ClearVariableArrayP( #P[], -1, -1 )
```

Example 2 explanation

The current values of all the elements of the position type array variable #P[] are set to (0,0).



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ClearVariableArrayPL(V[], P1, P2)

Clears (zeros out) a plane type array variable.

Parameters

- V[]: Plane type array variable
- P1, P2: Constant, scalar variable, or a function that returns a scalar value
 - P1: The start index of the array elements to clear (all elements if -1)
 - P2: The stop index of the array elements to clear (P2 is not valid when P1=-1)

Return value

Scalar value (0=Success)

Error conditions

- When P1 < -1, the function terminates abnormally.
- When P1 > P2, and P2 > (V[] array elements count - 1), the function terminates abnormally.

Example 1

```
@a = ClearVariableArrayPL(#A[], 0, 9)
```

Example 1 explanation

The current values of the plane type array variable #A[0] to #A[9] are set to 0.

Example 2

```
@a = ClearVariableArrayPL(#A[], -1, -1)
```

Example 2 explanation

The current values of all elements of plane type array variable #A[] are set to 0.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ClearVariableArrayS(V[], P1, P2)

Clears (zeros out) a scalar array variable.

Parameters

- V[]: Scalar array variable
- P1, P2: Constant, scalar variable, or a function that returns a scalar value
 - P1: The start index of the array elements to clear (all elements if -1)
 - P2: The stop index of the array elements to clear (P2 is not valid when P1=-1)

Return value

Scalar value (0=Success)

When the error conditions are fulfilled, the function abnormally terminates, so the return value is not returned.

Error conditions

- If P1 < -1, the function abnormally terminates.
- If P1 > P2 and P2 > (V[] array elements count - 1), the function abnormally terminates.

Example 1

```
@a=ClearVariableArrayS( #S[], 0, 9 )
```

Example 1 explanation

The current values of the scalar array variable #S[0] to #S[9] are set to 0.

Example 2

```
@a=ClearVariableArrayS( #S[], -1, -1 )
```

Example 2 explanation

The current values of all the elements in the scalar array variable #S[] are set to 0.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

Operation Function List

ClearVariableArrayT(V[], P1, P2)

Clears (zeros out) a 3D position type array variable.

Parameters

- V[]: 3D position type array variable
- P1, P2: Constant, scalar variable, or a function that results in a scalar value
 - P1: The start index of the array elements to clear (all elements if -1)
 - P2: The stop index of the array elements to clear (P2 is not valid when P1=-1)

Return value

Scalar value (0=Success)

Error conditions

- If P1 < -1, the function terminates abnormally.
- If P1 > P2, and P2 > (V[] array elements count - 1), the function terminates abnormally.

Example 1

@a = ClearVariableArrayT(#T[], 0, 9)

Example 1 explanation

The current values of the 3D position type array variable #T[0] to #T[9] are set to 0.

Example 2

@a = ClearVariableArrayT(#T[], -1, -1)

Example 2 explanation

The current values of the 3D position type array variable #T[] are set to 0.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ClearVariableC(V)

Clears (zeros out) a Circle type variable.

Parameters

V: Circle type variable

Return value

Scalar value (0=Success)

Example

@a=ClearVariableC(#C)

Example explanation

The current value of the Circle type variable #C is set to (0,0,0).



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ClearVariableL(V)

Clears (zeros out) a line type variable.

Parameters

V: Line type variable

Return value

Scalar value (0=Success)

Example

@a=ClearVariableL(#L)

Example explanation

The current value of the line type variable #L is set to (0,0).



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ClearVariableP(V)

Clears (zeros out) a position type variable.

Parameters

V: Position type variable

Return value

Scalar value (0=Success)

Example

@a=ClearVariableP(#P)

Example explanation

The current value of the position type variable #P is set to (0,0).



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ClearVariablePL(V)

Clears (zeros out) a plane type variable.

Parameters

V: Plane type variable

Return value

Scalar value (0=Success)

Examples

`@a = ClearVariablePL(#A)`

Example explanation

The current values of plane type variable #A is set to 0.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ClearVariableS(V)

Clears (zeros out) a scalar type variable.

Parameters

V: Scalar type variable

Return value

Scalar value (0=Success)

Example

`@a=ClearVariableS(#S)`

Example explanation

The current value of the scalar type variable #S is set to 0.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ClearVariableT(V)

Clears (zeros out) a 3D position type variable.

Parameters

V: 3D position type variable

Return value

Scalar value (0=Success)

Examples

`@a = ClearVariableT(#T)`

Example explanation

The current values of 3D position type variable #T is set to 0.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

CopyVariableArrayC(D[], S[], P1, P2)

Copies a circle type array variable.

Parameters

- D[]: Copy destination, circle type array variable
- S[]: Copy from, circle type array variable, result data
- P1, P2: Constant, scalar variable, or a function that results in a scalar value
 - P1: The start index of the copy from array elements (all elements if -1)
 - P2: Numbers to be copied (P2 is not valid when P1=-1, to the end of the copy from when -1)

Return value

Scalar value (0=Success)

When the error conditions are fulfilled, the function terminates abnormally, so the return value is not returned.

Error conditions

- When P1 < -1 or P2 < -1, the function terminates abnormally.
- When the number of elements S[] < P2, or the number of elements D[] < P2, the function terminates abnormally.
- When the number of elements S[] <= P1, the function terminates abnormally.
- When the number of elements S[] < (P1 + P2), the function terminates abnormally.

Examples

`@a = CopyVariableArrayC(#L0000[], #L0001[], 0, 10)`

Example explanation

Copies ten data starting from index 0 of circle type array variable #L0001[] to circle type array variable #L0000[].



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

Operation Function List

CopyVariableArrayL(D[], S[], P1, P2)

Copies a line type array variable.

Parameters

- D[]: Copy destination, line type array variable
- S[]: Copy from, line type array variable, result data
- P1, P2: Constant, scalar variable, or a function that results in a scalar value
 - P1: The start index of the copy from array elements (all elements if -1)
 - P2: Numbers to be copied (P2 is not valid when P1=-1, to the end of the copy from when -1)

Return value

Scalar value (0=Success)

When the error conditions are fulfilled, the function terminates abnormally, so the return value is not returned.

Error conditions

- When P1 < -1 or P2 < -1, the function terminates abnormally.
- When the number of elements S[] < P2, or the number of elements D[] < P2, the function terminates abnormally.
- When the number of elements S[] <= P1, the function terminates abnormally.
- When the number of elements S[] < (P1 + P2), the function terminates abnormally.

Examples

```
@a = CopyVariableArrayL(#L0000[], #L0001[], 0, 10)
```

Example explanation

Copies ten data starting from index 0 of line type array variable #L0001[] to line type array variable #L0000[].



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

CopyVariableArrayP(D[], S[], P1, P2)

Copies a position type array variable.

Parameters

- D[]: Copy destination, position type array variable
- S[]: Copy from, position type array variable, result data
- P1, P2: Constant, scalar variable, or a function that results in a scalar value
 - P1: The start index of the copy from array elements (all elements if -1)
 - P2: Numbers to be copied (P2 is not valid when P1=-1, to the end of the copy from when -1)

Return value

Scalar value (0=Success)

When the error conditions are fulfilled, the function terminates abnormally, so the return value is not returned.

Error conditions

- When P1 < -1 or P2 < -1, the function terminates abnormally.
- When the number of elements S[] < P2, or the number of elements D[] < P2, the function terminates abnormally.
- When the number of elements S[] <= P1, the function terminates abnormally.
- When the number of elements S[] < (P1 + P2), the function terminates abnormally.

Example 1

```
@a = CopyVariableArrayP(#L0000[], #L0001[], 0, 10)
```

Example 1 explanation

Copies ten data starting from index 0 of position type array variable #L0001[] to position type data array variable #L0000[].

Example 2

```
@a = CopyVariableArrayP(#L0002[], !U[0003], RSLT.XYI[]:MS, 0, 10)
```

Example 2 explanation

Copies ten data starting from index 0 of the position type array that is the result data of unit 0003 to position type array variable #L0002[].



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

CopyVariableArrayPL(D[], S[], P1, P2)

Copies a plane type array variable.

Parameters

- D[]: Copy destination, plane type array variable
- S[]: Copy from, plane type array variable, result data
- P1, P2: Constant, scalar variable, or a function that results in a scalar value
 - P1: The start index of the copy from array elements (all elements if -1)
 - P2: Numbers to be copied (P2 is not valid when P1=-1, to the end of the copy from when -1)

Return value

Scalar value (0=Success)

When the error conditions are fulfilled, the function terminates abnormally, so the return value is not returned.

Error conditions

- When P1 < -1 or P2 < -1, the function terminates abnormally.
- When the number of elements S[] < P2, or the number of elements D[] < P2, the function terminates abnormally.
- When the number of elements S[] <= P1, the function terminates abnormally.
- When the number of elements S[] < (P1 + P2), the function terminates abnormally.

Examples

```
@a = CopyVariableArrayPL(#L0000[], #L0001[], 0, 10)
```

Example explanation

Copies ten data starting from index 0 of plane type array variable #L0001[] to plane type array variable #L0000[].



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

CopyVariableArrayS(D[], S[], P1, P2)

Copies a scalar type array variable.

Parameters

- D[]: Copy destination, scalar type array variable
- S[]: Copy from, scalar type array variable, result data
- P1, P2: Constant, scalar variable, or a function that results in a scalar value
 - P1: The start index of the copy from array elements (all elements if -1)
 - P2: Numbers to be copied (P2 is not valid when P1=-1, to the end of the copy from when -1)

Return value

Scalar value (0=Success)

When the error conditions are fulfilled, the function terminates abnormally, so the return value is not returned.

Error conditions

- When P1 < -1 or P2 < -1, the function terminates abnormally.
- When the number of elements S[] < P2, or the number of elements D[] < P2, the function terminates abnormally.
- When the number of elements S[] <= P1, the function terminates abnormally.
- When the number of elements S[] < (P1 + P2), the function terminates abnormally.

Example 1

```
@a = CopyVariableArrayS(#L0000[], #L0001[], 0, 10)
```

Example 1 explanation

Copies ten data starting from index 0 of scalar type array variable #L0001[] to scalar type array variable #L0000[].

Example 2

```
@a = CopyVariableArrayS(#L0002[], !U[0003].RSLT.AR[]:MS, 0, 10)
```

Example 2 explanation

Copies ten data starting from index 0 of the scalar type array that is the result data of unit 0003 to scalar type array variable #L0002[].



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

Operation Function List

CopyVariableArrayT(D[], S[], P1, P2)

Copies 3D position type array variable.

Parameters

- D[]: Copy destination, 3D position type array variable
- S[]: Copy from, 3D position type array variable, result data
- P1, P2: Constant, scalar variable, or a function that results in a scalar value
 - P1: The start index of the copy from array elements (all elements if -1)
 - P2: Numbers to be copied (P2 is not valid when P1=-1, to the end of the copy from when -1)

Return value

Scalar value (0=Success)

When the error conditions are fulfilled, the function terminates abnormally, so the return value is not returned.

Error conditions

- When P1 < -1 or P2 < -1, the function terminates abnormally.
- When the number of elements S[] < P2, or the number of elements D[] < P2, the function terminates abnormally.
- When the number of elements S[] <= P1, the function terminates abnormally.
- When the number of elements S[] < (P1 + P2), the function terminates abnormally.

Examples

```
@a = CopyVariableArrayT(#L0000[], #L0001[], 0, 10)
```

Example explanation

Copies ten data starting from index 0 of 3D position type array variable #L0001[] to 3D position type array variable #L0000[].



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ResetVariableArrayC(V[], P1, P2)

Initializes a circle type array variable.

Parameters

- V[]: Circle type array variable
- P1, P2: Constant, scalar variable, or function that returns a scalar value
 - P1: The start index of the array elements to clear (all elements if -1)
 - P2: The stop index of the array elements to clear (P2 is not valid when P1=-1)

Return value

Scalar value (0=Success)

When the error conditions are fulfilled, the function abnormally terminates, so the return value is not returned.

Error conditions

- If P1 < -1, the function abnormally terminates.
- If P1 > P2 and P2 > (V[] array elements count - 1), the function abnormally terminates.

Example 1

```
@a=ResetVariableArrayC( #C[], 0, 9 )
```

Example 1 explanation

The current values of the circle type array variable #C[0] to #C[9] are set to their initial values.

Example 2

```
@a=ResetVariableArrayC( #C[], -1, -1 )
```

Example 2 explanation

The current values of all the elements of the circle type array variable #C[] are set to their initial values.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ResetVariableArrayL(V[], P1, P2)

Initializes a line type array variable.

Parameters

- V[]: Line type array variable
- P1, P2: Constant, scalar variable, or function that returns a scalar value
 - P1: The start index of the array elements to clear (all elements if -1)
 - P2: The stop index of the array elements to clear (P2 is not valid when P1=-1)

Return value

Scalar value (0=Success)

When the error conditions are fulfilled, the function abnormally terminates, so the return value is not returned.

Error conditions

- If P1 < -1, the function abnormally terminates.
- If P1 > P2 and P2 > (V[] array elements count - 1), the function abnormally terminates.

Example 1

```
@a=ResetVariableArrayL( #L[], 0, 9 )
```

Example 1 explanation

The current values of the line type array variable #L[0] to #L[9] are set to their initial values.

Example 2

```
@a=ResetVariableArrayL( #L[], -1, -1 )
```

Example 2 explanation

The current values of all the elements of the line type array variable #L[] are set to their initial values.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ResetVariableArrayP(V[], P1, P2)

Initializes a position type array variable.

Parameters

- V[]: Position type array variable
- P1, P2: Constant, scalar variable, or function that returns a scalar value
 - P1: The start index of the array elements to clear (all elements if -1)
 - P2: The stop index of the array elements to clear (P2 is not valid when P1=-1)

Return value

Scalar value (0=Success)

When the error conditions are fulfilled, the function abnormally terminates, so the return value is not returned.

Error conditions

- If P1 < -1, the function abnormally terminates.
- If P1 > P2 and P2 > (V[] array elements count - 1), the function abnormally terminates.

Example 1

```
@a=ResetVariableArrayP( #P[], 0, 9 )
```

Example 1 explanation

The current values of the position type array variable #P[0] to #P[9] are set to their initial values.

Example 2

```
@a=ResetVariableArrayP( #P[], -1, -1 )
```

Example 2 explanation

The current values of all the elements of the position type array variable #P[] are set to their initial values.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

Operation Function List

ResetVariableArrayPL(V[], P1, P2)

Initializes a plane type array variable.

Parameters

- V[]: Plane type array variable
- P1, P2: Constant, scalar variable, or a function that results in a scalar value
 - P1: The start index of the array elements to clear (all elements if -1)
 - P2: The stop index of the array elements to clear (P2 is not valid when P1=-1)

Return value

Scalar value (0=Success)

When the error conditions are fulfilled, the function terminates abnormally, so the return value is not returned.

Error conditions

- If P1 < -1, the function terminates abnormally.
- If P1 > P2, and P2 > (V[] array elements count - 1), the function terminates abnormally.

Example 1

```
@a = ResetVariableArrayPL(#A[], 0, 9)
```

Example 1 explanation

The current values of the plane type array variable from #A[0] to #A[9] are set to their initial values.

Example 2

```
@a = ResetVariableArrayPL(#A[], -1, -1)
```

Example 2 explanation

The current values of all the elements of the plane type array variable #A[] are set to their initial values.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ResetVariableArrayS(V[], P1, P2)

Initializes a scalar type array variable.

Parameters

- V[]: Scalar type array variable
- P1, P2: Constant, scalar variable, or a function that returns a scalar value
 - P1: The start index of the array elements to clear (all elements if -1)
 - P2: The stop index of the array elements to clear (P2 is not valid when P1=-1)

Return value

Scalar value (0=Success)

When the error conditions are fulfilled, the function abnormally terminates, so the return value is not returned.

Error conditions

- If P1 < -1, the function abnormally terminates.
- If P1 > P2 and P2 > (V[] array elements count - 1), the function abnormally terminates.

Example 1

```
@a=ResetVariableArrayS( #S[], 0, 9 )
```

Example 1 explanation

The current values of the scalar type array variable #S[0] to #S[9] are set to their initial values.

Example 2

```
@a=ResetVariableArrayS( #S[], -1, -1 )
```

Example 2 explanation

The current values of all the elements of the scalar type array variable #S[] are set to their initial values.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ResetVariableArrayT(V[], P1, P2)

Initializes a 3D position type array variable.

Parameters

- V[]: 3D position type array variable
- P1, P2: Constant, 3D position type variable, or a function that results in a scalar value
- P1: The start index of the array elements to clear (all elements if -1)
- P2: The stop index of the array elements to clear (P2 is not valid when P1 =-1)

Return value

Scalar value (0=Success)

When the error conditions are fulfilled, the function terminates abnormally, so the return value is not returned.

Error conditions

- If P1 < -1, the function terminates abnormally.
- If P1 > P2, and P2 > (V[] array elements count - 1), the function terminates abnormally.

Example 1

```
@a = ResetVariableArrayT(#T[], 0, 9)
```

Example 1 explanation

The current values of the 3D position type array variable from #T[0] to #T[9] are set to their initial values.

Example 2

```
@a = ResetVariableArrayT(#T[], -1, -1)
```

Example 2 explanation

The current values of all the elements of the 3D position type array variable #T[] are set to their initial values.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ResetVariableC(V)

Initializes a circle type variable.

Parameters

V: Circle type variable

Return value

Scalar value (0=Success)

Example

```
@a=ResetVariableC( #C )
```

Example explanation

The current value of the circle type variable #C is set to its initial value.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ResetVariableL(V)

Initializes a line type variable.

Parameters

V: Line type variable

Return value

Scalar value (0=Success)

Example

```
@a=ResetVariableL( #L )
```

Example explanation

The current value of the line type variable #L is set to its initial value.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ResetVariableP(V)

Initializes a position type variable.

Parameters

V: Position type variable

Return value

Scalar value (0=Success)

Example

```
@a=ResetVariableP( #P )
```

Example explanation

The current value of the position type variable #P is set to its initial value.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ResetVariablePL(V)

Initializes a plane type variable.

Parameters

V: Plane type variable

Return value

Scalar value (0=Success)

Example

```
@a = ResetVariablePL(#A)
```

Example explanation

The current value of the plane type variable #A is set to its initial value.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ResetVariableS(V)

Initializes a scalar type variable.

Parameters

V: Scalar type variable

Return value

Scalar value (0=Success)

Example

@a=ResetVariableS(#S)

Example explanation

The current value of the scalar type variable #S is set to its initial value.



This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

ResetVariableT(V)

Initializes a 3D position type variable.

Parameters

V: 3D position type variable

Return value

Scalar value (0=Success)

Example

@a = ResetVariableT(#T)

Example explanation

The current value of the 3D position type variable #T is set to its initial value.

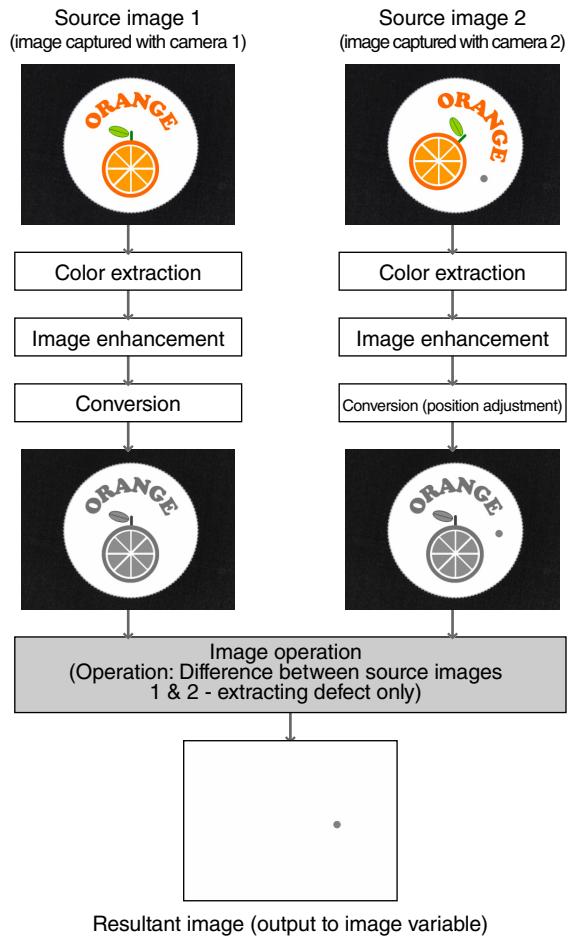


This function returns the execution result as a return value. Be aware that if the return value is not assigned into a variable, a setting error will occur.

Image Operation Unit

Image operation gives the ability to create and store new images in a user specified result image variable. This image is the result of a process or a conversion being performed on multiple or single source images respectively.

Image Operation Flow

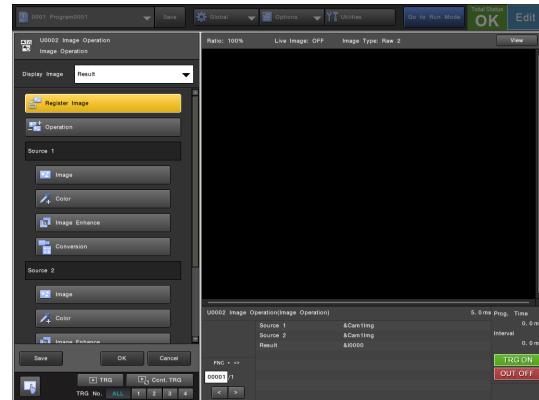


Point

- Besides the captured image, the registered image can also be specified as the source image.
- If a color image is specified as the source image, the resultant image will always be a grayscale image due to the grayscale conversion performed by the color extraction process.
- This unit cannot be used with the XG-X2000/2200.

Top Menu

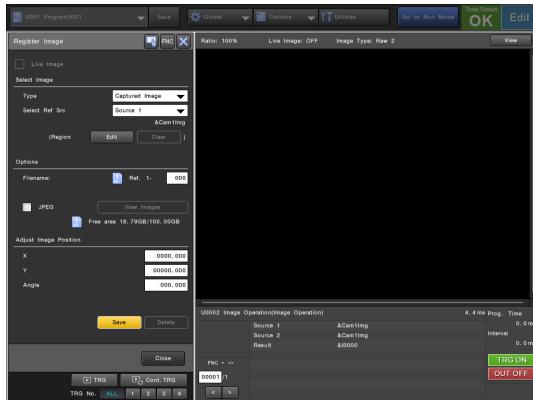
The top menu of the image operation function consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-374)	Register an image to be used as a template for settings.
Operation (Page 2-375)	Outline the operation to be performed using source images 1 and 2 after individual image processing.
Source 1 (Page 2-377)	Selection and processing of image 1 used in the operation.
Source 2 (Page 2-381)	Selection and processing of image 2 used in the operation.
Inspect Region (Page 2-382)	Define the region to be used for unit processing.
Result Image (Page 2-382)	Outline the settings for the result image.
Display Options (Page 2-384)	Specify the display method for the region.
Save (Page 2-384)	Save the current state to the program setting file.

Register Image

An image can be saved to the controller to be used as a template for measurements and settings. It is recommended to adjust and fix lighting and other external influences before registering an image.



Live Image

Check this box to display live images through a continuous feed.



- A live feed is only available while the unit is being edited.
- This setting cannot be changed when the screen update mode is set to [Live Image] in the trigger settings (Page 2-30).
- If the capture on trigger input is disabled in the trigger settings (Page 2-30), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when registering as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is set to custom and the capture unit which was most recently executed is being edited, the images collected in the buffer will still be displayed even if the capture unit is not presently capturing images.
- Continuous update cannot be used when HDR capture (Page 2-29) is enabled or when a line scan camera is being used.
- The unit's captured image variables need to aligned with the capture unit's image variable for containing images during implementation (trigger paused). If the image capture buffer is enabled, the capture unit's image variable for containing images which was recently implemented will be compared.

Select Image

Type

Select an image to register.

- Captured Image:** Displays the latest image from the specified camera (image variable).

- Registered Image:** The registered image specified in [Options] is displayed.



When registered images are being set via the [Select Image] in source 1 or source 2, if [Captured Image] is selected, then the registered images being set will be displayed.

Select Ref Src

Select the number of the camera used for registration.

Choose from Source1 - Source 4, and select only the source number used for the capture unit being edited.

Region

To register only part of an image, select [Edit] then specify the region to register. To cancel the selected region, select [Clear].

Options

Filename

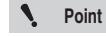
Specify the registered image number used for image registration in the form "(Camera No.)-(User-specified No.)".



The name of the saved file is "ref (Camera No.)_(Specified No.)" (for full screen image registration) or "ref (Camera No.)(Specified No.)_XXX_YYY" (for partial image registration).

JPEG

Check this box to save the image in JPEG format. When this box is not checked, the image will be saved in BMP format as either a 24-bit color bitmap image (when a color camera is used) or an 8-bit grayscale bitmap image (when a monochrome camera is used).



Using image compression may result in some image deterioration, thus results from a compressed image may differ to those when using non compressed images.

View Images

View all registered images in a list.

Adjust Image Position

Adjust the position of the image being captured.

X

Adjust the movement in the X (horizontal) direction between -8191.000 and 8191.000 pixels.

Y

Adjust the movement in the Y (vertical) direction between -16383.000 and 16383.000 pixels.

Angle

Adjust the position angle (rotation) around the center of the image between -999.999° and 999.999°.



- When [Captured Image] is selected as the [Type] and a [Position Adjustment ID] is selected in [Conversion] (Page 2-46), [Pos. Adjust. value] can be selected in addition to [Number Input]. This option is useful because even when the image capture position deviates, the current image is automatically adjusted using the adjustment value based on the reposition unit. However, note that when [Pos. Adjust. value] is selected in the state where a correct adjustment value cannot be measured for the current image, the position used for registration may be incorrect.
- Position adjustment may cause missing peripheries (black areas) due to image movement or jagged edges (jaggies) due to rotation in the registered image.

Save

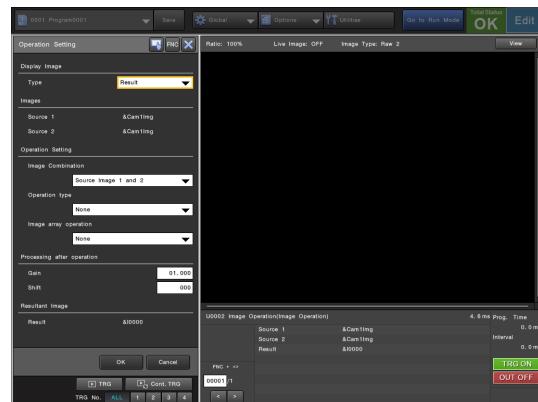
Save the displayed image as a registered image under the conditions specified in the [Register Image] menu.

Delete

When [Registered Image] is selected for [Type], you can delete the registered image specified in [Options].

Operation Setting

Outline the operation to be performed using source images 1 and 2 after individual processing.



In this option the processing combination of the source images 1 and 2 can be set. See "What is "Image Operation""? (Page 2-384) for more details.

Display Image

Type

- Source 1:** Display source image 1.
- Source 2:** Display source image 2.
- Result:** Display the resultant image.
- Source 1 4 scr.:** Display a split screen showing the raw image, filtered image, converted image, and resultant image of source image 1.
- Source 2 4 scr.:** Display a split screen showing the raw image, filtered image, converted image, and resultant image of source image 2.

Images

Source 1

The captured image or registered image specified for operation in [Select Image] under [Source 1] is displayed. If the image operation is set so that [Source 1] is not used, nothing is displayed.

Source 2

The captured image or registered image specified for operation in [Select Image] under [Source 2] is displayed. If the image operation is set so that [Source 2] is not used, nothing is displayed.

Operation setting

Image Combination

Select the combination of images used for operation.

- **Source Image 1 and 2** (default): Perform image operation using source images 1 and 2.
- **Source Image 1 Only**: Perform image operation using source image 1 only (Source image 2 is not used).

Operation type

Specify the type of operation for combining source images. Refer to "Functional Explanation of Operations" (Page 2-390) for more details on individual operations.

- **None** (default): No image operation.
- **Add**: Create an image by adding the specified images together.
- **Subtract**: Create an image by subtracting the specified images from each other.
- **AbsoluteDifference**: Create an image using the absolute difference between the specified images.
- **Average**: Create an image from the average across the specified images.
- **Multiply(Normalized)**: Create an image by multiplying the specified images together and then scaling across 0-255.
- **Multiply**: Create an image by multiplying the specified images together.
- **Maximum**: Create an image by using the maximum value from the specified images.
- **Minimum**: Create an image by using the minimum value from the specified images.
- **AND**: Create an image by using the logical product (AND) function between the specified images.
- **OR**: Create an image by using the logical sum (OR) function between the specified images.
- **XOR**: Create an image by using the logical exclusive sum (XOR) function between the specified images.
- **NAND**: Create an image by using the negative of the logical product (NAND) function between the specified images.
- **NOR**: Create an image by using the negative of the logical sum (OR) function between the specified images.
- **XNOR**: Create an image by using the negative of the logical exclusive sum (XNOR) function between the specified images.

Reference

Normalizing is the dividing of the result by 256 to scale the result in accordance with the 0-255 processing range to avoid saturation.



- [None] can only be selected if source image 1 is the only image used.
- The operation type is limited to [Subtract] or [AbsoluteDifference], when [Source Image 1 and 2] is selected for [Image Combination] with the current image variable being specified as an array and [Use Image Array] option checked.
- If [Source Image 1 only] is selected for [Image Combination] and [Use Image Array] is not selected, no operation can be specified.

Image array operation

Specify the method to process a source image array when either source image 1 or 2 has [Use Image Array] selected, after which the image operation is applied.

This option is only available enabled when [Subtract] or [AbsoluteDifference] is selected in [Operation type], and an array based image variable is set for the current image and [Use Image Array] is selected in [Image] under [Source 1]. Refer to "Functional Explanation of Operations" (Page 2-390) for more details on individual operations.

- **None** (default): No image operation.
- **Add**: Create an image by adding the pixels of the target images together.
- **Average**: Create an image by averaging the pixels of the target images together.
- **Multiply(Normalized)**: Create an image by multiplying the pixel of the target images together, normalizing the result on a 0 to 255 scale.
- **Multiply**: Create an image by multiplying the pixel of the target images together.
- **Maximum**: Create an image by comparing the pixel of the target images and using the maximum pixel value.
- **Minimum**: Create an image by comparing the pixel of the target images and using the minimum pixel values.
- **AND**: Obtain the logical (AND) product of the pixels of the target images.
- **OR**: Obtain the logical (OR) sum for the pixels of the target images.
- **XOR**: Obtain the exclusive logical (XOR) sum of the pixels of the target images.
- **NAND**: Obtain the negative logical (NAND) product of the pixels of the target images.
- **NOR**: Obtain the negative logical (NOR) sum of the pixel of the target images.
- **XNOR**: Obtain the negative exclusive logical (XNOR) sum of the pixel of the target images.

Reference

Normalizing is the dividing of the result by 256 to scale the result in accordance with the 0-255 processing range to avoid saturation.

Processing after operation

The grayscale levels of the resultant image can be adjusted after the operation has been performed.

Gain

Multiplies the pixel value in the resultant image by a specified factor (0.000 to 64.000). This option can be used to remap and adjust the overall balance and distribution of the high or low contrast areas.

Shift

Offsets the pixel value of the resultant image by adding a specified level value (-510 to 510). This option can be used to increase or decrease the overall brightness of the image.

Resultant Image

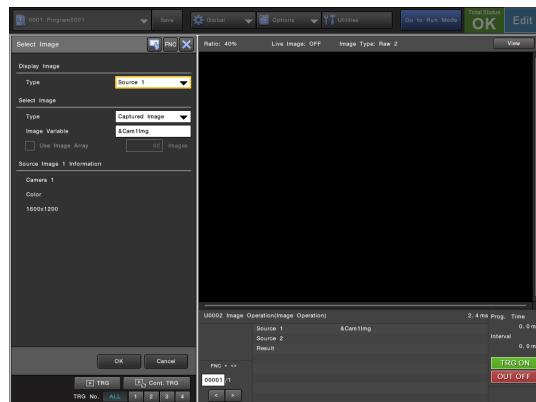
Displays the Resultant Image Variable which was set to "Result" in the "Result Image" screen.

Source 1

Source image 1 settings and processing parameters.

Image

Selection of the current or registered image to be used for source 1.



Point The images used in source image 1 and source image 2 must be of the same resolution.

Type

- **Source 1:** Display source image 1.
- **Source 2:** Display source image 2.
- **Source 1 4 scr.:** Display a split screen showing the raw image, filtered image, converted image, and resultant image of source image 1.
- **Source 2 4 scr.:** Display a split screen showing the raw image, filtered image, converted image, and resultant image of source image 2.



Point When [Source Image 1 Only] is selected for [Image Combination], [Source 2] and [Source 2 4 scr.] cannot be selected.

Select Image: Type

Choose whether to use the captured image or a registered image for source 1.

Select Image: Image Variable

Select this option and specify the image variable to use the captured image for source image 1.

- **Use Image Array:** If the image variable referenced is an image array specify the number of images to be used. This setting is unavailable when an image array variable is not specified.



Point If the captured image size from any camera exceeds 26214400 pixels, it is not possible to use [Use Image Array].

Image Operation Unit

Registered Image

Select this option to use a registered image for source image 1.

Specify the registered image No.

- Advance:** Set advance options for the switching of registered images as necessary.

- **Use numerical variable for registered image No.:** To use a variable for the registered image No., check this box and assign a numerical or numerical array variable reference. By using a variable for the registered image No. and then issuing a variable reference value apply command (NU), the image is switched to the specified registered image in the variable and the reference image information is updated. For more details, see the XG-X2000 Series Communications Control Manual.

- **Process variable when changing programs:** Use this option to switch to the registered image based on the initial value of the variable referenced when the program is changed or the controller is next turned on.

 Point

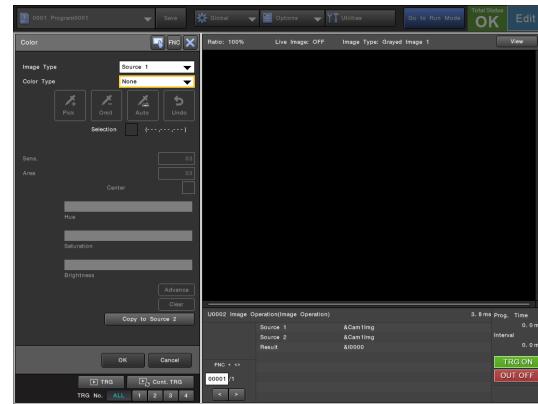
Note that the registered image No. does not switch in accordance with a change in the variable.

 Reference

The camera No., type (color / monochrome), and number of pixels of the camera associated to the image variable specified in the [Captured Image] or [Registered Image] field are displayed in [Source Image 1 Information].

Color

When working with a color camera, convert the captured color image into a binary (black and white) or a grayscale converted image by using the desired extraction method.



 Point

This setting is disabled when the captured image or registered image use monochrome image variables.

Refer to "Color Extraction" (Page 2-483) for concepts involving color extraction and its operation.

Image type

- Source 1:** Display source image 1.
- Source 2:** Display source image 2.

Copy to Source 2

Reflects the color extraction settings from source image 1 to source image 2.

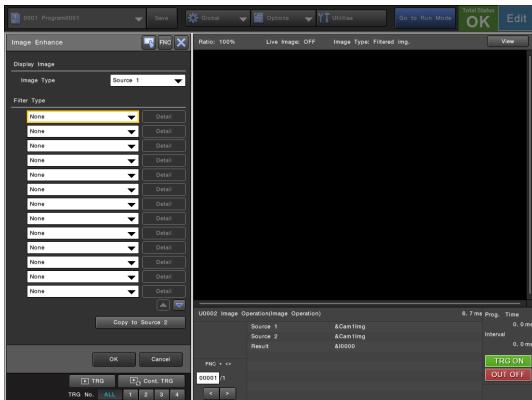
Select [OK] on the confirmation message.

 Point

- When [Source Image 1 Only] is selected in [Image Combination], [Source 2] cannot be selected.
- When source image 2 is monochrome data or when [Source Image 1 Only] is selected in [Image Combination], [Copy to Source 2] cannot be selected.
- When a variable has been assigned to the parameter to be copied and the user does not have an account with privileges to change the variable settings, the current value for the variable will be copied. (The variable itself will not be copied.)

Image Enhance

Specify the filter processing to apply to the image.



When a color camera is used, the filter is applied to the images converted using color extraction.

Reference Color extraction settings can be copied within the same image operation unit if the operation is set to [Source Image 1 and 2] by selecting [Copy to Source 1] or [Copy to Source 2].

Image type

- **Source 1:** Display source image 1.
- **Source 2:** Display source image 2.
- **Source 1 4 scr.:** Display a split screen showing the raw image, filtered image, converted image, and resultant image of source image 1.
- **Source 2 4 scr.:** Display a split screen showing the raw image, filtered image, converted image, and resultant image of source image 2.

Point When [Source Image 1 Only] is selected for [Image Combination], [Source 2] and [Source 2 4 scr.] cannot be selected.

Filter type

Select the [Filter Type] field and then select the filter to apply. See "Image Enhance" (Page 2-489) for more details of each filter processing.

Point

- The subtract filter cannot be selected.
- The binary and blob filters cannot be used more than once in the same unit.

Reference

- Use [Detail] to apply more detailed filter settings.
- Up to 13 types of filters can be stacked according to application requirements. When multiple filters are set, they are processed one by one from the top.
- The order of the filters can be changed by selecting a filter in one of the [Filter Type] fields, holding down the No. 1 (FUNCTION) button of the handheld controller, and then moving the 8-way key up or down.

Copy to Source 2

Reflects the image enhancement settings from source image 1 to source image 2.

Select [OK] on the confirmation message.



Point

- When [Source Image 1 Only] is selected in [Image Combination], [Copy to Source 2] cannot be selected.
- When a variable has been assigned to the parameter to be copied and the user does not have an account with privileges to change the variable settings, the current value for the variable will be copied. (The variable itself will not be copied.)
- The setting of an expanded custom filter cannot be copied when the user does not have an account with privileges to change variable settings.

Image Operation Unit

Conversion

After the image has been through color extraction and image enhancement filtering, further conversion image processing can be applied.

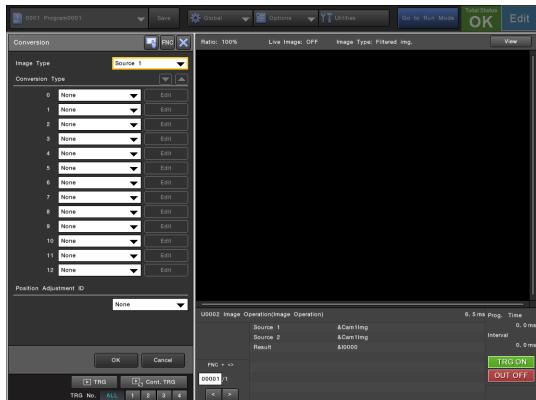


Image type

- Source 1:** Display source image 1.
- Source 2:** Display source image 2.
- Source 1 4 scr.:** Display a split screen showing the raw image, filtered image, converted image, and resultant image of source image 1.
- Source 2 4 scr.:** Display a split screen showing the raw image, filtered image, converted image, and resultant image of source image 2.



When [Source Image 1 Only] is selected for [Image Combination], [Source 2] and [Source 2 4 scr.] cannot be selected.

Conversion type

Up to 13 types of conversions can be set according to application requirements. When multiple conversions are set, they are processed one by one from the top. See "Functional Explanation of Conversions" (Page 2-385) for more details on the individual conversion types.

- None:** No conversion.
- Add:** Add a specified value to the pixel.
- Subtract:** Subtract a specified value from the pixel.
- AbsoluteDifference:** Obtain the absolute difference of the pixel and a specified value.
- Multiply:** Multiply the pixels in the image by a specified value.
- Rotate / Translate:** Rotate and or translate the image.
- Zoom:** Enlarge or reduce the image.
- Trapezoid Correct:** Transform the image so that four specified user points are re-mapped to four different specified points.
- Pixel Val. Conv.:** Convert pixels in the image falling into a specified range into a single value.
- Blob:** Apply blob filtering to the image for hole filling or border exclusion.

- NOT:** Reverse the black and white pixels in the image.
- AND:** Obtain the logical product (AND) of the pixel and a specified value.
- OR:** Obtain the logical sum (OR) of the pixel and a specified value.
- XOR:** Obtain the exclusive logical sum (XOR) of the pixel and a specified parameter value.
- NAND:** Obtain the negative logical product (NAND) of the pixel and a specified parameter value.
- NOR:** Obtain the negative logical sum (NOR) of the pixel and a specified parameter value.
- XNOR:** Obtain the negative exclusive logical sum (XNOR) of the pixel and a specified parameter value.
- Right Bit Shift:** Shift the 8 bit binary of the pixel value to the right by a specified quantity.
- Left Bit Shift:** Shift the 8 bit binary of the pixel value to the left by a specified quantity.



The blob filter cannot be used more than once on the same source image.

Edit

Display the menu for detailed setting of each conversion function.

See "Functional Explanation of Conversions" (Page 2-385) for more details.



The order of conversions can be changed by selecting a conversion in one of the [Conversion Type] fields, holding down the No. 1 (FUNCTION) button of the handheld controller, and then moving the 8-way key up or down.

Position Adjustment ID

To apply position adjustment to source image 1, select the position adjustment unit to be referenced.

Source 2

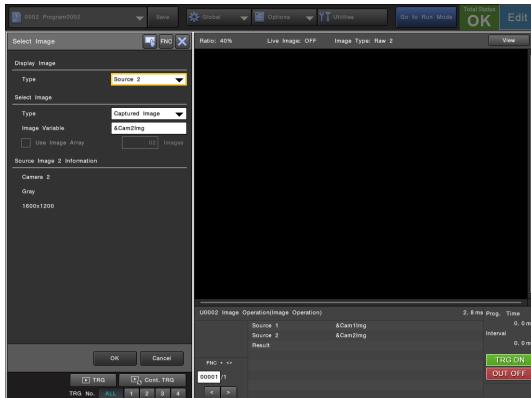
Source image 2 settings and processing parameters.

Point

- When [Source Image 1 Only] is selected in [Image Combination], [Source 2] can not be selected.
- The images used in source image 1 and source image 2 must be of the same resolution.

Image

The setting options for [Source 2] are the same as [Source 1].

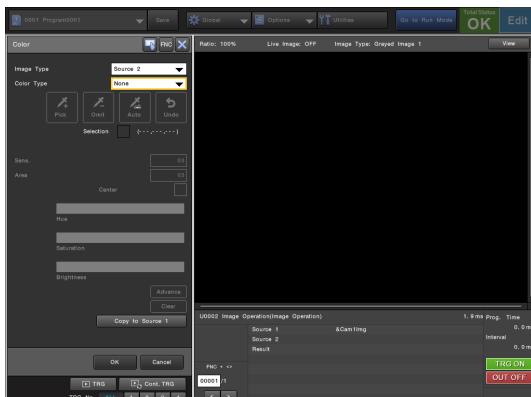


Reference

The camera No., type (color / monochrome), and number of pixels of the camera associated to the image variable specified in the [Captured Image] or [Registered Image] field are displayed in [Source Image 2 Information].

Color

The setting options for [Source 2] are the same as [Source 1].



Reference

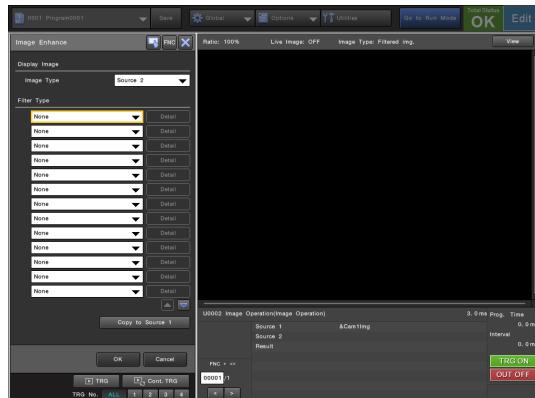
Selecting [Copy to Source 1] applies the specified color extraction information to the color extraction setting of [Source 1].

Point

- When source image 1 is monochrome data, [Copy to Source 1] cannot be selected.
- When a variable has been assigned to the parameter to be copied and the user does not have an account with privileges to change the variable settings, the current value for the variable will be copied. (The variable itself will not be copied.)

Image Enhance

The setting options for [Source 2] are the same as [Source 1].



Reference

Selecting [Copy to Source 1] applies the specified image enhancement information to the image enhancement setting of [Source 1].

Point

- When a variable has been assigned to the parameter to be copied and the user does not have an account with privileges to change the variable settings, the current value for the variable will be copied. (The variable itself will not be copied.)
- The binary and blob filters cannot be used more than once in the same source image.
- The setting of an expanded custom filter cannot be copied when the user does not have an account with privileges to change variable settings.

Conversion

The setting options for [Source 2] are the same as [Source 1].

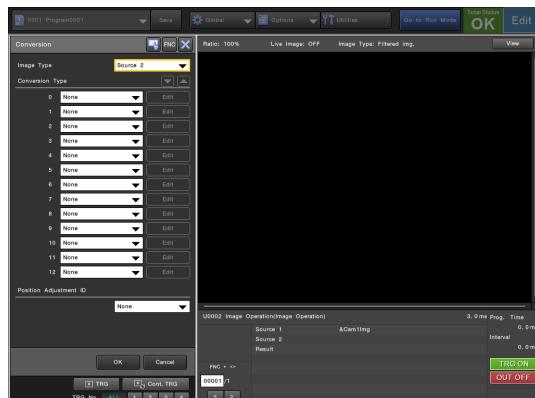
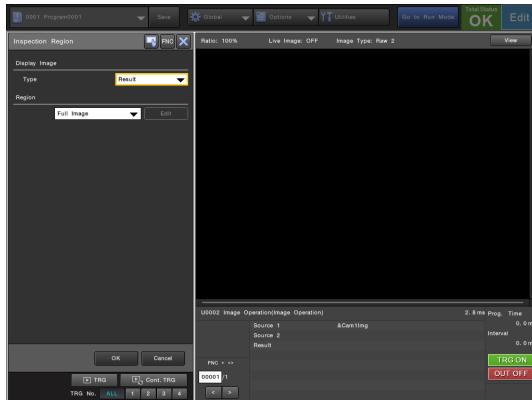


Image Operation Unit

Inspect Region

Define a specific rectangular region to be used for inspection when only a specific area is to be processed. The default setting for this option results in the full image being processed.



Display Image

Type

- Source 1:** Display source image 1.
- Source 2:** Display source image 2.
- Result:** Display the resultant image.

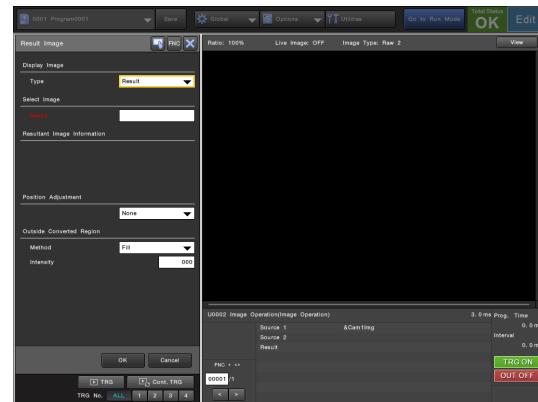
Region

Select [Rectangle] and then draw the region, or select [Edit] and specify the region with numerical values. See "Drawing a Region" (Page 2-474) for more details.

- Point**
- You can only use a rectangle shape as the region for image operation.
 - You cannot set a mask region or an image region.
 - The areas outside the region are output to the resultant image variable as black (level 0).

Result Image

Result image settings and processing parameters.



Display Image

Type

- Source 1:** Display source image 1.
- Source 2:** Display source image 2.
- Result:** Display the resultant image.
- Source 1 4 scr.:** Display a split screen showing the raw image, filtered image, converted image, and resultant image of source image 1.
- Source 2 4 scr.:** Display a split screen showing the raw image, filtered image, converted image, and resultant image of source image 2.

Select image

Result

Specify a resultant image variable for the result.

- Point** The resultant image resolution must be the same as source images 1 and 2.

Resultant Image Information

The camera information of the resultant image variable specified at [Result] is displayed. The information includes the following items.

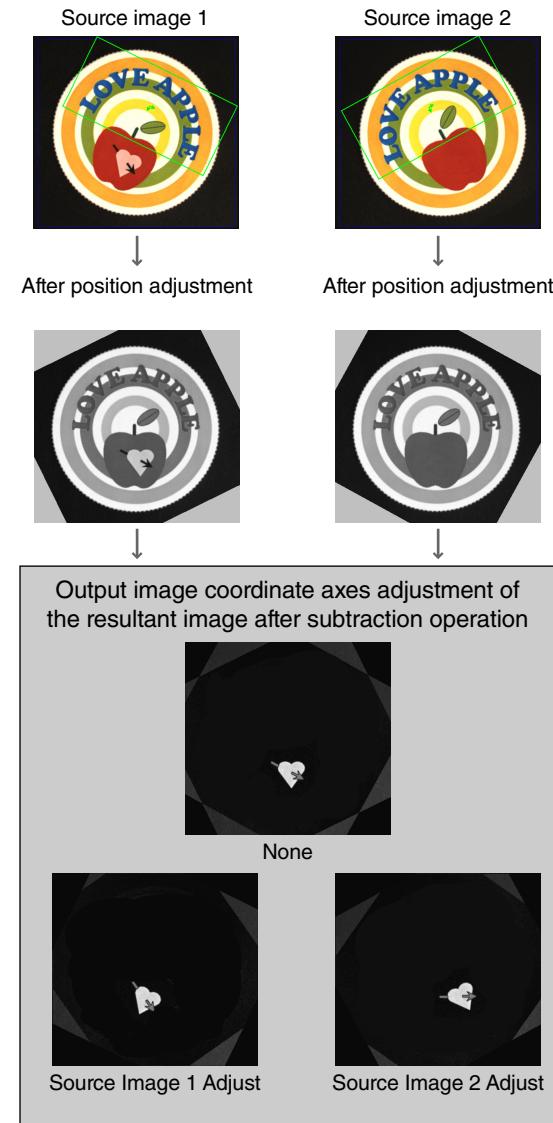
- Camera No.
- Color
- Image size

Position Adjustment

When position adjustment is used for conversion of the source images specify which position adjustment information the resultant image should use.

- **None** (default): Output the exact result after image operation.
- **Source Image 1 Adjust**: Re-adjust the resultant image based on the original position of source image 1.
- **Source Image 2 Adjust**: Re-adjust the resultant image based on the original position of source image 2.

Example for [Position Adjustment] setting



Outside Converted Region

Use this option for handling any areas in the resultant image region which are formulated from outside of the source images area due to position adjustment or other processing functions.

Method

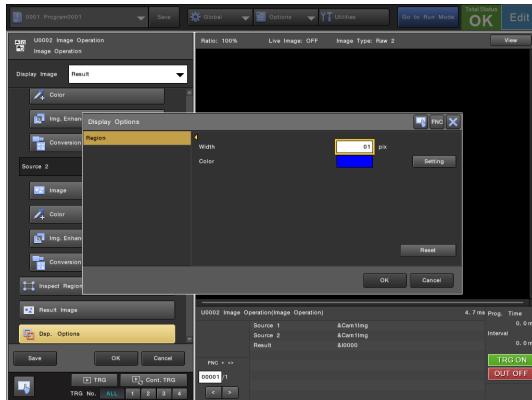
- **Fill** (Default): Convert all pixel values in the missing information area to a specified intensity value.
- **Extended Image**: Replace the pixel values in the missing information area by extending the pixel values at the border known image.

Intensity

When [Fill] is selected in [Method], set the pixel value used to fill the area (from 0 (black) to 255 (white) (default 0))

Display Options

Specify the display method for the region.



Region

Specify the line thickness and display color of the region.

Reset

Returns the display options to their defaults.

Save

Save the current unit changes the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

What is "Image Operation"?

Image operation creates and stores a resultant image in a user specified result image variable. This image is the result of performing conversion processing such as operation processing of several images specified as source images or pixel value conversion of a single source image. This section explains the types of processing patterns which use the image operation unit, and an example of the basic flow of image operation processing between 2 images.

Point

- Both source images 1 and 2 used in an image operation must be of the same type (resolution).
- The image variable used to store the resultant image must be the same type (corresponding camera) as the image variable used by either source image 1 or 2.

Image Operation Processing Patterns

Processing patterns using the Image Operation unit

O: Available, X: Not Available

Pattern	Number of Processing images		Conversion	Operation type	Image array operation
	Source 1	Source 2			
1	1	0	O/x	X	X
2	1	1	O/O	O	X
3	n	0	O/x	O ^{*1}	X
4	n	1	O/O	O ^{*2}	O ^{*3}
5	n	n	O/O	O ^{*2}	O ^{*3}

^{*1} Any operation other than Subtract and AbsoluteDifference may be used.

^{*2} Only the Subtract and AbsoluteDifference operations may be used.

^{*3} Image array operation must be used otherwise an error will occur.

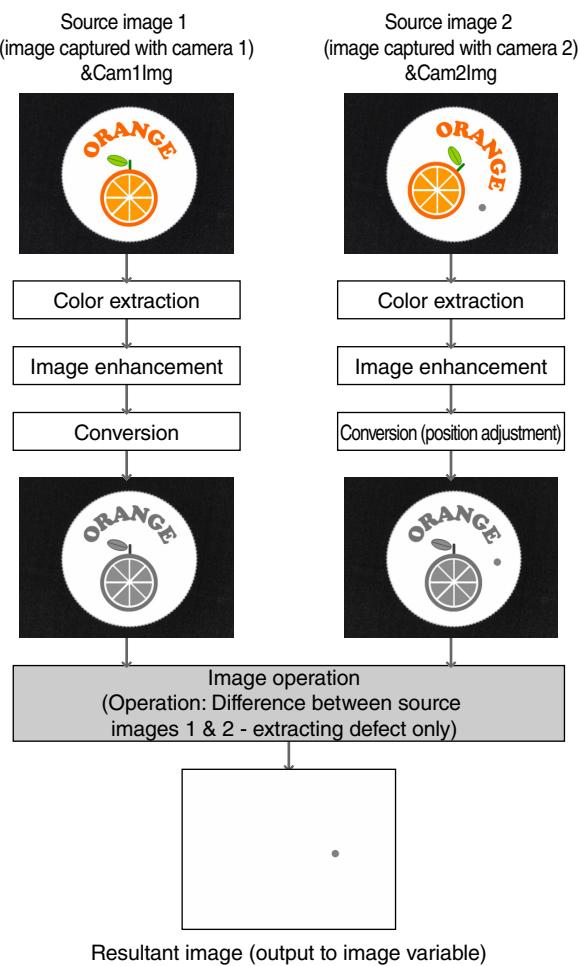
Point

- The number of images "n" can be set from 2 - 32.
- A settings error will occur if [None] is selected for the operation type of patterns 2 - 5.
- If the captured image size from any camera exceeds 26214400 pixels, it is not possible to use an image variable array.

Example of basic flow of Image Operation unit usage

This explains as an example pattern 2 in the chart

"Processing patterns using the Image Operation unit".



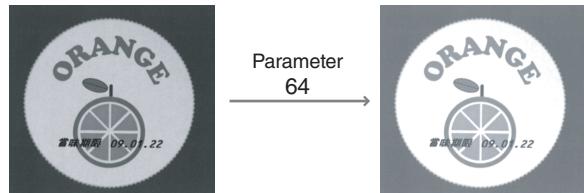
Functional Explanation of Conversions

Conversions apply parametric image processing, such as image composition and correction, to color extracted and/or image enhanced images.

Reference The screen shots shown in these explanations are from the Edit Unit menu.

(1) Add

Adds the specified parameter (grayscale level) to every pixel in the source image.



200 50 150	255 114 214
45 80 65	109 144 129
0 215 100	64 255 164

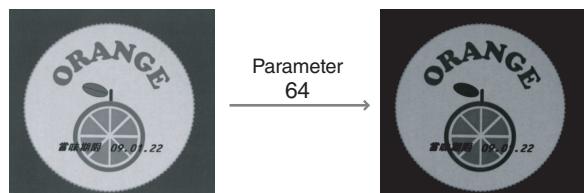
Forces pixel values greater than 255 to 255

- **Value** : Specify a value for the conversion (0 to 255).

- **Conversion Count** : Choose to execute (1) or not to execute (0) the conversion.

(2) Subtract

Subtracts the specified parameter (grayscale level) from every pixel in the source image.



200 50 150	136 0 86
45 80 65	0 16 1
0 215 100	0 151 36

Forces pixel values less than 0 to 0

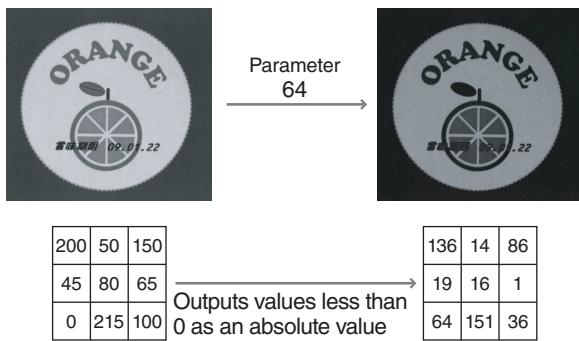
- **Value** : Specify a value for the conversion (0 to 255).

- **Conversion Count** : Choose to execute (1) or not to execute (0) the conversion.

Image Operation Unit

(3) AbsoluteDifference

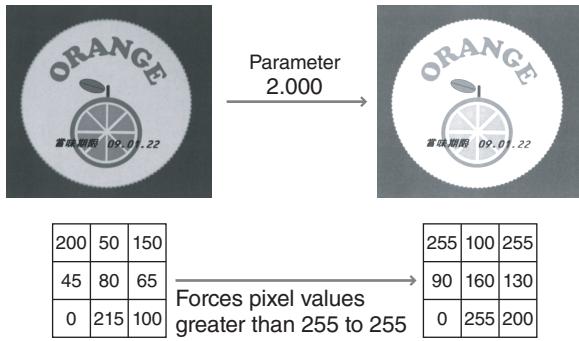
Subtracts the specified parameter (grayscale level) from every pixel in the source image and outputs the absolute result.



- **Value**: Specify a value for the conversion (0 to 255).
- **Conversion Count**: Choose to execute (1) or not to execute (0) the conversion.

(4) Multiply

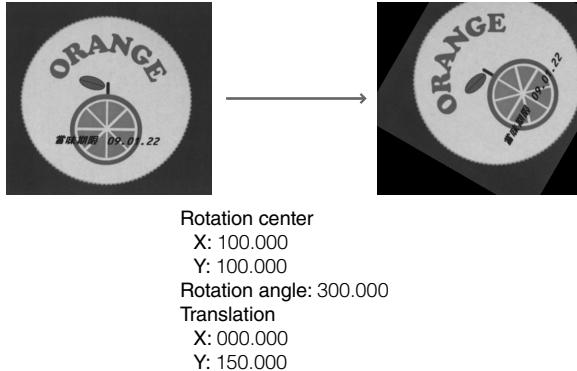
Multiplies every pixel in the source image by the specified parameter (grayscale level).



- **Value**: Specify a value for the conversion (0 to 255).
 - 0.000 <= Parameter < 1.000: darkens the pixel.
 - 1.000 < Parameter <= 255.000: brightens the pixel.
- **Conversion Count**: Choose to execute (1) or not to execute (0) the conversion.

(5) Rotate/Translate

Rotate the image about a set of coordinates and shift it in the X and Y direction (translation). Interpolation can be used for improving image quality / processing speed.



- **Rotation Center**: Specify the X, Y rotation center.

- **X**: -16383 to 16383
- **Y**: -16383 to 16383

- **Angle**: Specify the angle of rotation from 0.000 to 359.999.

- **Translation**: Specify the X and Y shift (in pixels).

- **Shift X**: -9600.000 to 9600.000
- **Shift Y**: -7200.000 to 7200.000

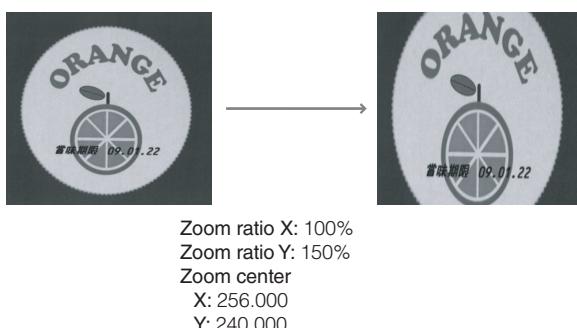
- **Use interpolation**: Choose whether to use interpolation.

- **Enable**: Use interpolation.
- **Disable**: Do not use interpolation.

- **Conversion Count**: Choose to execute (1) or not to execute (0) the conversion.

(6) Zoom

Enlarge or shrink the image about an X Y center point and X Y zoom ratio.



- **Zoom ratio X**: Specify the zoom ratio in the X direction from 16 to 2500 %.

- **Zoom ratio Y**: Specify the zoom ratio in the Y direction from 16 to 2500 %.

- **Zoom Center**: Specify X, Y zoom center.

- **X**: -9600.000 to 9600.000
- **Y**: -7200.000 to 7200.000

- **Conversion Count**: Choose to execute (1) or not to execute (0) the conversion.

(7) Trapezoid Correct

Correct the trapezoidal distortion of an image based on matching up four specified points before and after.



Shape Before Adjust: User set



Shape After Adjust: User set

- Shape Before Adjust** : Specify the shape / points before correction.
 - None**: No shape.
 - User set**: Manually select the four points to correct from in a clockwise fashion (starting at what should be the upper left). Refer to "Drawing a Polygon" (Page 2-478) for more details on this setting method.
- Shape After Adjust** : Specify the matching shape / points after correction.
 - None**: No target
 - User set**: Manually select the four points for the correction to adjust to in a clockwise fashion (starting at what should be the upper left). Refer to "Drawing a Polygon" (Page 2-478) for more details on this setting method.
 - Rectangle**: Set the target area as a rectangle. The first point being the upper left corner of the rectangle.
- Use Interpolation** : Choose whether to use interpolation.
 - Enable**: Use interpolation.
 - Disable**: Do not use interpolation.
- Conversion Count** : Choose to execute (1) or not to execute (0) the conversion.



- This adjustment may not be able to completely correct severely warped images.
- If the shape is defined in the opposite order for either image the resultant image will be inverted.

(8) Pixel Value Conversion

Replace pixel values with a specified value for pixels that fall within or beyond a user-specified range.



→



200	50	150
45	80	65
0	215	100

Max pixel value: 150
Min pixel value: 70
Conversion range: within limits
Pixel value after conversion: 255

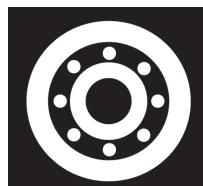
200	50	255
45	255	65
0	215	255

- Target Pixel Range**

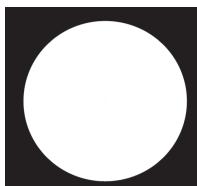
- Max**: Specify the upper value (grayscale level) of the range (0 to 255).
- Min**: Specify the lower value (grayscale level) of the range (0 to 255).
- Range**: Choose whether to convert the pixels that fall within or outside of the range.
- Pixel Values After Conv** : Specify the value (grayscale level) to use after the conversion (0 to 255).
- Conversion Count** : Choose to execute (1) or not to execute (0) the conversion.

(9) Blob

The blob filter produces a monochrome image (binary image), after filling holes and removing border noises. The filter converts the pixels in the image to the specified detection and background colors.

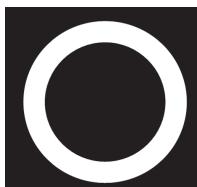


Fill holes
OFF→ON



Holes in primary target
are filled

Count
30→1



Blobs from inside and
beyond are removed

Area filter low
limit
100→2000



White blobs (bearings)
smaller than lower limit
are removed

- Detect** : Specify the color of pixels (black/white) to be detected in the binary (monochrome) image.
 - White**: Set white blobs to be the target of detection.
 - Black**: Set black blobs to be the target of detection.

Image Operation Unit

- **Count** : Specify the maximum number of blobs to be detected from 1 to 9999. The number of blobs cannot exceed the [Maximum Count] value.
- **Fill holes** : Specify whether to fill the inside of blobs with the color specified in [Detect].

If the inside of a blob contains an area different in color to the [Detect] color, the area, center of gravity, or roundness referenced by the blob filter may be affected. In order to prevent this, the inside of blobs can be filled using the [Detect] color as follows.



Fill holes: OFF



Fill holes: ON

- **OFF**: Do not fill the inside of blobs.
- **ON**: Fill the inside of blobs.

- **Active Border** : Specify whether to detect blobs located on the border of the inspection region.

- **OFF**: Detect blobs located on the border of the inspection region.
- **ON**: Exclude blobs located on the border of the inspection region from detection.



Point The active border ON/OFF setting can only be specified if the inspection region is a rectangle and no mask or image regions have been set. If any other inspection region is selected, the active border will be processed as if set to OFF.

- **Filter Setting** : Specify whether to enable or disable each filter and change the maximum and minimum values for it.

- **Area**: This filter ignores blobs that are larger than the specified maximum value or smaller than the specified minimum value (Area filter).
- **Roundness**: This filter ignores blobs that have roundness values higher than the specified maximum value (their shapes are closer to a perfect circle) or the blobs that have roundness values lower than the specified minimum value (Roundness filter).
- **Major Axis**: This filter ignores blobs that have major axis values higher than the specified maximum value or the blobs that have major axis values lower than the specified minimum value (Major axis filter).
- **Axes Ratio**: This filter ignores blobs that have axes ratios higher than the specified maximum value (thin-shaped blobs) or the blobs that have axes ratios lower than the specified minimum value (Axes ratio filter).
- **D. Oval Major Axis**: This filter ignores blobs that have distributed oval major axis values higher than the specified maximum value or the blobs that have values lower than the specified minimum value (Distributed oval major axis filter).
- **D. Oval Aspect Ratio**: This filter ignores blobs that have aspect ratios higher than the specified maximum value (thin-shaped blobs) or the blobs that have aspect ratios lower than the specified minimum value (Aspect ratio filter).



Point Each filter enabled adds to the total processing time.

- **Primary target**

- **Primary Target**: This specifies which blobs are to be converted.

All: Converts all blobs detected from all primary targets.

Specified: Converts only specified blob number (0 to 9998). Conversion is only done on the blob specified here.

- **Detection Order**: Select the blob numbering order.

The following 12 sorting methods are available for assigning numbers to blobs.

Y>X:Ascend: Sorts blobs in ascending Y order. When Y values are the same, reorders in ascending X order.

X>Y:Ascend: Sorts blobs in ascending X order. When X values are the same, reorders in ascending Y order.

X:Ascend: Sorts blobs in ascending X order.

X:Descend: Sorts blobs in descending X order.

Y:Ascend: Sorts blobs in ascending Y order.

Y:Descend: Sorts blobs in descending Y order.

Area:Ascend: Sorts blobs from smallest area to largest.

Area:Descend: Sorts blobs from largest area to smallest.

Roundness: Ascend: Sorts blobs from lowest roundness value to highest.

Roundness: Descend: Sorts blobs from highest roundness value to lowest.

Clockwise: Sorts blobs clockwise from the start angle.

Counterclockwise: Sorts blobs counter-clockwise from the start angle.

- **Start Angle**: Specify the start angle to begin assigning numbers to blobs when [Detection Order] is set to [Clockwise] or [Counterclockwise]



- This setting is ignored when [Detection Order] is not [Clockwise] or [Counterclockwise].
- Targets cannot be specified if [Primary Target] is set to [All].

- **Pixel Value After Conversion**

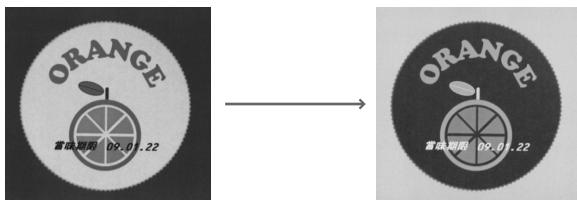
- **Detected**: Specify the value (grayscale level) for the target pixels after filtering (0 to 255).

- **Background**: Specify the value (grayscale level) for the background pixels after filtering (0 to 255).

- **Conversion Count** : Choose to execute (1) or not to execute (0) the conversion.

(10) NOT

Inverts (grayscale level) every pixel in the source image.



200	50	150	Results in same value as subtracting Input pixel values from 255.	55	205	105
45	80	65		210	175	190
0	215	100		0	40	155

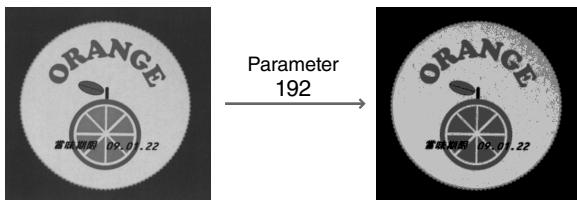
Input pixel values: 100	bit 7 6 5 4 3 2 1 0	NOT
	0 1 1 0 0 1 0 0	

Resultant pixel value: 155	bit 7 6 5 4 3 2 1 0	
	1 0 0 1 1 0 1 1	

- **Conversion Count** : Choose to execute (1) or not to execute (0) the conversion.

(11) AND

Performs a logical AND function on the BIT's of every pixel in the source image and the BIT's of the value specified in [Value].



200	50	150	Results in a value where bits 0 to 5 of Input pixel values are taken as 0.	192	0	128
45	80	65		0	64	64
0	215	100		0	192	64

Parameter: 192	bit 7 6 5 4 3 2 1 0	AND
	1 1 0 0 0 0 0 0	

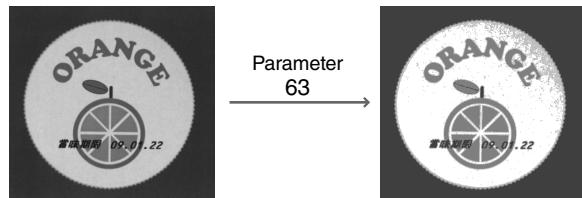
Input pixel values: 100	bit 7 6 5 4 3 2 1 0	
	0 1 1 0 0 1 0 0	

Resultant pixel value: 64	bit 7 6 5 4 3 2 1 0	
	0 1 0 0 0 0 0 0	

- **Value** : Specify a value for the conversion (0 to 255).
- **Conversion Count** : Choose to execute (1) or not to execute (0) the conversion.

(12) OR

Performs a logical OR function on the BIT's of every pixel in the source image and the BIT's of the value specified in [Value].



200	50	150	Results in a value where bits 0 to 5 of Input pixel values are taken as 1.	255	63	191
45	80	65		63	127	127
0	215	100		63	255	127

Parameter: 63	bit 7 6 5 4 3 2 1 0	OR
	0 0 1 1 1 1 1 1	

Input pixel values: 100	bit 7 6 5 4 3 2 1 0	
	0 1 1 0 0 1 0 0	

- **Value** : Specify a value for the conversion (0 to 255).
- **Conversion Count** : Choose to execute (1) or not to execute (0) the conversion.

(13) XOR

Performs a logical XOR function on the BIT's of every pixel in the source image and the BIT's of the value specified in [Value]. Applying XOR against 255 inverts the pixel value.

- **Value** : Specify a value for the conversion (0 to 255).
- **Conversion Count** : Choose to execute (1) or not to execute (0) the conversion.

(14) NAND

Performs a logical NAND function on the BIT's of every pixel in the source image and the BIT's of the value specified in [Value].

- **Value** : Specify a value for the conversion (0 to 255).
- **Conversion Count** : Choose to execute (1) or not to execute (0) the conversion.

(15) NOR

Performs a logical NOR function on the BIT's of every pixel in the source image and the BIT's of the value specified in [Value].

- **Value** : Specify a value for the conversion (0 to 255).
- **Conversion Count** : Choose to execute (1) or not to execute (0) the conversion.

(16) XNOR

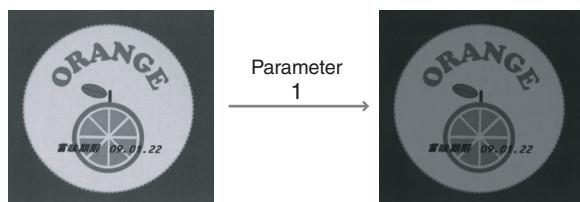
Performs a logical XNOR function on the BIT's of every pixel in the source image and the BIT's of the value specified in [Value]. Applying XNOR against 0 inverts the pixel value.

- **Value** : Specify a value for the conversion (0 to 255).
- **Conversion Count** : Choose to execute (1) or not to execute (0) the conversion.

Image Operation Unit

(17) Right Bit Shift

Shifts each pixel in the source image to the right by the number of bits specified by [Value]. This darkens the image. Each bit-wise shift halves the image brightness (or, darkens it by two times).



Input pixel values: 100

bit	7	6	5	4	3	2	1	0
	0	1	1	0	0	1	0	0

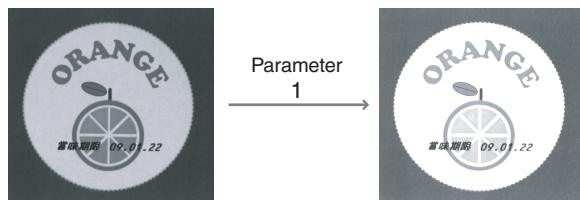
Resultant pixel value: 50

bit	7	6	5	4	3	2	1	0
	0	0	1	1	0	0	1	0

- **Value** : Specify the number of bits to shift (0 to 8).
- **Conversion Count** : Choose to execute (1) or not to execute (0) the conversion.

(18) Left Bit Shift

Shifts the BIT's of every pixel in the image to the left by the number of bits specified in [Value]. This lightens the image, and with each shift the image brightness is doubled.



Input pixel values: 100

bit	7	6	5	4	3	2	1	0
	0	1	1	0	0	1	0	0

Resultant pixel value: 200

bit	7	6	5	4	3	2	1	0
	1	1	0	0	1	0	0	0

- **Value** : Specify the number of bits to shift (0 to 8).
- **Conversion Count** : Choose to execute (1) or not to execute (0) the conversion.

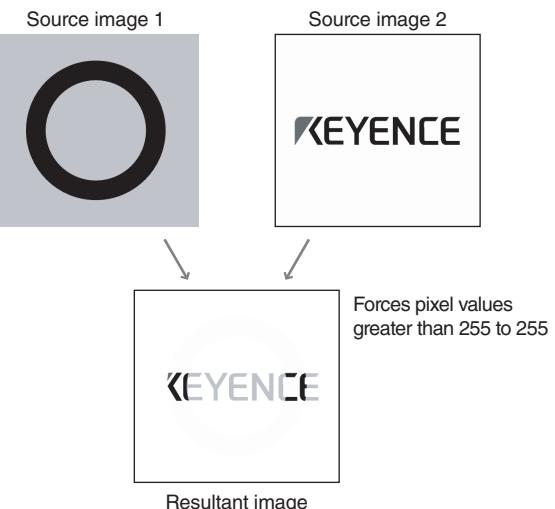
Functional Explanation of Operations

Operations are used to decide how to combine images together.

(1) Add

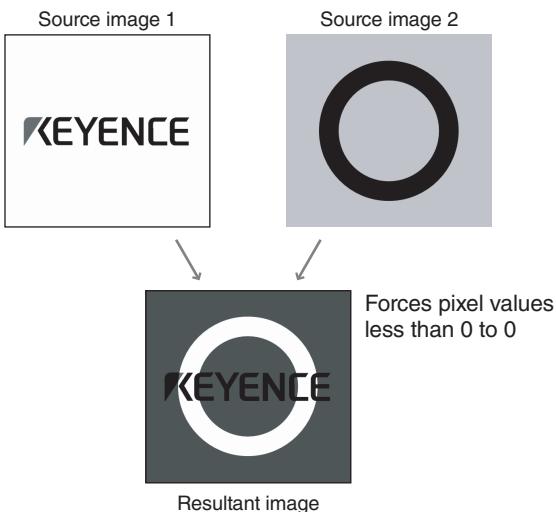
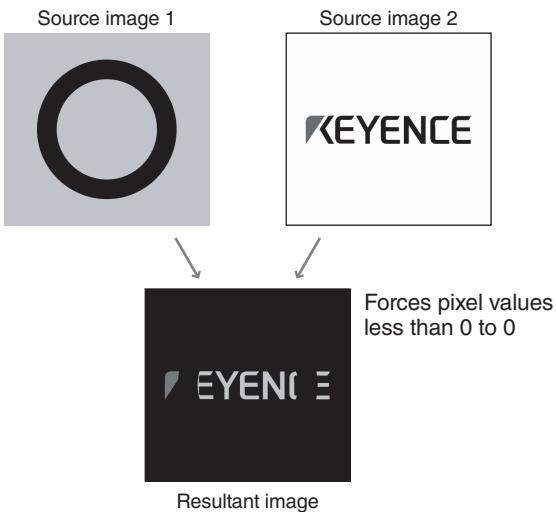
Adds the corresponding pixels of the source images together.

Compared to the source image, the results of adding dark pixel values is unnoticeable ($2 + 2 = 4$), but bright pixel values result in brighter images ($127 + 128 = 255$).

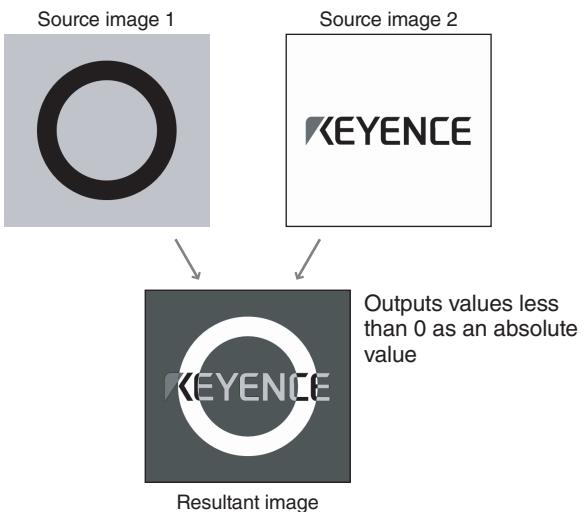


(2) Subtract

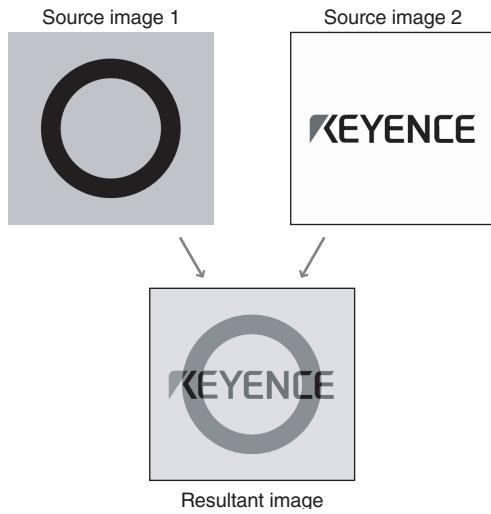
Subtracts the corresponding pixels of source image 2 from those in source image 1. Because resulting values that are less than 0 are considered to be 0, this produces different results depending on the order the images are input.

**(3) AbsoluteDifference**

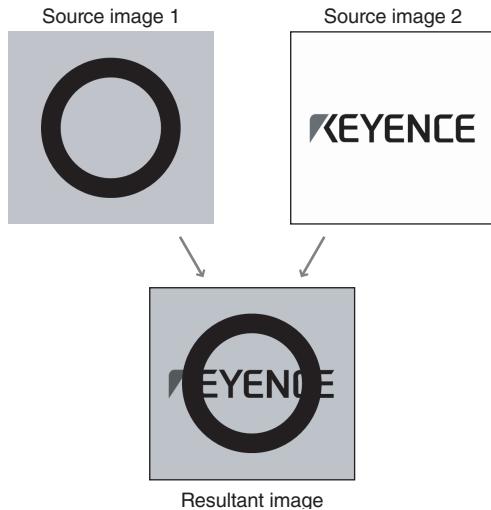
Subtracts the corresponding pixels of source image 2 from those in source image 1 and outputs the absolute result.

**(4) Average**

Takes the average of the corresponding pixels of the source images.

**(5) Multiply (Normalized)**

Multiply the corresponding pixels of source 1 and source 2, then divide by 256. Dividing by 256 eliminates the problem of grayscale saturation at 255 after the operation.

**(6) Multiply**

Multiplies the corresponding pixels of the source images together.

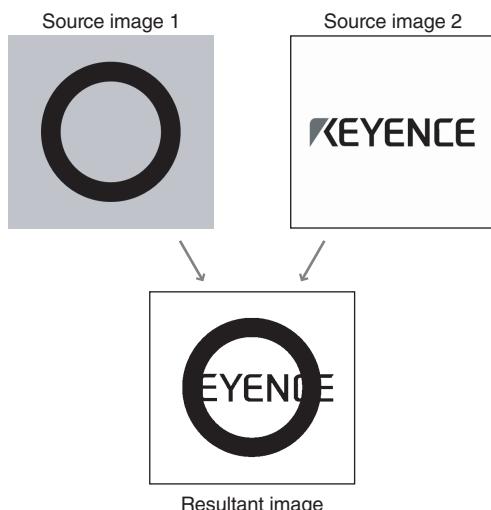
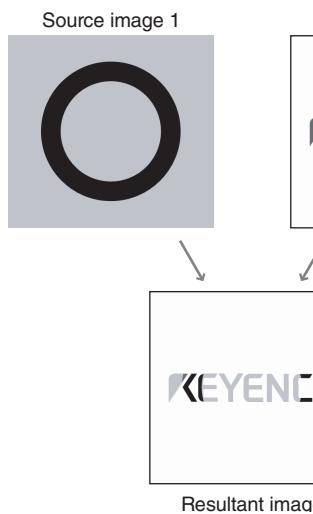


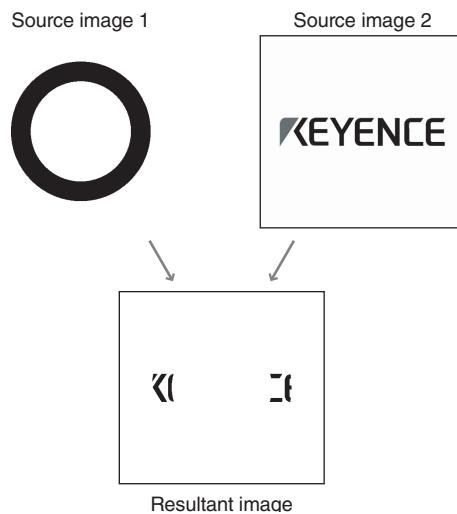
Image Operation Unit

(7) Maximum

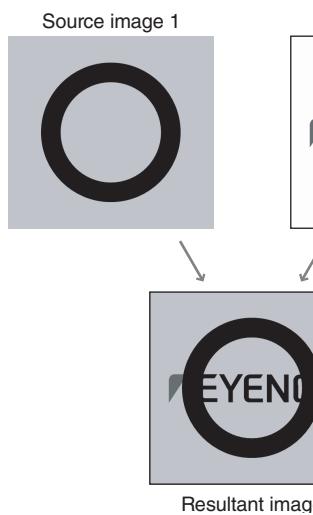
Takes the maximum (brighter) of the corresponding pixels of the source images.

**(10) OR**

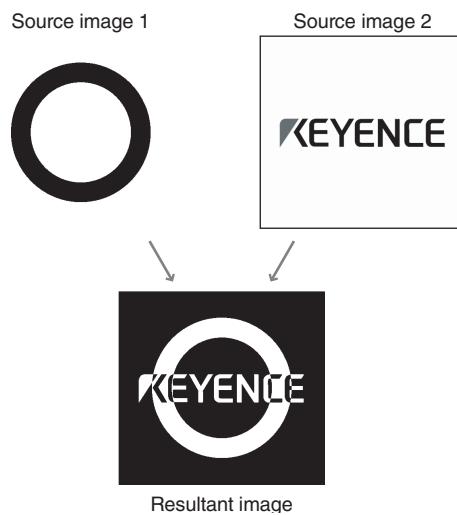
Performs a logical OR function on the BIT's for the corresponding pixels of the source images.

**(8) Minimum**

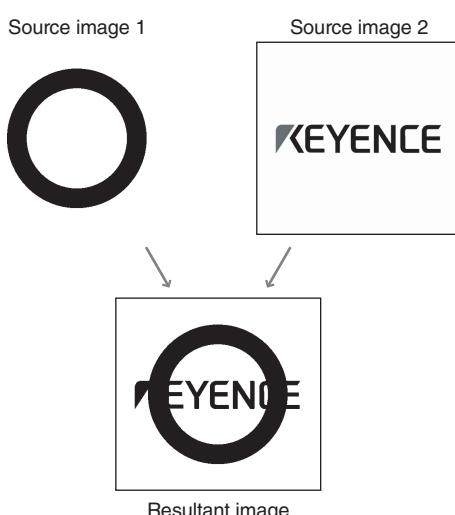
Takes the minimum (darker) of the corresponding pixels of the source images together.

**(11) XOR**

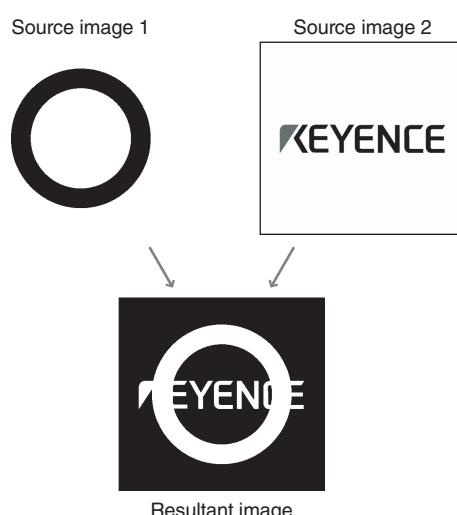
Performs a logical XOR function on the BIT's for the corresponding pixels of the source images.

**(9) AND**

Performs a logical AND function on the BIT's for the corresponding pixels of the source images.

**(12) NAND**

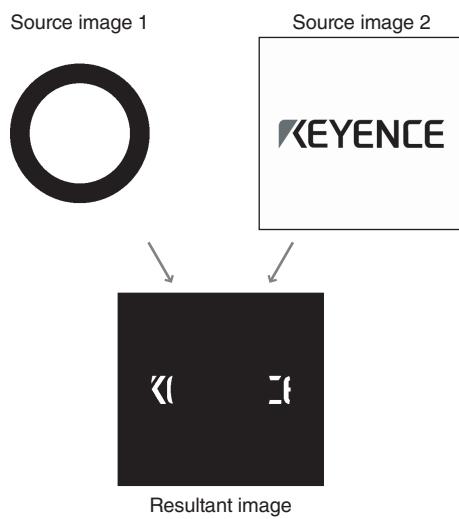
Performs a logical NAND function on the BIT's for the corresponding pixels of the source images.



If the operation uses only the image array variable for source 1, the operation is performed on a pair of images.

(13) NOR

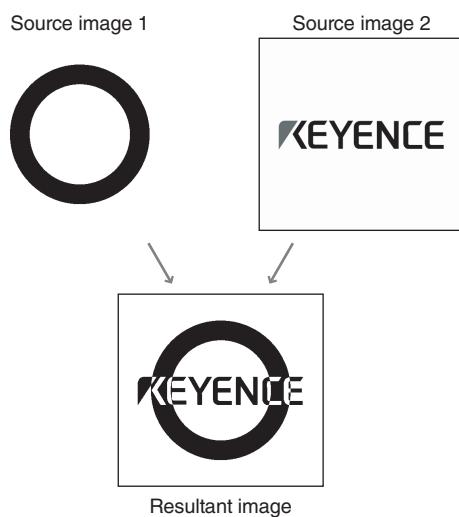
Performs a logical NOR function on the BIT's for the corresponding pixels of the source images.

**Point**

If the operation uses only the image array variable for source 1, the operation is performed on a pair of images.

(14) XNOR

Performs a logical XNOR function on the BIT's for the corresponding pixels of the source images.

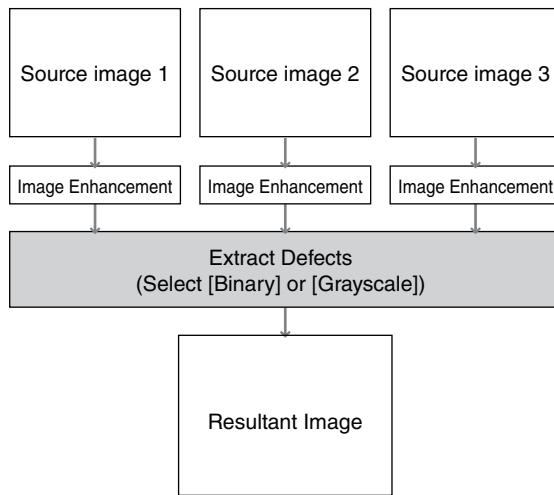
**Point**

If the operation uses only the image array variable for source 1, the operation is performed on a pair of images.

Defect Extraction Operation Unit

The Defect Extraction Operation unit generates an image of extracted defects based on the intensity data of up to three images specified as Source Image and on the intensity range data of good parts and defective parts specified on the source images. You can use the image generated as an inspection target image on other inspection units by substituting the generated image into any result image variable.

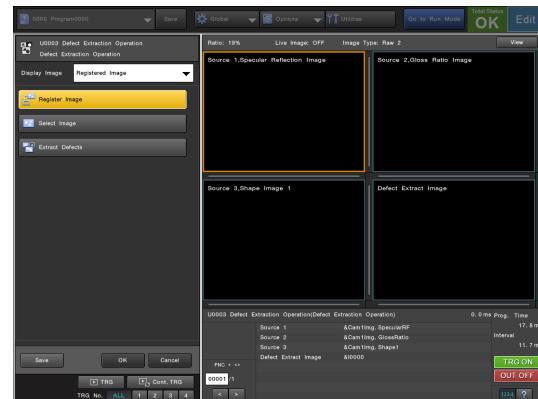
Defect Extraction Operation Flow



- Only grayscale images can be specified as source images. When using a color camera, specify image variables whose images have been converted to grayscale images using Image Operation or the like.
- Images captured with a 3D-supporting camera, including grayscale images, cannot be specified.

Top Menu

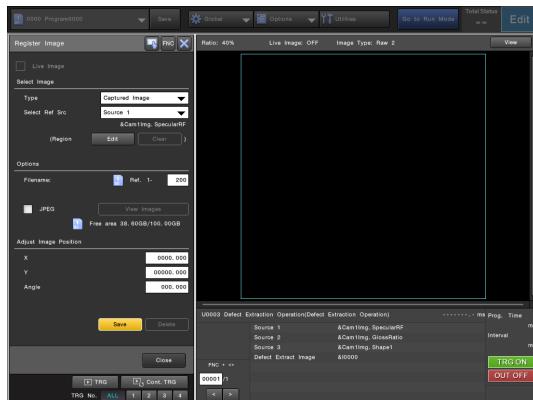
The top menu of the Defect Extraction Operation tool consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 2-395)	Register an image to be used as a template for settings.
Select Image (Page 2-396)	Specify images for the Defect Extraction Operation unit and registered images to be referenced when setting good parts and defective parts.
Extract Defects (Page 2-396)	Specify the conditions for defect extraction.
Save (Page 2-384)	Save the current state to the program setting file.

Register Image

An image can be saved to the controller to be used as a template for operations and settings. It is recommended to register the image acquired under the same installation and lighting conditions as in operation.



Select Image

Type

Select an image to register.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** The registered image specified in [Options] is displayed.

Select Ref Src

Extract defective parts from up to three images captured from the same position. When an image where the shading difference between the defective parts and the good parts is great is used, the defective parts can be extracted stably. Image enhance filters can also be applied to each source image on the [Select Image] screen.

Options

Filename

Specify the registered image number used for image registration in the form "(Camera No.)-(User-specified No.)".

Reference The name of the saved file is "ref (Camera No.)_(Specified No.)" (for full screen image registration) or "ref (Camera No.)_(Specified No.)_XXX_YYY" (for partial image registration).

JPEG

Check this box to save the image in JPEG format. When this box is not checked, the image will be saved in BMP format as either a 24-bit color bitmap image (when a color camera is used) or an 8-bit grayscale bitmap image (when a monochrome camera is used).

Point

Using image compression may result in some image deterioration, thus results from a compressed image may differ to those when using non-compressed images.

View Images

View all registered images in a list.

Adjust Image Position

Adjust the position of the image being captured.

X

Adjust the movement in the X (horizontal) direction between -8191.000 and 8191.000 pixels.

Y

Adjust the movement in the Y (vertical) direction between -16383.000 and 16383.000 pixels.

Angle

Adjust the position angle (rotation) around the center of the image between -999.999° and 999.999°.

Point

Position adjustment may cause missing peripheries (black areas) due to image movement or jagged edges (jaggies) due to rotation in the registered image.

Reference

Position adjustment can only be specified when Source Image 1 is selected for Select Ref Src.

Save

Save the displayed image as a registered image under the conditions specified in the [Register Image] menu.

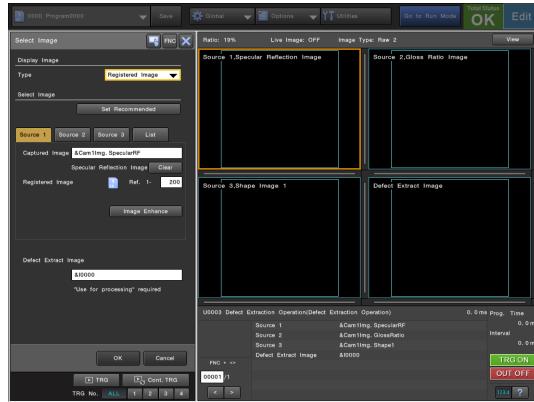
Delete

When [Registered Image] is selected for [Type], you can delete the registered image specified in [Options].

Defect Extraction Operation Unit

Select Image

Specify images for the Defect Extraction Operation unit and registered images to be referenced when setting good parts and defective parts.



Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** The registered image specified under [Select Image] is displayed.

Select Image

Source Image 1 to 3

The settings for Source Image 1 to 3 can be changed. If the Capture Mode is set to LumiTrax Specular Reflection mode, selecting [Set Recommended] automatically selects image variables for which defects can be easily extracted.

- Captured Image:** Specifies the image variable for the captured image for Source Image 1 to 3.
- Registered Image:** Specifies a registered image for the specified image.
- Image Enhance:** Specifies the image enhancement to be applied to the specified image. For more details on image enhancement, see "Image Enhance" (Page 2-489).

List

You can check the settings for Source Image 1 to 3 in a list.

Defect Extract Image

Specify the result image variable that will contain the defect extract image.

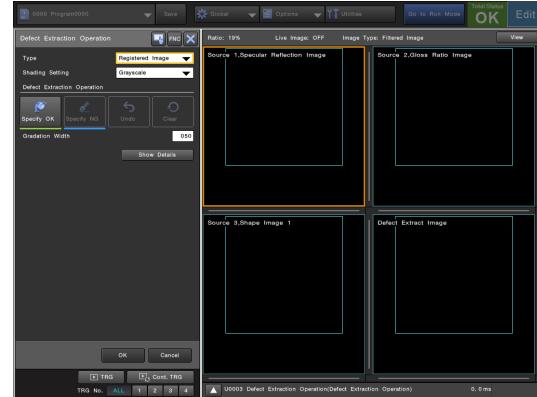


The camera type for Source Image 1 to 3 and the resultant image must match.

Extract Defects

Specify the conditions for defect extraction.

Specify the conditions to extract defects from source images by specifying places for which good parts and defective parts are easy to distinguish on Source Image 1 to 3.



Operation Workflow

On the [Defect Extraction Operation] screen, defects shown on Source Image 1 to 3 are integrated into the defect extract image on the bottom right of the screen and displayed.

- Select [Specify OK] and then select several good parts on Source Image 1 to 3 or the defect extract image.**

The selected parts and parts with similar characteristics are displayed on the defect extract image in white.

If defective parts are white on the defect extract image:

Select [Specify NG] and then select defective parts that are white on Source Image 1 to 3. The defective parts will now be displayed in black on the defect extract image.

If defects are hard to distinguish on the image:

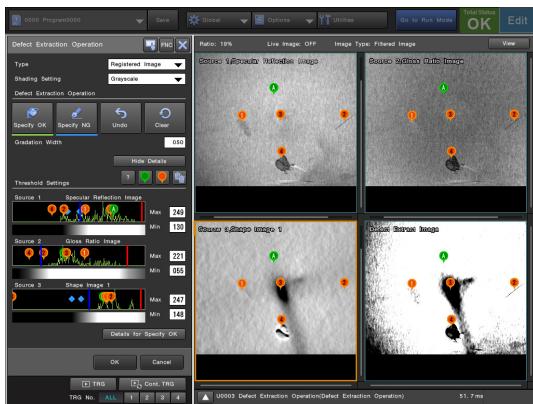
The defects that are easy to distinguish differ depending on the image type. Change the type of source image on the [Select Image] screen.

- Repeat step 1 to make adjustments so that only the defective parts are shown in black on the defect extract image.**

- Once you have extracted the defects, select [OK].**

The image shown on the [Defect Extract Image] screen is stored in the result image variable specified for [Defect Extract Image] on the [Select Image] screen.

Interface



Type

- Captured Image:** Displays the latest image from the specified Source Image (image variable).
- Registered Image:** Displays the registered image specified in [Select Image].

Shading Setting

Select whether to make the defect extract image to be generated a grayscale image or a binary image.

- Grayscale:** Generates a 256-tone grayscale image.
- Binary:** Generates a binary image.

Specify OK

Select the good parts of the inspection target on the source images and the defect extract image. When the good parts are selected on the defect extract image after selecting several parts on the source image, the defective parts can be extracted quickly.

Specify NG

When the defect to extract is displayed as white pixels, it can be returned to black pixels by specifying the defective part on Source Image 1 to 3.

Undo

Cancel the last operation of [Specify OK] and [Specify NG].

Clear

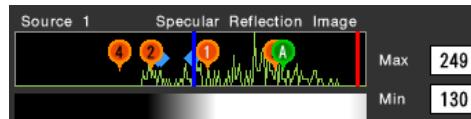
Return the state to the initial state where [Specify OK] and [Specify NG] operations have not been performed.

Gradation Width

Set the width of the gradation of the boundary of good parts (white) and defective parts (black) when [Shading Setting] is set to [Grayscale]. Increase the value to make the black and white change gradual. To make the change sharp, decrease the value.

Show Details

You can display the image data for Source Image 1 to 3 individually.



Max/Min (Threshold): The pixel whose gray value is within the threshold range in all of the source images will be white in the defect extract image. The pixel whose gray value is outside of the threshold range in any one of the Source Image 1 to 3 will be black in the defect extract image.

Graph Display: Displays the gray value information of the image visually.

- **Green Polygonal Line (Histogram):** Displays the distribution of the gray value of the pixels selected for [Specify OK]. The x-axis indicates the gray value (0 to 255) and the y-axis indicates the number of pixels for that gray value.

- **Red Vertical Line/Blue Vertical Line (Upper and Lower Limit of the OK Range):** Displays the upper limit of the OK range for the gray value as a vertical red line and the lower limit for the gray value as a blue vertical line.

- **Bar at the Bottom of the Graph (Distribution of the Gray Values After Defect Extraction Processing):**

The gray values after defect extraction processing are indicated on the grayscale bar in conjunction with the x-axis on the graph. The Defect Extract Image is determined based on the gray values after the defects in all of the source image have been extracted by pixel.

- **Pin:** A pin can be dropped on the image to show the x-axis position of the gray values on the graph (Adding and deleting pins has no effect on the OK range settings.)

For example, if you want to know whether good parts and defective parts can be distinguished, drop different colored pins on good parts and defective parts and then check the different colored pins on the graph. If the pins dropped on good parts and defective parts are sufficiently apart on at least one source image, defective parts can be distinguished. Select to delete all pins.

The gray values for pixels selected for [Specify NG] are displayed on the graph with a light blue diamond (◆).

Details for Specify OK

- Sensitivity:** The bigger the value, the wider the upper and lower limits for good parts will be set.
- Region Size:** The bigger the value, the wider the range of pixels that are selected as good parts.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

 Point

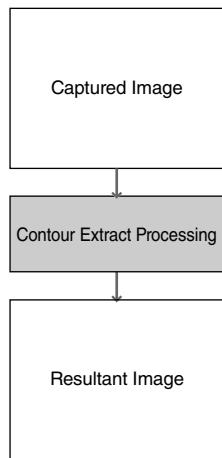
- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

Contour Region Generator Unit

The Contour Region Generator unit outputs areas enclosed by the specified contour regions to the desired resultant image variable. The output resultant image variable can be referenced by the inspection region settings of other inspection units as an image region.

The contour region can also be fit along the contour of the captured image with the same processing as Multi-Profile Defect (Page 2-202).

Flow of Contour Region Generator

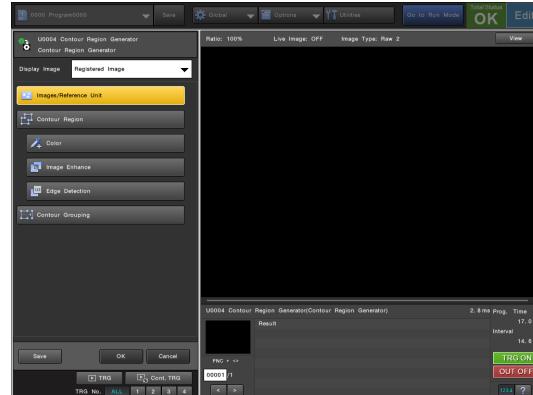


Point

Even if a color image variable is specified for the source image, the image that will be stored in the resultant image variable, which is the operation result, will always be a black and white image since the image operation is performed on the black and white image obtained after the color extraction process.

Top Menu

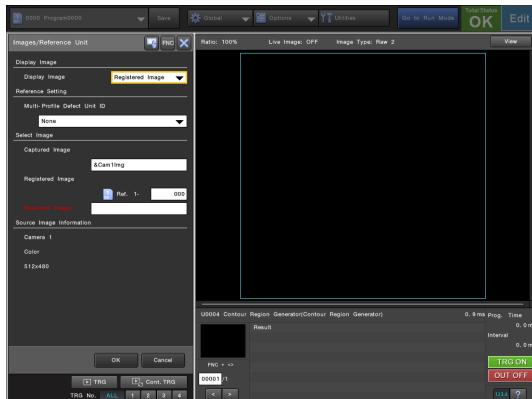
The Contour Region Generator function consists of the following options. Configure settings under each option as required for the inspection.



Images/Reference Unit (Page 2-400)	Register an image to be used as a reference for operation and setting as a registered image. This setting also specifies the multi-profile defect unit to be used as the reference.
Contour Region (Page 2-400)	Set the contour region to detect contours on the object.
Color (Page 2-402)	When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process. (only when [Fit to Contour of Captured Image] is enabled).
Image Enhance (Page 2-402)	Specify the filter processing to apply to the image (only when [Fit to Contour of Captured Image] is enabled).
Edge Detection (Page 2-402)	Specify detailed conditions to detect edges (only when [Fit to Contour of Captured Image] is enabled).
Contour Grouping (Page 2-404)	Group contours that can be linked as closed regions from detected contour data.
Save (Page 2-406)	Save the current state to the program setting file.

Images/Reference Unit

Register an image to be used as a reference for operation and setting as a registered image.



Display Image

Display Image

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified.
- Result:** Displays the contour region image stored in the specified resultant image variable.

Reference Setting

Multi-Profile Defect Unit ID

The model line regions created in the multi-profile defect unit can be used as contour regions for this unit. If you want to use the same contour region, the setting of the contour region can be skipped.

Select Image

Captured Image

Set an image variable to be used as the current image for the unit.

Registered Image

Specify the registered image No. for the registered image to be used.

- The registered images are managed as "ref (Camera No.) - (Registered image No. 0 to 999)".
- The "Camera No." is fixed to the number of the camera associated to the image variable specified for Captured Image for the current image.

Resultant Image

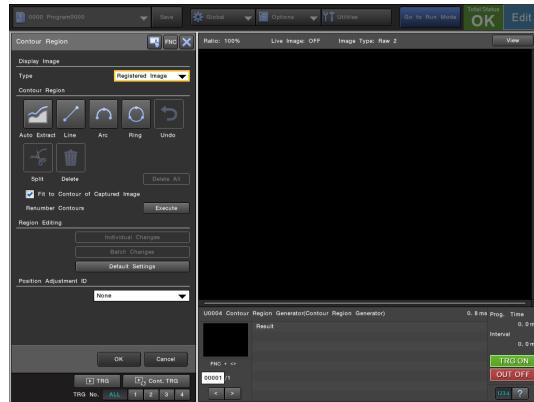
Specify the result image variable that will contain the contour region image.

Source Image Information

The camera No., type (color / monochrome), and resolution of the camera associated to the image variable specified for Captured Image is displayed.

Contour Region

Set the contour region to detect contours on the object.



Drawing a Region

1 Select the region shape from the [Contour Region] field and draw a contour line.

Auto Extract

If you select a spot near the contour line, the contour will be automatically extracted from the image selected under [Display Image]. If the contour cannot be extracted as you expected, change the Search Step Width, Edge Search Direction, Color extraction, Height Extraction, Image Enhance, and other settings.

- Search Step Width:** Specifies the step width for when searching for the contour. When capturing a contour that has sharp changes, set [Search Step Width] to [Narrow]. When capturing a contour that only has gradual changes, by setting [Search Step Width] to [Wide], the program memory consumption can be limited and the processing time decreased.

- **Narrow:** Searches for the contour at an interval of approximately 8 pixels.

- **Standard:** Searches for the contour at an interval of approximately 16 pixels.

- **Wide:** Searches for the contour at an interval of approximately 32 pixels.

- Edge Search Direction:** Specifies the direction where the light-dark boundary can be detected stably. Between light and dark, by searching in the direction from the one which is more uniform to the other, the light-dark boundary can be detected stably.

- **Dark to Light:** Searches for a shift from dark to light.

- **Light to Dark:** Searches for a shift from light to dark.

Line

If you select the start and end points in order, a line will be drawn between the two points. If you select the [Draw Continuously] check box, you can draw a line continuously to the drawn line.

If you select [Switch to Arc], you can continue drawing and draw an arc without breaking away from the line that has been drawn (you can also return to a line after switching to an arc).

Arc

If you select the start, mid, and end points in order, an arc will be drawn that passes through the three specified points. If you select the [Draw Continuously] check box, you can draw an arc continuously to the drawn arc.

If you select [Switch to Line], you can continue drawing and draw a line without breaking away from the arc that has been drawn (you can also return to an arc after switching to a line).

Ring

If you select three points, a ring will be drawn that passes through the three specified points.

2 If you drew lines using [Line], [Arc], and [Ring], select [Exit].

If [Fit to Contour of Captured Image] is enabled, a region where the specified region width is secured to the left and right of the drawn contour line will be drawn.

Fit to Contour of Captured Image

Selecting this check box generates a contour region near the drawn contour line and a model line for the image captured at every inspection. A region along the contour of the object is extracted through this setting. Edge detection conditions, image enhancement, and other settings need to be configured.

Clearing this check box outputs contour lines drawn at the time of configuration as is.

Renumber Contours

When configured contours are deleted, the contour number assigned to that contour is left blank (the contour numbers will not be automatically re-sorted). When new contours are added, they are assigned the next number after the largest number that is already assigned as the contour number. Therefore, if you repeatedly add and delete contours, the contour numbers may not be sequential.

If this occurs, you can move up the contour numbering to fill up the blank numbers (numbers that are not in use) by executing [Renumber Contours].

Changing Region Settings

Changing Individual Region Settings

Select [Individual Changes] from the [Region Editing] field and edit drawn contours by selecting [Edit].

If [Fit to Contour of Captured Image] is enabled, you can also change the region width, scan direction, edge direction, smoothing range, and other settings.

Changing All Region Settings at the Same Time (Only When [Fit to Contour of Captured Image] is Enabled)

Select [Batch Changes] from the [Region Editing] field and specify the region width, scan direction, edge direction, and smoothing range.

Setting the Initial Value for the Region (Only When [Fit to Contour of Captured Image] is Enabled)

Select [Default Settings] and specify the region width, scan direction, and edge direction. The values set here are applied to the region width and so on for contour lines drawn subsequently.

Splitting a Region

You can split regions by splitting drawn contour lines halfway.

1 Select [Split] from the [Contour Region] field.

2 Select the point where you want to split.

The region is split at the point you selected.



You can also select [Specify Splitting Position by Value] and then specify the region number and the position to be split by values to split a region.

If you accidentally select the wrong split position:

Select [Undo].

Deleting a Region

You can delete regions by deleting drawn contour lines.

1 Select [Delete] from the [Contour Region] field.

2 Select the contour line that you want to delete.

The selected contour line and the region secured to the left and right of the contour line are deleted.



You can also select [Specify Contour to Delete by No.] and then specify the number of the contour to be deleted.

To cancel deletion:

Select [Undo].



You can also select [Delete All] to delete all the contour lines at the same time.

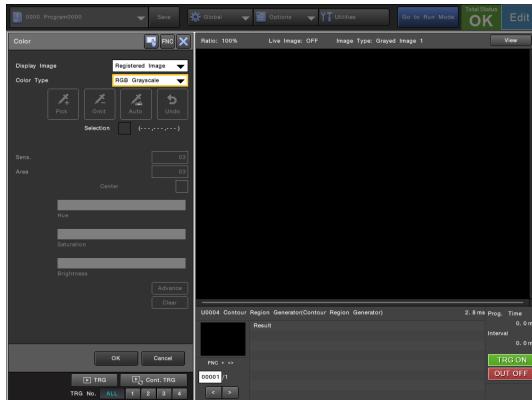
Contour Region Generator Unit

Color

When a color image variable is used for the captured image, convert the captured color image into a black and white image through the desired extraction process.

Reference

The [Color] screen will only appear when a multi-profile defect unit is not referenced on the [Images/Reference Unit] screen and the [Fit to Contour of Captured Image] check box is selected on the [Contour Region] screen.



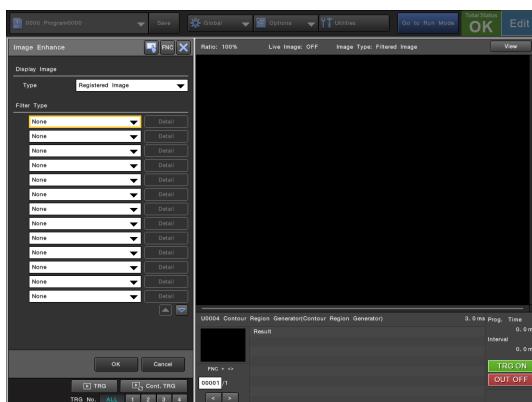
For more details, see "Color Extraction" (Page 2-483).

Image Enhance

Specify the filter processing to apply to the image.

Reference

The [Image Enhance] screen will only appear when a multi-profile defect unit is not referenced on the [Images/Reference Unit] screen and the [Fit to Contour of Captured Image] check box is selected on the [Contour Region] screen.



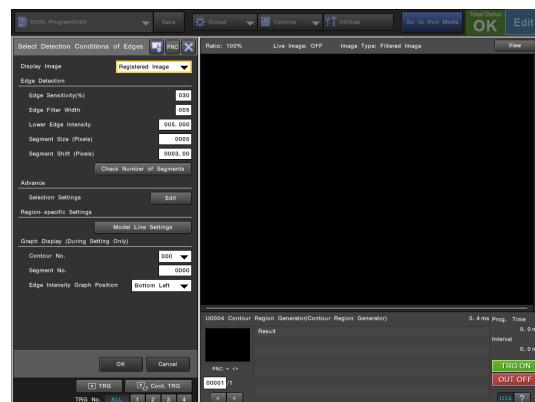
For more details, see "Image Enhance" (Page 2-489).

Edge Detection

Specify detailed conditions to detect edges.

Reference

The [Edge Detection] screen will only appear when a multi-profile defect unit is not referenced on the [Images/Reference Unit] screen and the [Fit to Contour of Captured Image] check box is selected on the [Contour Region] screen.



Reference

Refer to "What is an Edge?" (Page 2-95) for the technical description of edge detection.

Display Image

Switch the image displayed on the screen.

- Captured image:** Displays the latest image from the specified camera (image variable).
- Registered image:** Displays the registered image specified under [Select Image] in [Images/Reference Unit].

Edge Detection

Edge Sensitivity (%)

Set the percentage threshold (0% to 100%) for recognizing edges.

Edge Filter Width

Set the width (0 to 100 pixels) of the smoothing filter applied to the differential graph for detecting edges.

Lower Edge Intensity

Specify the lower limit (0.000 to 255.000) of edge intensity for detecting edges.

Reference

It may be possible to exclude noise edges in the segment by adjusting the upper and lower edge intensity values based on the highest edge intensity in the segment, shown on the left of the edge graph. See "What is an Edge?" (Page 2-95) for more details.

Segment Size (Pixels)

Specify the size of the segment, from 1 to 9999 (pixels), in the inspection region. If the segment size is larger than the inspection region width in the trend direction, a measurement error will occur.

Segment Shift (Pixels)

Specify the shifting distance of the segment, from 0.01 to 9999.99 (pixels), along the trend.

Check Number of Segments

You can select a contour number and check the contour shape. You can also check the current number of segments and total number of segments.

Advance

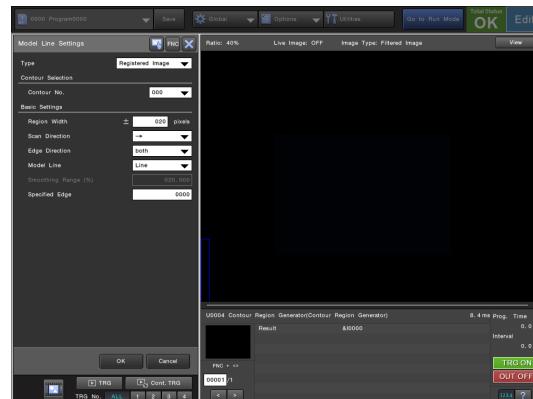
Selection Settings

- Selection:** Specify the culling rate of detection data for creating a model line. To increase (for a more precise model line detection) or decrease (for faster processing) the number of reference values used to create the model line, select [Manual] and then specify the cull rate.
 - **Auto:** Set the culling rate automatically.
 - **Manual:** Set the desired culling rate.
- Edge Selection (%):** When [Manual] is selected for the [Selection], specify the culling rate between 0 and 99.99%.



Setting the cull rate too high will make the model line undetectable.

Region-specific Settings



Model Line Settings

You can select [Model Line Settings] to set detection conditions to be used for model line regions by region.

- Region Width:** Specifies the width of the model line region.
- Scan Direction:** Specifies the direction in which to scan for edges within the model line region (segment).
- Edge Direction:** Specifies the light-dark change direction to detect as an edge. Select from [Light to Dark], [Dark to Light], or [both].
- Model Line:** Selects the model line fitted to the contour shape of the inspection target from [Line (Only for Line region)], [Circle], [Free Curve], or [Oval (Only for Ring/Arc regions)].
 - **Line:** Sets a line as the model line.
 - **Circle:** Sets a circle as the model line.
 - **Free Curve:** Sets a free curve line as the model line.
 - **Oval:** Sets an oval as the model line.
- Smoothing Range (%):** Set this option when [Free Curve] is selected for the model line. Increase the value to draw the free curve smoothly on the contour of the measurement target. To make it sharper, decrease the value.
- Specified Edge:** Specifies the number of the edge in the segment that is to be the measurement target. If a value of 0 or higher is specified, it is counted in the order of detection in the scan direction. If a negative value is specified, it is counted in the order opposite to that of the scan direction. If the specified edge number is not detected, the result of that segment is 0.

Contour Region Generator Unit

Graph Display (During Setting Only)

Specify things such as the segment to display the edge intensity graph of, and the display position on the screen.

Contour No.

Specify the contour of which to display the graph of.

Segment No.

Specify the segment for which to display the segment position, edge graph, edge intensity value, and measurement results on the screen. The setting range is 0 to 9999.



Point The number of segments set in the current inspection region is updated automatically according to the change in the segment size and shift. The maximum number of segments per region is 10,000 (and a maximum of 90,000 for the entire unit), but the actual number of segments that can be set may be lower depending on other settings.



Reference During operation, the position, edge graph, edge intensity value of the segment specified in Segment No. are displayed. Changing the Segment No. is useful for checking the detection status of specific segments.

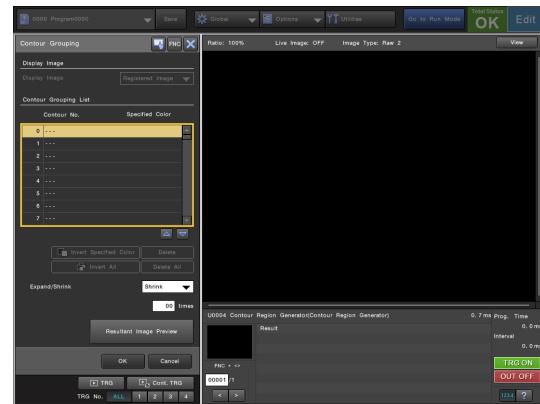
Edge Intensity Graph Position

Select the position to display the edge intensity graph.

Contour Grouping

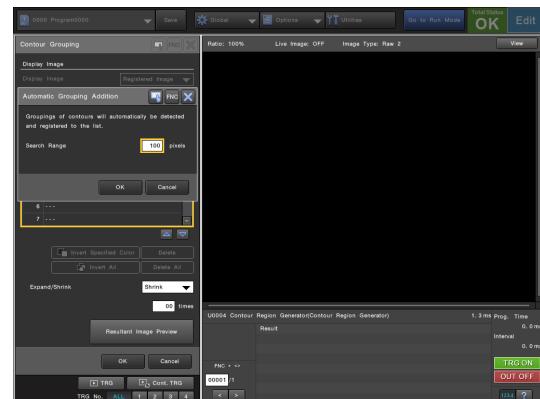
Group contours that can be linked as closed regions from detected contour data.

Configure settings related to contour grouping and filling the inside of grouped contours. You can also check the resultant image created by the combination of these contour groupings.



If the [Contour Grouping] screen is displayed when contour groupings have not been registered:

The [Automatic Grouping Addition] screen appears.



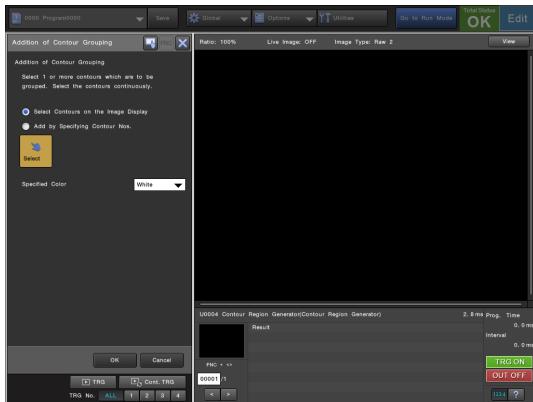
Specify the range to search for contours to consider as being of the same group from the end of the contour region in [Search Range] and then select [OK] to automatically register detected groupings.

Registering Contour Groupings

You can register 128 contour groupings from No. 0 to 127.

1 Select the contour grouping number that you want to add in the [Contour Grouping List] field.

The [Addition of Contour Grouping] screen appears.



2 Specify the contours that you want to register as a contour grouping.

Register by Selecting Contours on the Image Display

Select [Select Contours on the Image Display] and then select the contours that you want to register as a contour grouping.

Register by Specifying Contour Nos.

Select [Add by Specifying Contour Nos.], select the contour number, and then select [Add].

3 In the [Specified Color] field, select the color to fill the inside of the contour grouping.

4 Select [OK].

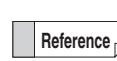
The specified contours are registered as a contour grouping and displayed in the [Contour Grouping List] field.



- Selecting [Invert Specified Color] enables you to invert the specified color for the selected contour grouping. Additionally, selecting [Invert All] enables you to invert the specified colors for all groups in the contour grouping list.
- If multiple contour groupings with different color specification are overlapping, the grouping at the end of the list is given priority.

Deleting Registered Contour Groupings

Select the grouping number that you want to delete in the [Contour Grouping List] field and then select [Delete]. To delete all registered groupings at the same time, select [Delete All].



Even if you delete contour groupings, the contours that make up the contour groupings will not be deleted.

Widening and Reducing the Contour Grouping Range

You can widen or reduce the range of the contour grouping by applying expand or shrink filters to the contour grouping range.

Select [Expand] (to widen the range) or [Shrink] (to reduce the range) in the [Expand/Shrink] field and then specify the number of times to apply the filter.

Changing the Resultant Image Preview Settings

Select [Resultant Image Preview] and then change the preview settings.

- **Display the Generated Resultant Image:** Select this check box to display the generated image.
- **Expand/Shrink:** To apply the expand or shrink filters on the resultant image, select the filter type and then specify the number of times to apply the filter.

Save

Save the current state to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

 Point

- If the controller is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As an example of parameters that can be made so they are not saved, there are variables changed in the current program settings and the screen display state including the display templates.

Calibration Unit

The calibration unit enables the correction of captured images for linear and non-linear distortion caused by lens distortion and camera mounting.

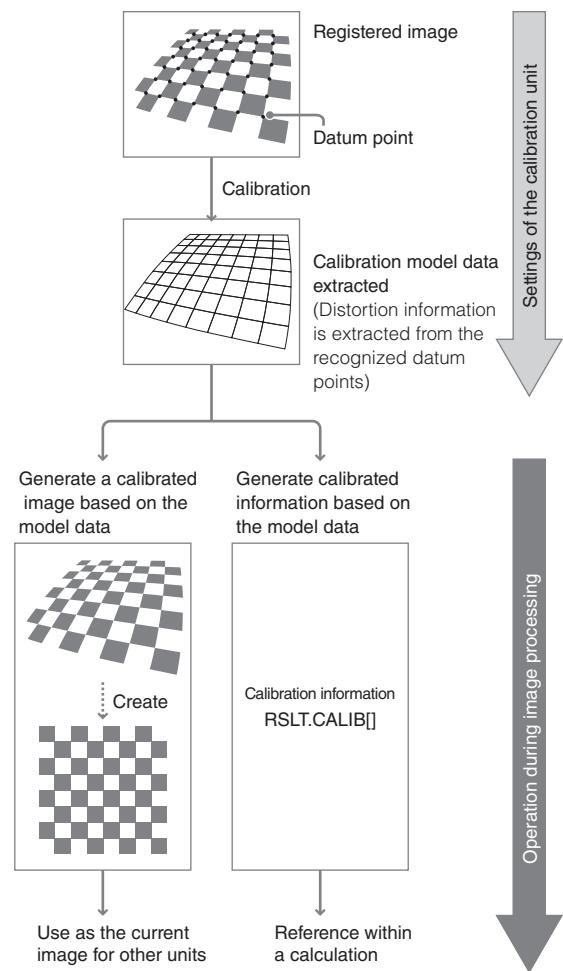
Using the calibration function enables the generation of a corrected image and numerical conversion of measurement values from other units (Page 2-317) into a real world coordinate system. Actual dimensions can also be easily calculated from the scale factor values generated through calibration (Page 4-18).

Point

- For calibration to be performed correctly the calibration pattern needs to be registered under installation conditions. If the installation conditions change the calibration will need to be performed again.
- Errors in inspection / measurement may occur if the target is at a different height or angle to the calibration pattern plane.
- To correct for trapezoid distortion by selecting four reference points on the image use the conversion option in the image operation unit (Page 2-373).

Calibration

In the initial unit setup a "calibration model" is built from registered coordinate datum points obtained via the captured image of a chess board or dot pattern calibration grid (which can be printed from XG-X VisionEditor). During normal operation the "calibration model" can be used as a base to create a "calibrated image" or "calibrated data" for coordinate conversion.



Point

- Calibration patterns can be printed by selecting [Print Calibration Pattern] from the [Other Tools] menu of the XG-X VisionEditor. The pattern accuracy depends on the printer performance, and errors in calibration can occur from how the pattern is presented when registered as an image. If sub-pixel order accuracy is required, it is recommended to use a calibration grid (such as a glass) with a known associated accuracy standard. See the XG-X VisionEditor Reference Manual for more details.
- To perform calibration, the image of the calibration pattern needs to be saved in advance as a registered image.

Calibration Unit

Main execution results

The standard results and data returned by the calibration unit are as follows:

Src. Origin (X, Y)	The coordinates of the origin based on the calibration grid before image calibration in pixels.
Dst. Origin (X, Y)	The coordinates of the origin based on the calibration grid after image calibration in pixels (Valid only when a calibrated image is generated).
Pattern spacing after calibration	The spacing in-between calibration datum points after calibration in pixels (Valid only when a calibrated image with [Lens & Angled Camera] distortion correction is generated).
Corrected Angle (radians)	The correction angle from the calibration (Valid only when a calibrated image with [Lens & Angled Camera] distortion correction is generated).
X Scale Val.	The X scaling factor to be used for scaling (Page 4-18) of measurement values in other units (Valid only when a calibrated image with [Lens & Angled Camera] distortion correction is generated).
Y Scale Val.	The Y scaling factor to be used for scaling (Page 4-18) of measurement values in other units (Valid only when a calibrated image with [Lens & Angled Camera] distortion correction is generated).
Len. Scale Val.	The length scaling factor to be used for scaling (Page 4-18) of measurement values in other units (Valid only when a calibrated image with [Lens & Angled Camera] distortion correction is generated).
Model Param.	The internal parameters to be used for conversion of measurement values into the real world coordinate system using the conversion function (ConvPixTo Wld) (Page 2-317). The information stored is the either the conversion information from the current image (when a calibration image is not generated) or the conversion image from a calibrated image (when a calibration image is generated)



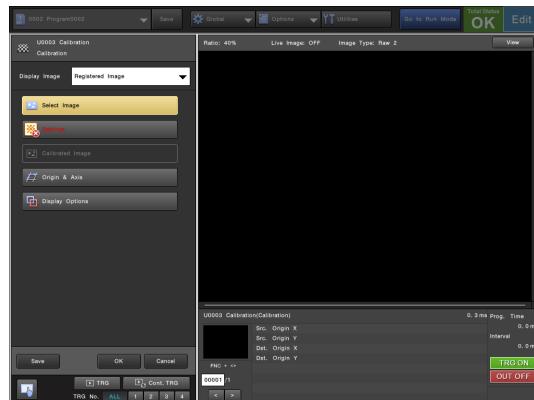
The value of Model Param [] (RSLT.CALIB[]) is only to be used in the calculation unit. When this value changes the result of the calculation may fail.



For the lists of available measurement output values, refer to "List of Result Data" in the XG-X2000 Series Communications Control Manual.

Top Menu

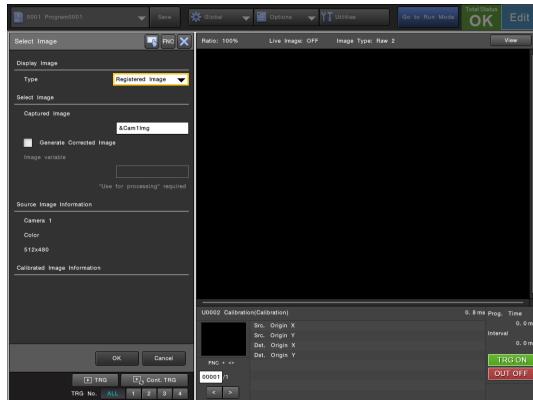
The top menu of the calibration tool consists of the following options. Configure settings under each option as required for the inspection.



Select Image (Page 2-409)	Specify the image variable that will be the target of calibration. When a corrected image is to be generated, specify the result image variable that will store the calibrated image.
Settings (Page 2-410)	Parameters for using a calibration pattern in order to create the calibration model.
Calibrated Image (Page 2-414)	Parameters for generating a calibrated image from the calibration model (This menu is active only when [Generate corrected image] is selected in the [Select Image] menu).
Origin & Axis (Page 2-415)	Define the relationship between the pixel and world coordinate systems (based on calibration image No. 1).
Display Options (Page 2-417)	Specify the display methods for things such as the detection region and result.
Save (Page 2-417)	Save the current state to the program setting file.

Select Image

Specify the image variable that will be the target of calibration. When a corrected image is to be generated, specify the result image variable that will store the calibrated image.



Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified for Image No. 1 in the Settings screen.

Select Image

Captured Image

Set an image variable to be used as the current image for the unit.

Generate Corrected Image

Check this option to generate a corrected image.

Image variable

If [Generate corrected image] is selected, input a result image variable for storing the calibrated image.



- Only a result image variable can be entered in [Image variable].
- A result image variable for storing the calibrated image should be setup in advance in the [Variable Settings] menu (Page 4-4). The camera associated to the result image variable must be the same as the camera used for the current image of the calibration unit.

Source Image Information

The camera No., type (color / monochrome), and resolution of the camera associated to the image variable specified for the captured image are displayed.

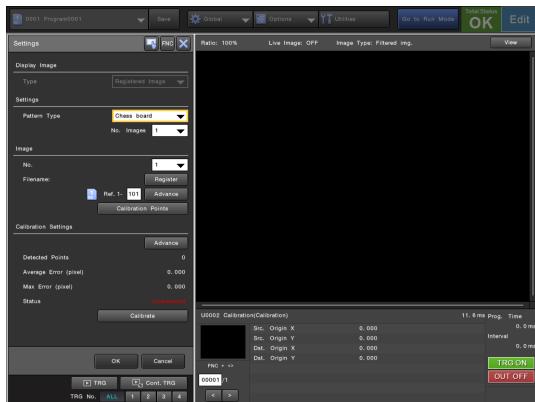
Calibrated Image Information

The camera No., type (color / monochrome), and resolution of the camera associated to the result image variable specified in the [Image variable] option are displayed.

Calibration Unit

Settings

Specify the options for using a calibration pattern in order to generate a calibration model, taking into account lens distortion and angled camera mounting.



Display Image

Type

- **Registered Image:** Displays the registered image specified for [No.] under [Image].

Settings

Pattern Type

Select the type of pattern used for teaching.

- **Chess board** (default): Use a black-and-white chess board pattern.
- **Dot pattern:** Use a dot pattern.

Point

- For calibration set the field of view and calibration grid size so that the pattern spacing is 15 pixels or more for the chess board pattern, and the dot size is 10 pixels or more for the dot pattern. If the number of pixels exceeds the 5 megapixel camera pixel count (4985600 pixels), or if the image width exceeds the 5 megapixel camera width (2432 pixels), set a size that is twice the above or larger for image capture.
- Calibration may be unsuccessful if the angle of the camera is too shallow when using the dot pattern. When the angle is very shallow use the chess board calibration pattern for improved calibration performance.
- Calibration patterns can be printed by selecting [Print Calibration Pattern] from the [Other Tools] menu of the XG-X VisionEditor. The pattern accuracy depends on the printer performance, and errors in calibration can occur from how the pattern is presented when registered as an image. If sub-pixel order accuracy is required, it is recommended to use a calibration grid (such as a glass) with a known associated accuracy standard. See the XG-X VisionEditor Reference Manual for more details.

No. Images

Use this option to create a calibration model from several images (1 to 16, default: 1) captured on the same plane but with different pattern layouts.

This ensures that the calibration model is as accurate as possible when a single calibration grid cannot cover the full image.

Point

- Increasing the number of images for calibration may significantly increase the calibration time.
- The position and angle of the calibration grid can be changed for each image as long as all images are captured on the same plane.

Image

Set the options for each of the images determined in [No. Images].

No.

Select the image.

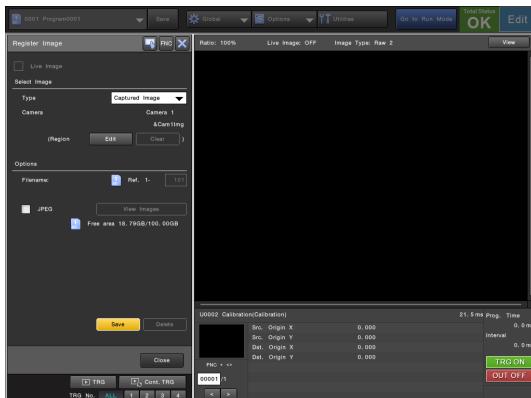
Filename

Specify the registered image No. to be used for calibration.

- Registered images are managed as "Image (Camera No.) - (Registered image No. 0 to 999)".
- The camera No. is fixed to camera of the image variable specified in the [Captured Image].

Register Image

An image can be saved to the controller to be used as a template for measurements and settings. It is recommended to adjust and fix lighting and other external influences before registering an image.



- **Live Image:** Check this box to display live images through a continuous feed.

Point

- A live feed is only available while the unit is being edited.
- This setting cannot be changed when the screen update mode is set to [Live Image] in the trigger settings (Page 2-30).
- If the capture on trigger input is disabled in the trigger settings (Page 2-30), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when registering as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is set to custom and the capture unit which was most recently executed is being edited, the images collected in the buffer will still be displayed even if the capture unit is not presently capturing images.
- Continuous update cannot be used when HDR capture (Page 2-29) is enabled or when a line scan camera is being used.
- The Vision Tools captured image variable must match the storage destination image variable for the running (waiting for trigger) capture unit. When the image capture buffer is on, the storage destination image variable for the recently run capture unit is a comparison subject.

- **Type:** Select an image to register.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** The registered image specified in [Options] is displayed.
- **Region:** To register only part of an image, select [Edit] then specify the region to register. To cancel the selected region, select [Clear].

Reference

The name of the saved file is "ref (Camera No.)_(Specified No.)" (for full screen image registration) or "ref (Camera No.)_(Specified No.)_XXX_YYY" (for partial image registration).

- **JPEG:** Check this box to save the image in JPEG format. When this box is not checked, the image will be saved in BMP format as either a 24-bit color bitmap image (when a color camera is used) or an 8-bit grayscale bitmap image (when a monochrome camera is used).

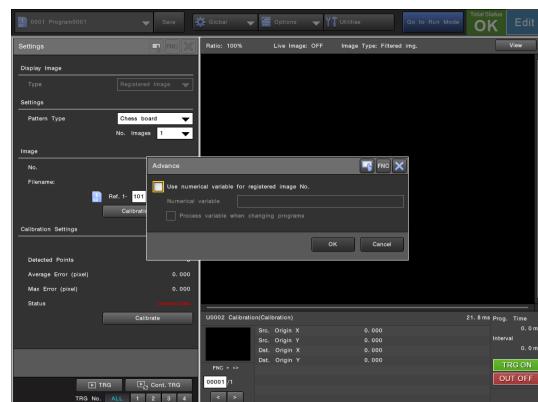
Point

Using image compression may result in some image deterioration, thus results from a compressed image may differ to those when using non compressed images.

- **View Images:** View all registered images in a list.
- **Save:** Save the displayed image as a registered image under the conditions specified in the [Register Image] menu.
- **Delete:** When [Registered Image] is selected for [Type], you can delete the registered image specified in [Options].

Advance

Set advance options for the switching of registered images as necessary.



- **Use numerical variable for registered image No.:** To use a variable to specify the registered image No. to be switched to for the unit, check this box and then assign a numerical or numerical array type variable as a destination to be referenced.
 - By using a variable for the registered image No. and then issuing a variable reference value apply command (NU) the image is switched to the specified registered image in the variable.
 - To apply the image change to teaching, you need to select [Settings] or issue the TG command. For more details, see the XG-X2000 Series Communications Control Manual.
- **Process variable when changing programs:** Use this option to switch to the registered image based on the initial value of the variable referenced when the program is changed or the controller is next turned on.

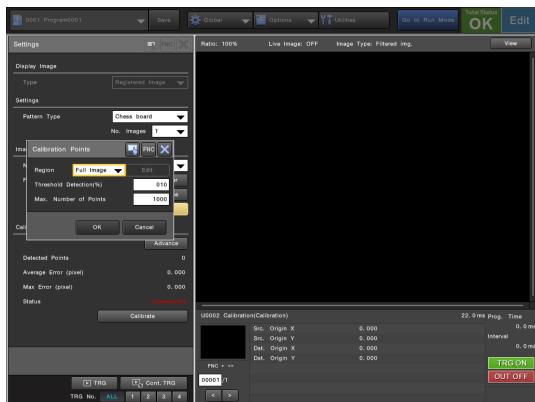
Point

Note that the registered image No. does not switch synchronously with a change in the variable value.

Calibration Unit

Calibration Points

Use the [Calibration Points] menu to change settings relating to the datum point detection during calibration.



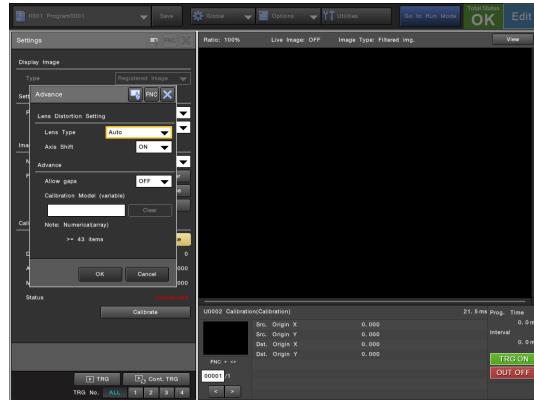
- Region:** Specify a region for detecting calibration points. If detection is unstable due to background data refine the region for stable detection.
 - **Full Image** (default): Use the entire image for detecting calibration points.
 - **User Set**: Define a user-specified rectangle for detecting calibration points.
- Threshold Detection (%)**: Specify a threshold for detecting calibration points (1 to 100, default: 10).
- Max. Number of Points**: Set the maximum number of points to be detected (100 to 4000, default: 1000).

- Point**
- Setting a low detection threshold value to detect more points may result in improper calibration due to noise being detected.
 - Increasing the number of points to be detected may greatly increase the time required for detection and calibration.

Calibration Settings

Advance

Use the [Advance] menu for changing other parameters relating to calibration.



- Lens Type:**
 - **None**: Do not take into account lens distortion and calibrate for camera angle (linear distortion) only.
 - **Low order magnitude**: Correct using a single parameter. Calibrate using one set of parameters, the information used is minimal, but processing is fast.
 - **High order magnitude**: Correct using 2 parameters. Calibrate using two sets of parameters, accuracy is higher than low order, but the processing time is also increased.
 - **Asymmetrical**: Use 4 sets of parameters to correct asymmetrical distortion. Accuracy is improved for asymmetrical distortion in the XY directions, but the processing time is also increased.
 - **Auto** (default): Use a range of parameters to minimize errors and result in stable calibration.
- Axis Shift**: Select whether to include axis shifting in the calibration parameters.
 - **ON** (Default): Correct for axis shift in calibration.
 - **OFF**: Do not correct for axis shift in calibration.
- Allow gaps**: When using two or more images choose whether to allow calibration to support different size calibration grids in each image.
 - **ON**: Allow different sizes between calibration grids across multiple images.
 - **OFF** (default): Do not allow different calibration grid sizes.

- Point**
- Small calibration grid spacing allows for high accuracy calibration; however the range across which points can be taken is limited. A large calibration grid spacing though allows for a large range to be calibrated across, but with an associated decrease in accuracy. "Allow Gaps" enables the use of the multi size calibration grids at different locations so the calibration accuracy can be maintained across the range of the image needing to be calibrated.

Calibration Model (variable)

Reference a numerical variable which contains previous model data from another calibration unit or use this option to share the model data with other calibration units. This function helps ensure that the same calibration model data can be used across numerous programs with calibration only needing to be performed once.



- The variable referenced has to be a numerical variable with 43 or more elements.
- If the variable is setup without the [Copy current value to initial value at save] checkbox checked, saving the program will not save the calibration data.

Calibrate

Perform calibration based on the specified registered image and settings. The result of the calibration is shown below and stored as part of the unit result settings.

Detected Points

The number of detected calibration points is displayed.

Average Error (pixel)

The average pixel value error from the calibration is displayed.

Max Error (pixel)

The maximum pixel value error from the calibration is displayed.

Status

The current status of the calibration is displayed.

- **Unexecuted:** No calibration has been performed yet.
- **Success:** Calibration was successful.
- **Fail:** Calibration failed due to improper extraction of datum points or unexpected distortion.
- **Illegal:** The size of the current image is different from the size from the previous image when performing multi image calibration.



Calibration can also be performed by using the TG command. For more details, see the XG-X2000 Series Communications Control Manual.

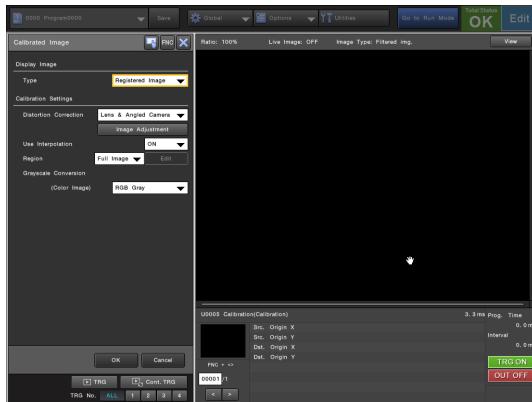


- The error shown relates to the accuracy of the calibration grid used. The error is intended to be used as a guide, and does not guarantee accuracy of the actual calibration result.
- The error display indicates the error around the calibration point. Areas other than the detected points are not considered. As a result, the image may not be calibrated properly around undetected points or the teaching may fail if, for example, points are concentrated in a certain area in all teaching images.
- If no calibration points are found in the image for image No. 1, the calibration fails.
- If two or more images are used and no calibration points are found in the image, those images are ignored in the calibration.
- Changes in the [Settings] menu are not applied to the calibration model data until [Calibrate] is selected.
- When lots of calibration points and images are specified for calibration, calibration may require several minutes to execute following the 50% mark of the progress bar

Calibration Unit

Calibrated Image

Specify options for generating a calibrated image from the calibration model.



This menu is only available when [Generate Corrected Image] is checked in the [Select Image] menu.

Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified for Image No. 1 in the Settings screen.

Calibration Settings

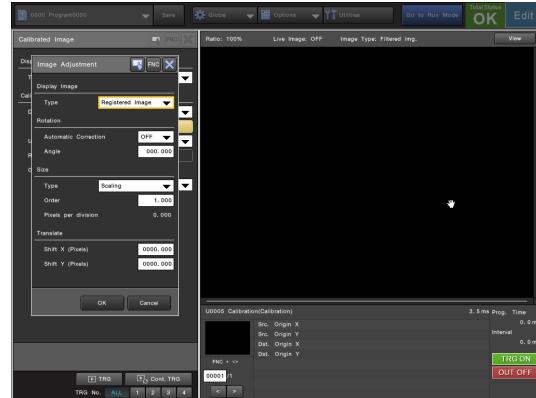
Distortion Correction

Select the type of distortion to correct.

- Lens Only:** Correct lens distortion only.
- Lens & Angled Camera** (Default): Correct both lens distortion and angled camera distortion.

Image Adjustment

Use the [Image Adjustment] menu for adjusting the calibrated image.



Rotation

- Automatic Correction:** Set this to correct the rotational component.
 - ON:** Corrects the rotational component based on the calibration grid used in image No. 1.
 - OFF** (default): Do not correct rotation.
- Angle:** Specify the angle to adjust the calibrated image by. When [Automatic Correction] is [ON], this angle is applied to the image after rotation correction.

Size

- Scaling:** Specify the scale factor to be applied to the calibrated image (0.200 to 5.000, default: 1.000).
- Division:** Specify the calibration grid spacing (pixels) to be applied to the calibrated image (5.000 to 1000.000, default: 50,000).
- Pixels per division:** The current calibration grid spacing is displayed in pixels.

Translate

- Shift X (pixels):** Specify the X translation of the calibrated image in pixels (-9999.999 to 9999.999, default: 0.000)
- Shift Y (pixels):** Specify the Y translation of the calibrated image in pixels (-9999.999 to 9999.999, default: 0.000)

Use interpolation

Select whether to interpolate the calibrated image.

Although interpolation requires additional processing time, it can reduce the generation of jaggies in the calibrated image.

- ON** (default): Use interpolation.
- OFF:** Do not use interpolation.

Region

Use this option to select the region for the generated calibrated image.

Limiting the region can reduce processing time for the image calibration.

- **Full Image** (default): Calibrate across the full image.
- **Rectangle**: Calibrate inside the specified rectangle region only.

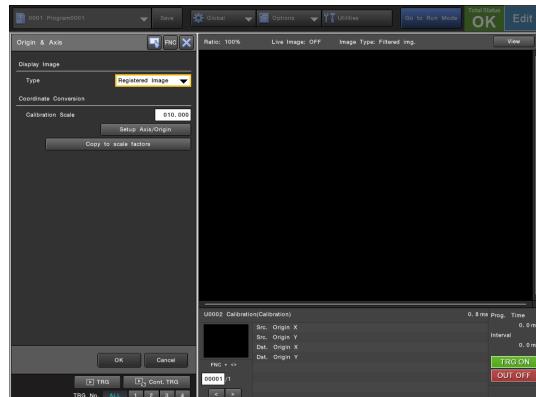
Grayscale conversion

When the current image is a color image, select the grayscale conversion method for the calibrated image.

- **Gray**: Take the maximum R, G and B intensity values for each pixel and convert them into grayscale information (producing a relatively bright grayscale image).
- **RGB Gray** (Default): Take the average R, G and B intensity values for each pixel and convert them into grayscale information (producing a gray image that is similar to one from a monochrome camera).

Origin & Axis

Set the relationship between the pixel and world coordinate systems (based on calibration image No. 1).



Display Image

Type

Switch the image displayed on the screen.

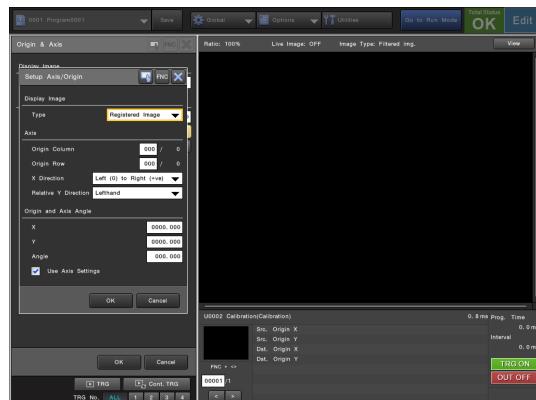
- **Captured Image**: Displays the latest image from the specified camera (image variable).
- **Registered Image**: Displays the registered image specified for Image No. 1 in the Settings screen.

Calibration Scale

Specify the spacing of the calibration grid as an actual dimension in order to convert measurement results in pixels into actual dimension values (0.001 to 999.999, default: 10.000).

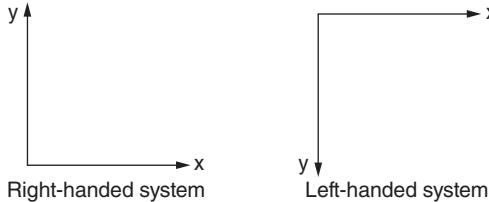
Setup Axis/Origin

Use the [Setup Axis/Origin] menu to change the origin and axis used as references for calibration (coordinate conversion) of the measurement value with a calculation unit.



Axis

- Origin Column:** Specify the column No. based on the calibration points of image No. 1 and set the origin point of the axis (0 to 255, default: 0).
- Origin Row:** Specify the row No. based on the calibration points of image No. 1 and set the origin point of the axis (0 to 255, default: 0).
- X Direction:** Select the direction of the X axis with respect to the origin point
 - **Right (0) to Left(+ve):** Set the X axis to increase when moving to the left of the origin point.
 - **Bottom (0) to Top (+ve):** Set the X axis to increase when moving upwards from the origin point.
 - **Left (0) to Right (+ve):** Set the X axis to increase when moving to the right of the origin point.
 - **Top (0) to Bottom (+ve):** Set the X axis to increase when moving downwards from the origin point.
- Relative Y Direction:** Select the coordinate system of the Y axis with respect to the origin of the axis.
 - **Righthand:** Use the right-handed system.
 - **Lefthand** (default): Use the left-handed system.

**Origin and Axis Angle**

Specify adjustments in the world coordinate system based on the [Axis] settings for changing the origin position with numerical values.

- X:** X origin coordinate adjustment (-9999.999 to 9999.999, default: 0.000)
- Y:** Y origin coordinate adjustment (-9999.999 to 9999.999, default: 0.000).
- Angle:** Angle adjustment (0 to 359.999, default: 0.000).
- Use Axis Settings:** Check this box to use the axis settings when specifying an adjustment value (default: ON).

Point

- If the origin deviates significantly from the detected datum points, the error between the world and pixel coordinate systems may increase.
- Depending on the calibration pattern layout and or camera settings, the initial origin may greatly deviate from the screen during calibration. In this instance, adjust the values of [Origin Column] and [Origin Row] to move the origin to an appropriate position.

Copy to scale factors

Copy the calculated calibration scale factor to the scale factor setting (Page 4-18). This setting effects units which use the calibrated image as the current image and when the scaling is set to convert measured values into actual dimensions.

Reference

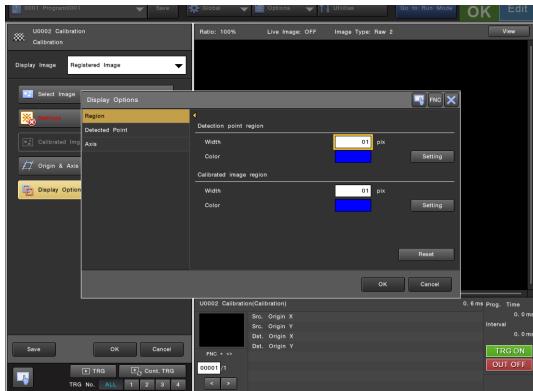
As the calibration scale factor changes with each calibration, the new coefficient will need to be applied to the scale factor setting after each calibration. If a variable is referenced in the scale factor settings this process can be eliminated by a calculation populating the variable with the scale factors.

Point

Before using this option, a calibrated image needs to be generated via the [Distortion Correction] option in the [Calibrated Image] menu. To perform calibration (coordinate conversion) of the measurement value using a calculation instead of an image, use the coordinate conversion function (ConvPixToWld) in a calculation unit.

Display Options

Specify the display methods for things such as the detection region and result.



Region

Detection point region

Specify the line thickness and display color of the region specified in [Calibration Points] (Page 2-412) in the [Settings] menu.

Calibrated image region

Specify the line thickness and display color of the region specified in the [Calibrated Image] menu.

Detected Point

Specify the thickness and display color of the detected points used for calibration.

Axis

Horizontal axis

Specify the line thickness and display color of the horizontal (default X) axis displayed at the origin.

Vertical axis

Specify the line thickness and display color of the vertical (default Y) axis displayed at the origin.

Save

Save the current unit changes the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

Point

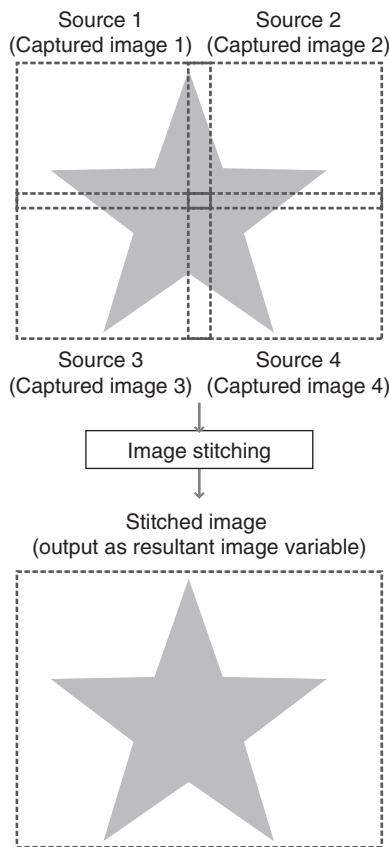
- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

The image stitching unit stitches together multiple source images at the specified position to create a single image. The created image can be used with the various inspection tools.

Point

- The XG-X2000/XG-X2200 can not use the image stitching unit.
- The source images that can be used for the Image Stitching unit are Gray images excluding Multi-Cam type images. In addition, images acquired using a 21 megapixel camera or a 3D-compatible camera cannot be used as well.
- When a 21 megapixel camera or a 3D-compatible camera is being used, a Multi-Cam type image variable cannot be added. Also, when selecting the said cameras, Multi-Cam type image variables that are already set are disabled.

Image stitching concept



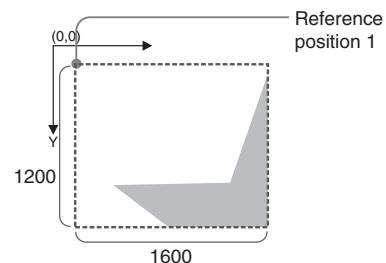
Two to four base images are stitched together to create a stitched image with a maximum size of 4864x4864 pixels.

- The stitching position for the image is set as the reference position and the result position coordinates.
- To stitch multiple camera images with high accuracy, first accurately find the reference position for the image with distortion correction applied to it by the calibration unit, and then stitch it together.

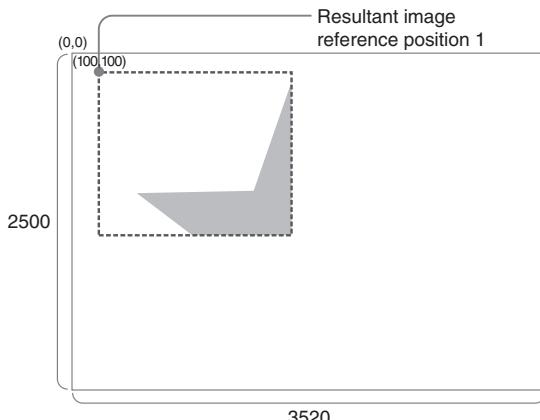
Specifying the result position

Specify the reference position for source image 1 from the (X, Y) coordinates of the source image.

As an example here, specify the upper left corner (0,0) of the captured image for source image 1 from a 2 megapixel camera image (1600x1200 pixels) as the reference position for source image 1.



Specify the source image 1 result position as the (X, Y) coordinates of the resultant image (this example specifies the size of the resultant image as 3520x2000 pixels and the result image reference position as (100,100) of the resultant image).



The reference position for source image 1 is moved to the coordinates of the resultant image specified by the result position for source image 1. The second image and on are specified using the same procedure with "source image n reference position" and "source image n result position" to determine their positions on the resultant image.

Measurement results

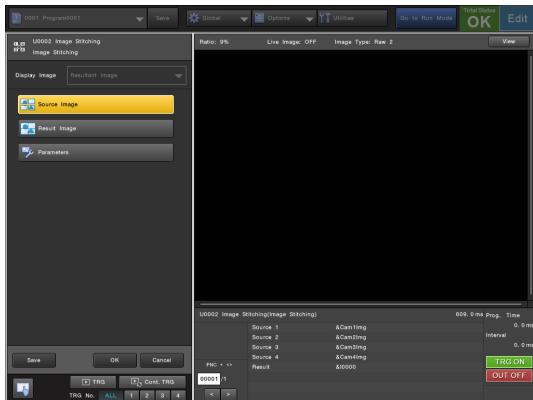
The measured results output by the image stitching unit are as follows.

Unit judgment value	Always OK.
Bounding rectangle coordinates	Outputs the coordinates for the four corners of the resultant image.

 For the lists of available measurement output values, refer to "List of Result Data" in the XG-X2000 Series Communications Control Manual.

Top Menu

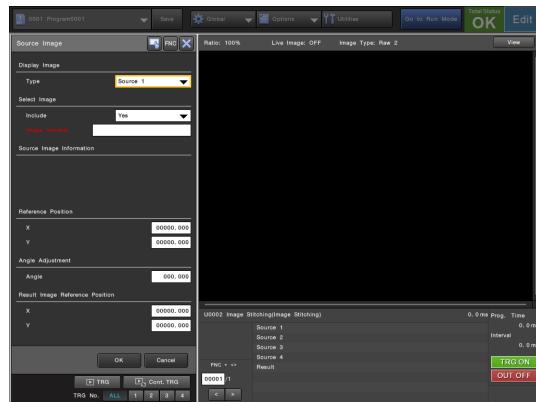
The screen for the image stitching unit dialog has the following structure. Change the settings as required.



Source Image (Page 2-419)	Specify the images to stitch and the result positions.
Result Image (Page 2-420)	Specify the image variable to store the resultant image and the detailed settings during the stitching process.
Parameters (Page 2-420)	As necessary, specify other parameters which can be used for image stitching.
Save (Page 2-384)	Save the current state to the program setting file.

Source Image

Specify the images to stitch.



Display Image

Type

Select the image to be set.

Select Image

Include

To stitch, select [Yes].

- **Yes** (default) (1): Use for stitching.
- **No** (0): Do not use for stitching.

Image Variable

Specify the image variable for the image to use as the source image (or a resultant image variable).



- The source images that can be used for the Image Stitching unit are Gray images excluding Multi-Cam type images. In addition, images acquired using a 21 megapixel camera or a 3D-compatible camera cannot be used as well.
- When a 21 megapixel camera or a 3D-compatible camera is being used, a Multi-Cam type image variable cannot be added. Also, when selecting the said cameras, Multi-Cam type image variables that are already set are disabled.

Reference Position

Specified the desired position on the coordinates of the captured image as the source image reference position. The coordinates specified here become the result image reference position for the resultant image.

A position type variable or individual X, Y variables can be specified.

Angle Adjustment

Specify the rotation for the source image.

The rotational center is the reference position coordinates.

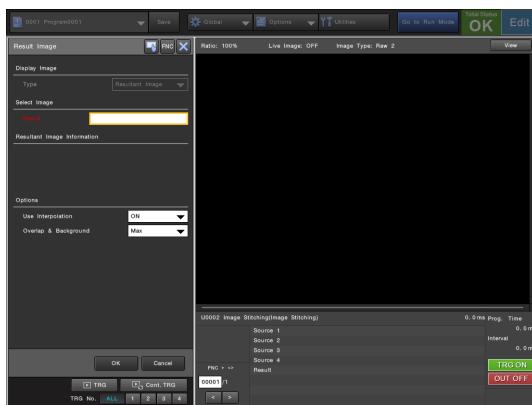
Result Image Reference Position

Specify the coordinates when moving the source image reference position on the resultant image.

Image Stitching Unit

Result Image

Set the processing applied to the resultant image.



Display Image

Type

- Resultant Image:** Displays the resultant image.

Select Image

Result

Specify the image variable for the resultant image.

Point The image variable that can be specified is only a multi-camera type variable specified in the image variable settings.

Use Interpolation

Select whether or not to interpolate the source image when moving it horizontally or rotating it.

The interpolation process takes time, but it reduces the effect of jaggies generated at the boundaries of light and dark colors.

- ON** (default): Perform interpolation processing.
- OFF**: Do not perform interpolation processing.

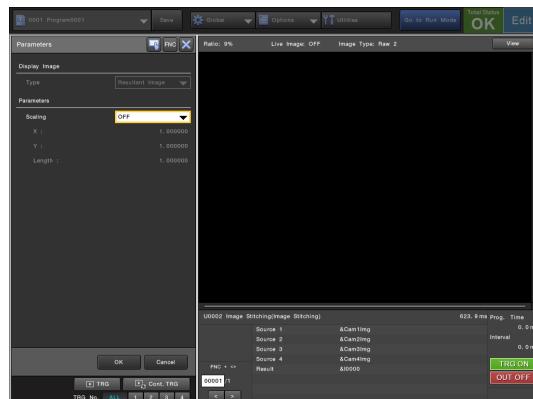
Overlap & Background

Specify the treatment for sections that multiple source images overlap.

- Max:** Use the brightest pixel information out of the overlapping images.
- Min:** Use the darkest pixel information out of the overlapping images.

Parameters

As necessary, specify other parameters which can be used for image stitching.



Parameters

Scaling

The controller processes image data in pixels internally. However, you can convert the results data and setting parameters used for on-screen display, judgment and calculation to values in any desired unit, such as actual dimension values by the configured scaling correction value. (This process is called "scaling.")

- OFF** (default): Do not use scaling.
- ON:** Use scaling.

Reference

- The scaling correction value can be changed with the Flow Editor [Options] menu.
- For a summary list of the result data for which scaling can be used, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Save

Save the current unit changes the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

Point

- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

Multi-camera Type Image Variables

Before stitching together images, you must add a multi-camera type image variable as the image variable to store the resultant image.

Point

The resultant image can only be a monochrome image.

1 Select [Variable Settings] from [Options] at the top of the screen.

The [Variable Settings] screen is displayed.

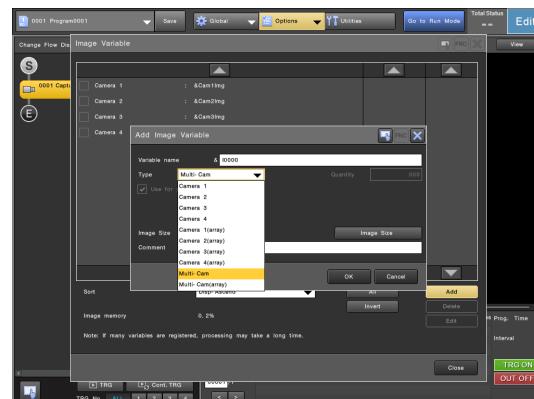
2 First select [Image Variable], and then select [OK].

The [Image Variable] screen is displayed.

3 Select [Add].

The [Add Image Variable] screen is displayed.

4 Select [Multi-Cam] or [Multi-Cam(array)] in the [Type] field.



5 As necessary, define or edit the image variable.

Edit the image variable in the same manner as a normal image variable.

Change the image size to store in the resultant image variable

Select [Image Size] to display the [Image Size] screen, and then change the image size stored in the resultant image variable as necessary.

- Width: 512 to 4864 pixels (32 pixel units)
- Height: 480 to 4864 pixels (1 pixel units)

Point

The change in image size is applied to all multi-camera type image variables and multi-camera array type image variables.

6 Select [OK].

Timing

Timing

Measurement Condition Setting

Image Acquisition

Vision Tools

Position Adjustment

Flowchart Functions

Operations

► Timing

Display

Output

Commands

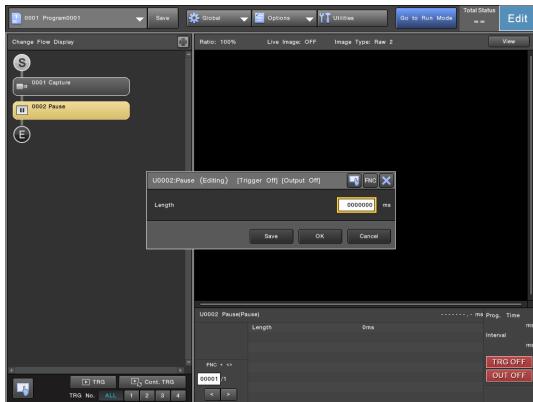
Common Setting Items

Pause Unit

The pause unit stops the flowchart operation for a specified period of time.

Pause

Specify the condition for the pause.



Length

Processing of the flowchart is stopped for a specified period of time.

Enter a pause time (0 to 3600000) ms (default: 0)

Save

Save the current unit changes the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



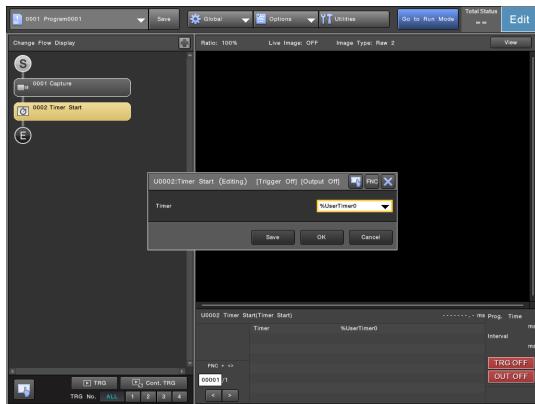
- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

Timer Start Unit

The timer start unit starts off a specified timer (%UserTimer0 to 7) and is used with the timer end unit (Page 2-425) to control processing based on elapsed time.

Timer Start

Specify the variable to use for the timer.



Timer

Specify the timer (system variable) to be used: %UserTimer0 to 7.

The timer activates with execution of the timer start unit. The elapsed time (in ms) of the timer once activated can be checked by referencing the specified variable.

- Point**
- The timer is reset by the following operations:
 - Turning off the controller
 - Changing the program No.
 - Reset
 - Executing another timer start unit in which the same timer is specified
- When the timer reaches 1073741824 ms after activation, its value returns to 0 and the time monitoring continues.

Save

Save the current unit changes the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

Point

- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

Timer End Unit

The timer end unit stops the flowchart operation until the value of the activated timer (setup in the timer start unit (Page 2-424)) reaches the set duration. These two units combined can be used to keep the processing time of sections of the flowchart to a constant.

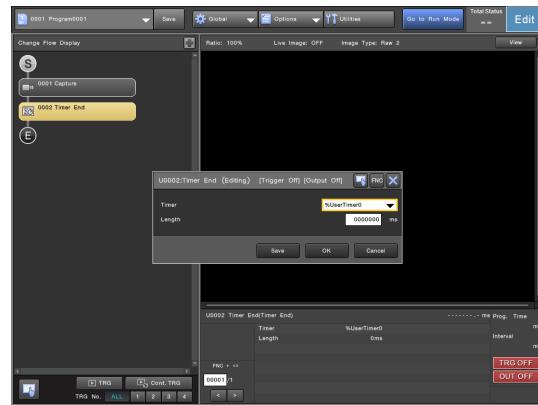
Main execution results

The standard results and data returned by the timer end unit are as follows:

Status	The status is 1 when stopping was not performed because the condition has already been satisfied by the time this unit was reached, 0 at all other times.
---------------	---

Timer End

Specify the conditions for timer expiration.



Timer

Specify the timer (system variable) used in the timer start unit to be associated with this timer end unit: %UserTimer0 to 7.

Length

Processing of the flowchart units is stopped until the value of the specified timer reaches the timer completion time length.

Enter a duration (0 to 3600000) for the timer in ms (default: 0)



If the timer value is greater than the length specified when the timer end unit is processed, processing of the rest of the flowchart continues.

Save

Save the current unit changes the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

Terminal I/O Delay Unit

The terminal I/O delay unit pauses the flowchart operation until the status of the input terminal(s) matches the set conditions. This unit can be used to synchronize the processing with external devices and inputs.

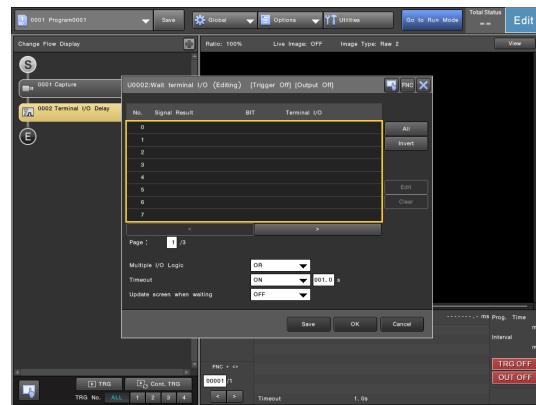
Main execution results

The standard results and data returned by the terminal I/O delay unit are as follows:

Status	The status of the unit based on the time-out condition can be referenced, 1 being output when the time-out has occurred and the delay function cancelled, 0 at all other times.
Condition Number	Outputs the matched condition number. When [AND] is selected, the first matched condition number in the list is output.
Condition Bit Combination	The decimal equivalent of the logical bit sum (OR function) of the conditions can be referenced with a matched condition turning a bit 0 through 19 on. Bits 0 through 19 are assigned to in order with condition No. 0 set to the LSB and condition No. 19 the MSB.

Wait terminal I/O

Specify conditions for the status matching of specified terminals.



Terminal settings

Setup conditions 0 through 19 for pausing the process unless the terminal settings are satisfied.

Edit

Specify the terminal settings for the condition No.

Signal Result

Select the system variable (I/O terminal) to be referenced.



Selectable system variables are those assigned to terminal control-related input (IN) terminals, to CC-Link bit devices (RY), or to EtherNet/IP, PROFINET or EtherCAT output bit areas. For details, refer to the XG-X2000 Series Communications Control Manual.

BIT

Select the bit of the system variable to be used in evaluation.

Terminal I/O

If the system variable specified in [Signal Result] is assigned to a bit device (RY) in the [CC-Link] settings (Page 6-23), to the EtherNet/IP, PROFINET or EtherCAT output bit area, or to a terminal in the [Terminal Block & Parallel Port] settings (Page 6-11), the name of the assigned terminal is displayed.



If a system variable which is not assigned to an input (IN) terminal, a CC-Link bit device (RY), or to the EtherNet/IP, PROFINET or EtherCAT output bit area is selected, the display is blank and a settings error will occur.

Signal Type/Direction

Select the type of signal to be evaluated in [Signal Type], and then specify the state in [Direction].

- **Rising/Falling Edge:** Select the signal transition type as the condition:
 - **OFF->ON:** Use the rising edge of the signal.
 - **ON->OFF:** Use the falling edge of the signal.
 - **Both:** Use both rising and falling edges of the signal.
- **Level:** Select the current signal state as the condition.
 - **ON:** Use the ON state of the signal.
 - **OFF:** Use the OFF state of the signal.

Multiple I/O Logic

If several terminals are specified in the conditions to delay the processing, select a compound condition for final judgment.

- **OR** (default): Use the logical (OR) sum of the specified conditions. If at least one condition is satisfied, the flowchart processing continues.
- **AND:** Obtain the logical (AND) product of the specified conditions. If all conditions are satisfied, the flowchart processing continues. (If one or more conditions is not satisfied, the delay remains in effect.)

Point The multiple BIT, single result logic setting is fixed to [OR] if there are two or more conditions using [Rising / Falling Edge] in [Signal Type].

Timeout

For time sensitive processing, a time-out can be used to specify a time (0.1 to 600.0 s) to wait for the conditions to be satisfied (default: 60.0).

- **ON:** Wait for conditions to be satisfied in the specified period of time. If the time-out time is reached continue to process the rest of the flowchart regardless of the state of the monitored terminals.
- **OFF** (Default): No time-out function, continued processing of the flowchart will only occur when the conditions are satisfied.

Point Depending on the processing load of the controller the timeout value maybe longer than specified.

Update screen when waiting

Choose to update the screen display while the process is paused based on the status of this unit.

- **ON:** Update the display. (Results for units processed up to this point are updated on the display)
- **OFF** (default): The display is not updated and displays results from the previous processing of the flowchart.

Save

Save the current unit changes the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

Variable Delay Unit

The variable delay unit pauses the flowchart operation until the value of the specified variable(s) matches the set conditions. This unit can be used to synchronize processing with the external changing of variable values.

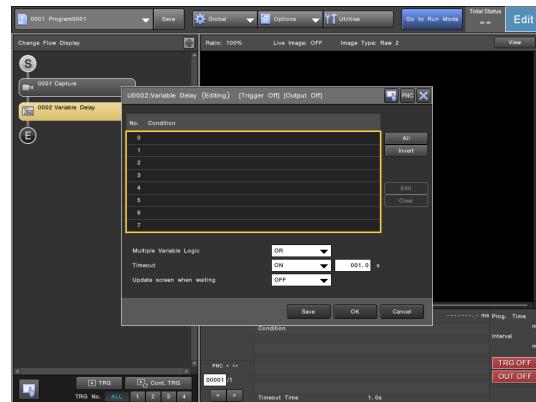
Main execution results

The standard results and data returned by the variable delay unit are as follows:

Status	The status of the unit based on the time-out condition can be referenced, 1 being output when the time-out has occurred and the delay function cancelled, 0 at all other times.
Condition Number	Outputs the No. of the matched condition number. When [AND] is selected, the first matched condition number in the list is output.
Condition Bit Combination	The decimal equivalent of the logical bit sum (OR function) of the conditions can be referenced with a matched condition turning a bit 0 through 7 on. Bits 0 through 7 are assigned to in order with condition No. 0 set to the LSB and condition No. 7 the MSB.

Variable Delay

Specify conditions for the matching of specified variables.



Edit

Specify the parameters for the condition No..

Calculation

Select one from the 14 different compare functions for the variable to match:

- Variable = Cond.1
- Variable <> Cond.1
- Variable > Cond.1
- Variable < Cond.1
- Variable >= Cond.1
- Variable <= Cond.1
- Cond.1 < Variable < Cond.2
- Cond.1 <= Variable < Cond.2
- Cond.1 < Variable <= Cond.2
- Cond.1 <= Variable <= Cond.2
- Variable < Cond.1 OR Cond.2 < Variable
- Variable <= Cond.1 OR Cond.2 < Variable
- Variable < Cond.1 OR Cond.2 <= Variable
- Variable <= Cond.1 OR Cond.2 <= Variable

Variable

Select a variable to be referenced against the conditions.



Point A numerical value can not be entered directly in the variable setting.

Condition 1/Condition 2

Select a variable or input a numerical value to be used for [Condition1] and or [Condition2] as specified in [Calculation].

Multiple Variable Logic

If several variables are specified in the conditions to delay the processing, select a compound condition for final judgment.

- **OR:** Use the logical (OR) sum of the specified conditions. If at least one condition is satisfied, the flowchart processing continues.
- **AND:** Obtain the logical (AND) product of the specified conditions. If all conditions are satisfied, the flowchart processing continues. (If one or more conditions is not satisfied, the variable delay remains in effect.)

Timeout

For time sensitive processing, a time-out can be used to specify a time (0.1 to 600.0 s) to wait for the conditions to be satisfied (default: 60.0).

- **ON** (Default): Wait for conditions to be satisfied in the specified period of time. If the time-out time is reached continue to process the rest of the flowchart regardless of the state of the monitored terminals.
- **OFF:** No time-out function, continued processing of the flowchart will only occur when the conditions are satisfied.

 **Point** Depending on the processing load of the controller the timeout value may be longer than specified.

Update screen when waiting

Choose to update the screen display while the process is paused based on the status of this unit.

- **ON:** Update the display. (Results for units processed up to this point are updated on the display).
- **OFF** (default): The display is not updated and displays results from the previous processing of the flowchart.

Save

Save the current unit changes the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

 **Point**

- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

User Menu Unit

The user menu unit delays the flowchart operation until the specified menu is closed. This unit can be used to synchronize the processing of the flowchart with user interaction for such operations like re-writing setting values.



When the menu specified is opened, the result of flowchart processing so far is applied to the screen display. After that, the screen display is updated every time a value is changed in the menu.

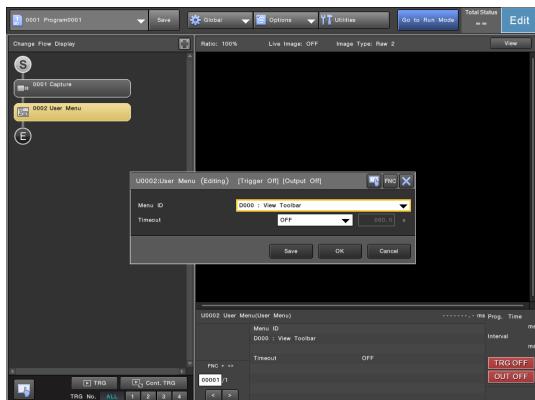
Main execution results

The standard results and data returned by the user menu unit are as follows:

Status	The status of the unit based on the time-out condition can be referenced, 1 being output when the time-out has occurred and the delay function cancelled, 0 at all other times.
---------------	---

User Menu

Specify conditions for the menu.



Menu ID

Select the ID of the menu to be referenced.



If a menu is selected that cannot be closed with the handheld controller, the menu needs to be closed with a command or via the time-out setting. For more details on the menu setting, refer to the XG-X VisionEditor Reference Manual.

Timeout

For time sensitive processing, a time-out can be used to specify a time (0.1 to 600.0 s) to wait for the conditions to be satisfied (default: 60.0).

- **ON:** Wait for conditions to be satisfied in the specified period of time. If the time-out time is reached, continue to process the rest of the flowchart regardless of the state of the monitored menu.
- **OFF** (Default): No time-out function, continued processing of the flowchart will only occur when the specified menu is closed.



Depending on the processing load of the controller the timeout value may be longer than specified.

Save

Save the current unit changes the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

Display

Display

Measurement Condition Setting

Image Acquisition

Vision Tools

Position Adjustment

Flowchart Functions

Operations

Timing

► **Display**

Output

Commands

Common Setting Items

On-Screen Graphics

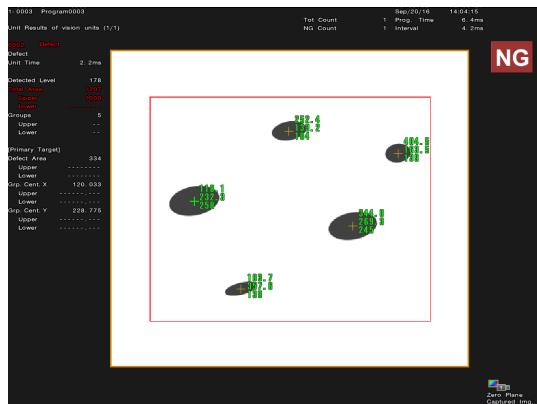
On-Screen Graphics Unit

The On-Screen Graphics unit allows up to 32 graphics / text to be displayed on screen based on the 8 different types of graphic and 4 types of text available.

As this unit supports the referencing of result data and or variables (including arrays) it can be used to display results of other units or numerical data contained in a variable or an array at a specified position on the screen.

Reference For details on the graphics display using an array variable, refer to "Using arrays to display multiple graphics" (Page 2-443).

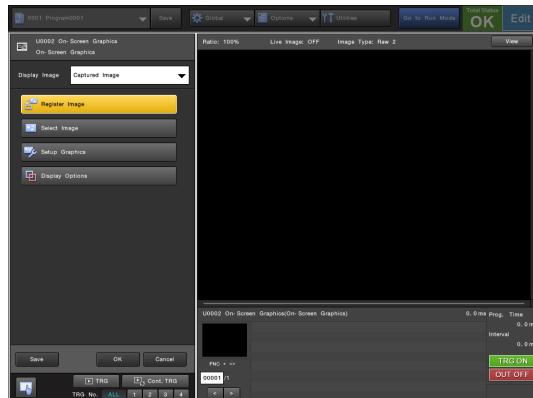
Sample display



Example of result data being displayed for several defects detected by the defect unit (Page 2-130) at various positions in accordance with the detected defect position using the [Value] style (Page 2-440).

Top Menu

The top menu of the On-Screen Graphics unit consists of the following options. Configure settings under each option as required for the inspection.



Register Image

Register an image to be used as a template for settings.
(Page 2-433)

Select Image

Specify the image to be used for unit processing.
(Page 2-433)

Setup Graphics

Define graphics and text to be displayed.
(Page 2-433)

Display Options

Specify the display methods for things such as the graphics and text.
(Page 2-434)

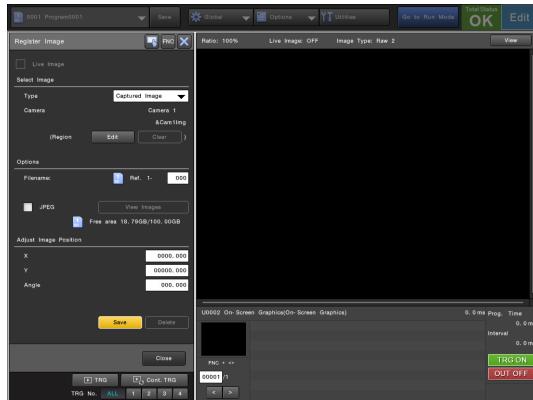
Save

Save the current state to the program setting file.
(Page 2-445)

Reference (The On-Screen Graphics unit displays [Captured Image] as the initial image.)

Register Image

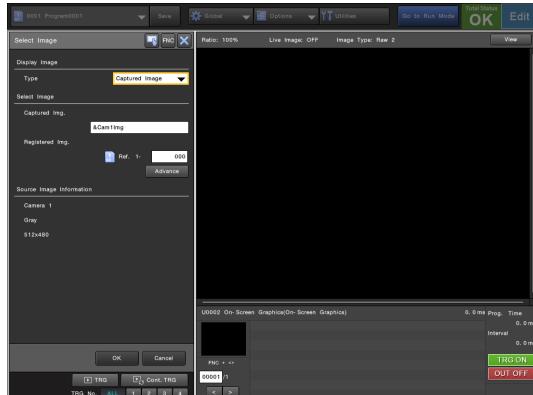
An image can be saved to the controller to be used as a reference for graphics display. It is recommended to adjust and fix lighting and other external influences before registering an image.



For more details, see "Register Image" (Page 2-468)

Select Image

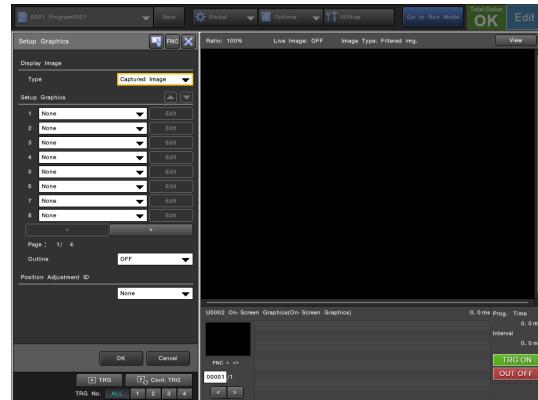
Specify the image variable and associated registered image to be used for graphic display.



For more details, see "Select Image" (Page 2-471).

Setup Graphics

Set the graphics and text to be displayed.



Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified under [Select Image].

Setup Graphics

Specify up to 32 graphics or text blocks to be displayed from the following.

- None:** No On-Screen Graphics.
- Rectangle:** Display a rectangle, select [Edit] to specify parameters such as position and size (Page 2-435).
- Rotated Rectangle:** Display a rotated rectangle select [Edit] to specify parameters such as position, size, and angle (Page 2-436).
- Circle:** Display a circle, select [Edit] to specify parameters such as position and size (Page 2-436).
- Oval:** Display an oval, select [Edit] to specify parameters such as position, size, and angle (Page 2-437).
- Ring:** Display a ring, select [Edit] to specify parameters such as position and size (Page 2-437).
- Arc:** Display an arc, select [Edit] to specify parameters such as position, size, and start/end angles (Page 2-438).
- Point:** Display a point / crosshair, select [Edit] to specify parameters such as display, size, and angle (Page 2-438).
- Line:** Display a line, select [Edit] to specify parameters such as position and tilt angle (Page 2-439).

On-Screen Graphics

- Text:** Display specified text, select [Edit] to specify parameters such as position and contents (Page 2-440).
- Value:** Display a numerical value, select [Edit] to specify parameters such as position and contents (Page 2-440).
- Active Text:** Display text from a predefined table based on matching conditions, select [Edit] to specify parameters such as position and contents (Page 2-441).
- Decimal to ASCII:** Display a character string converted from ASCII codes (decimal), select [Edit] to specify parameters such as position and contents (Page 2-442).

Reference You can change the line of the currently selected graphic or text one line upward or downward by holding down the No.1 (FUNCTION) button on the handheld controller and moving up or down.

Edit

Set the display parameters for the selected graphic or text. See "Individual Graphic Settings" (Page 2-435) for more details.

Point Due to display processing being performed in order beginning from the lowest number, the graphic / text on top is the graphic or text with the highest number.

Outline

Specify whether to show the outline of the area of the graphic. This option is useful for the alignment of graphics as the display range of a text or value is shown based on the maximum number of characters / digits.

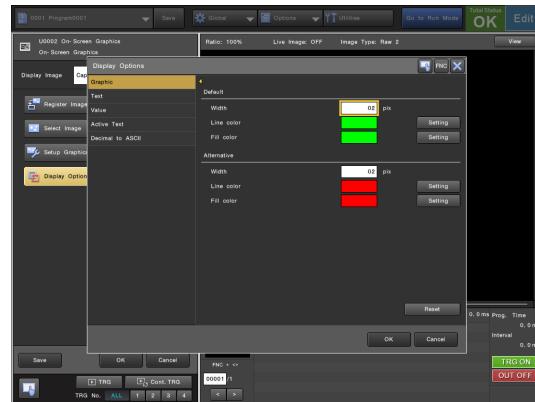
Point The outline is only shown when changing settings in the [Setup Graphics] menu.

Position Adjustment ID

To use position adjustment, specify the unit to be referenced.

Display Options

Specify the display methods for things such as the graphics and text.



Point

The enlarging / reducing (zooming) of the image affects the displaying of the graphics and text as follows:

- Text: The size remains fixed regardless of the level of magnification.
- Point: The size of the point can be associated to enlarge / reduce with the level of magnification or remain fixed.
- Other graphics: The size of the graphic is associated to enlarge / reduce with the level of magnification.

For more details on the zoom function, refer to the XG-X VisionEditor Reference Manual.

Graphic

Specify the line width, display, and fill color of the On-Screen Graphics.

Text

Specify the size, normal and alternative display color, and character edge color for the text displayed (Page 2-440).

Use these settings for other on-screen text graphics.

With this option checked, the settings for the text will also be applied to Value, Active Text, and Decimal to ASCII On-Screen Graphics (default: ON).

Value

Specify the size, normal and alternative display color, and character edge color for the value displayed (Page 2-440).

Active Text

Specify the size, normal and alternative display color, and character edge color for the text displayed (Page 2-441).

Point

Style settings made in the [Display Options] menu override the style settings (normal, alternative and outline color) in the active text display table.

Decimal to ASCII

Specify the size, normal and alternative display color, and character edge color for the text displayed (Page 2-442).

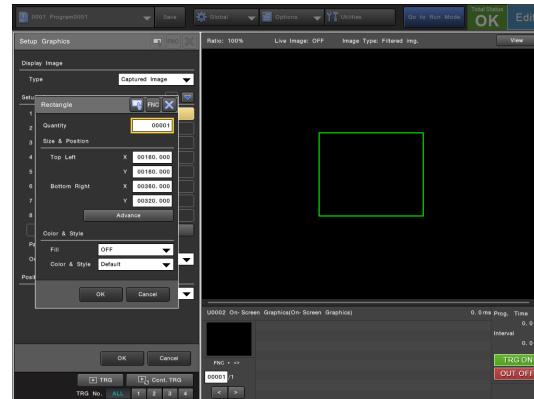
Individual Graphic Settings

To change the display settings of each graphic or text, select [Edit] on the [Setup Graphics] screen (Page 2-433). The setting menu that is displayed after [Edit] is selected varies depending on the type of graphic or text.

Reference [Advance] allows the setting of position offsets and rotation for each graphic or text individually (Page 2-443).

Rectangle

Rectangle display settings.



Quantity

Specify the number of rectangles to display at the same time (0 to 10000).

Top Left

Specify the X, Y position coordinates of the top left corner of the rectangle.

Bottom Right

Specify the X, Y position coordinates of the bottom right corner of the rectangle.

Fill

Choose whether to fill the inside of the rectangle and make it solid.

- **ON:** Fill the rectangle. The fill color can be specified in the [Display Options] menu (Page 2-434).
- **OFF** (default): Display outline only.

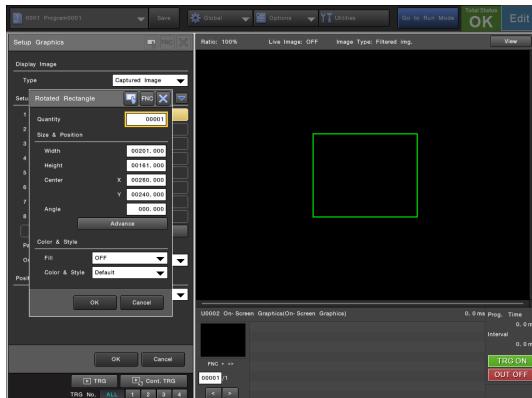
Color & style

Choose the display style specified in the [Display Options] menu (Page 2-434) from [Default] or [Alternative].

Reference If the unit is assigned to the system variable %JgAll, the display style will be switched according to the total judgment status: [Default] for OK (Pass) and [Alternative] for NG (Fail).

Rotated Rectangle

Rotated rectangle display settings.



Display

Quantity

Specify the number of rotated rectangles to display at the same time (0 to 10000).

Width

Set the width of the rotated rectangle.

Height

Set the height of the rotated rectangle.

Center

Specify the center X, Y position coordinates of the rotated rectangle.

Angle

Specify the rotation angle of the rotated rectangle.

Fill

Choose whether to fill the inside of the rotated rectangle and make it a solid.

- **ON:** Fill the rotated rectangle. The fill color can be specified in the [Display Options] menu (Page 2-434).
- **OFF** (default): Display outline only.

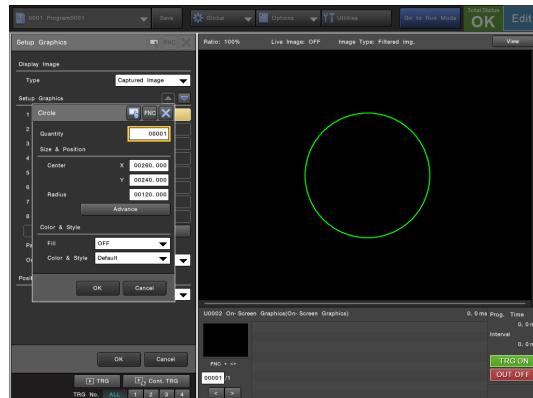
Color & style

Choose the display style specified in the [Display Options] menu (Page 2-434) from [Default] or [Alternative].

Reference If the unit is assigned to the system variable %JgAll, the display style will be switched according to the total judgment status: [Default] for OK (Pass) and [Alternative] for NG (Fail).

Circle

Circle display settings.



Quantity

Specify the number of circles to display at the same time (0 to 10000).

Center

Specify the center X, Y position coordinates of the circle.

Radius

Specify the radius of the circle.

Fill

Choose whether to fill the inside of the circle and make it a solid.

- **ON:** Fill the circle. The fill color can be specified in the [Display Options] menu (Page 2-434).
- **OFF** (default): Display outline only.

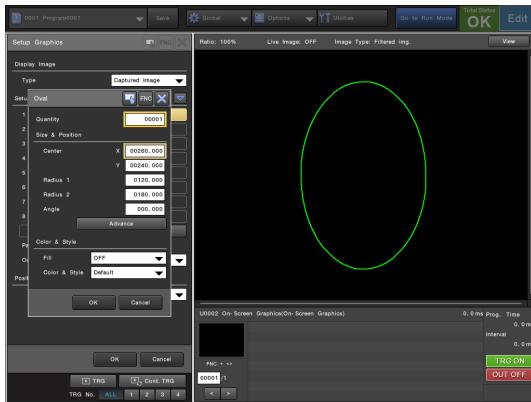
Color & style

Choose the display style specified in the [Display Options] menu (Page 2-434) from [Default] or [Alternative].

Reference If the unit is assigned to the system variable %JgAll, the display style will be switched according to the total judgment status: [Default] for OK (Pass) and [Alternative] for NG (Fail).

Oval

Oval display settings.



Quantity

Specify the number of ovals to display at the same time (0 to 10000).

Center

Specify the center X, Y position coordinates of the oval.

Radius 1

Specify either the major radius or minor radius of the oval.

Radius 2

Specify either the major radius or minor radius of the oval.

Angle

Specify the rotation angle of the oval.

Fill

Choose whether to fill the inside of the oval and make it a solid.

- **ON:** Fill the oval. The fill color can be specified in the [Display Options] menu (Page 2-434).
- **OFF** (default): Display outline only.

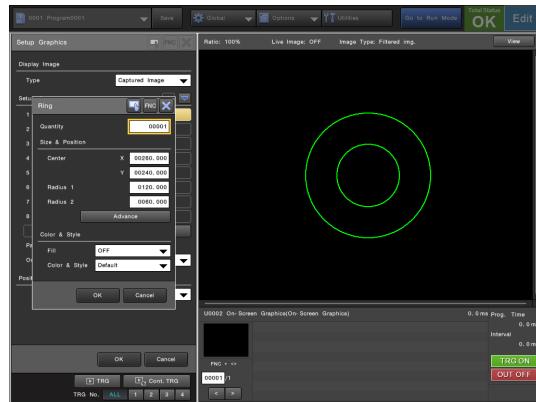
Color & style

Choose the display style specified in the [Display Options] menu (Page 2-434) from [Default] or [Alternative].

Reference If the unit is assigned to the system variable %JgAll, the display style will be switched according to the total judgment status: [Default] for OK (Pass) and [Alternative] for NG (Fail).

Ring

Ring display settings.



Quantity

Specify the number of rings to display at the same time (0 to 10000).

Center

Specify the center X, Y position coordinates of the ring.

Radius 1

Specify the radius of the outer ring.

Radius 2

Specify the radius of the inner ring.

Reference Radius 1 and Radius 2 are interchangeable and can be used for either the inner or outer ring.

Fill

Choose whether to fill the inside of the ring and make it a solid.

- **ON:** Fill the ring. The fill color can be specified in the [Display Options] menu (Page 2-434).
- **OFF** (default): Display outline only.

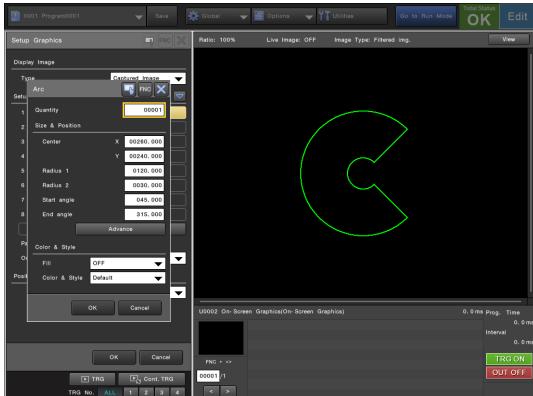
Color & style

Choose the display style specified in the [Display Options] menu (Page 2-434) from [Default] or [Alternative].

Reference If the unit is assigned to the system variable %JgAll, the display style will be switched according to the total judgment status: [Default] for OK (Pass) and [Alternative] for NG (Fail).

Arc

Arc display settings.



Quantity

Specify the number of arcs to display at the same time (0 to 10000).

Center

Specify the center X, Y position coordinates of the arc.

Radius 1

Specify the radius of the outer arc.

Radius 2

Specify the radius of the inner arc.

Radius 1 and Radius 2 are interchangeable and can be used for either the inner or outer arc.

Start angle

Specify the start angle of the arc.

End angle

Specify the end angle of the arc.

Fill

Choose whether to fill the inside of the arc and make it a solid.

- ON:** Fill the arc. The fill color can be specified in the [Display Options] menu (Page 2-434).
- OFF** (default): Display outline only.

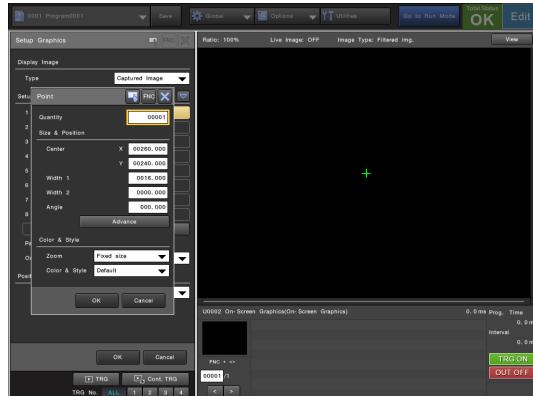
Color & style

Choose the display style specified in the [Display Options] menu (Page 2-434) from [Default] or [Alternative].

If the unit is assigned to the system variable %JgAll, the display style will be switched according to the total judgment status: [Default] for OK (Pass) and [Alternative] for NG (Fail).

Point

Point / Crosshair display settings.



Quantity

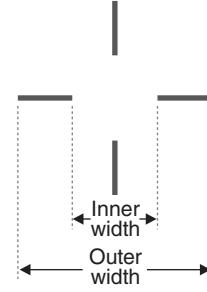
Specify the number of points to display at the same time (0 to 10000).

Center

Specify the center X, Y position coordinates of the point / crosshair.

Width 1

Specify the outer width of the point / crosshair.



Width 2

Specify the inner width of the point / crosshair.

Width 1 and Width 2 are interchangeable and can be used for either the inner or outer width.?

Angle

Specify the rotation angle of the point / crosshair.

Zoom

Choose whether to change the size of the point / crosshair to the image magnification.

- Resize:** Correlate with image magnification.
- Fixed size** (Default): Fixed size.

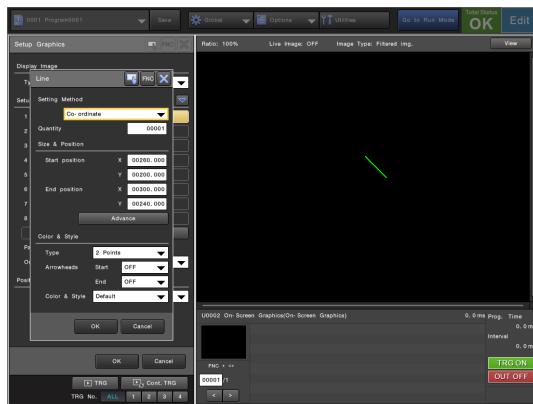
Color & style

Choose the display style specified in the [Display Options] menu (Page 2-434) from [Default] or [Alternative].

If the unit is assigned to the system variable %JgAll, the display style will be switched according to the total judgment status: [Default] for OK (Pass) and [Alternative] for NG (Fail).

Line

Line display settings.



Setting method

Choose the method for making a line.

- **Co-ordinate** (default): Specify the line from two X, Y coordinates.
- **Rotation about origin**: Specify the line using the distance and angle with respect to the origin.

Quantity

Specify the number of lines to display at the same time (0 to 10000).

Start position

Specify X, Y position coordinates for the start position of the line (when [Co-ordinate] is used for the [Setting Method]).

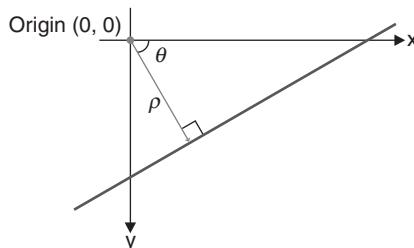
End position

Specify X, Y position coordinates for the end position of the line (when [Co-ordinate] is used for the [Setting Method]).

Origin Offset, Angle / Rotation

Specify the origin offset and rotation angle of the line (when [Rotation about origin] is used for the [Setting Method]).

- Reference**
- **Origin Offset**: The length of a perpendicular line connecting the line to the origin (0, 0)
 - **Angle / Rotation**: The clockwise angle of the perpendicular line between the origin and the line (origin offset parameter) (0 to 359.999°, 3 o'clock being 0°).



Type

Select the type of line (when [Co-ordinate] is used for the [Setting Method]).

- **2 Points** (Default): The line goes between the start and end position.
- **Continuous**: The line passes through the start and end position.

Arrowheads

Select ON to add an arrowhead to the start point, end point, or both (when [Co-ordinate] is used for the [Setting Method]).

Color & style

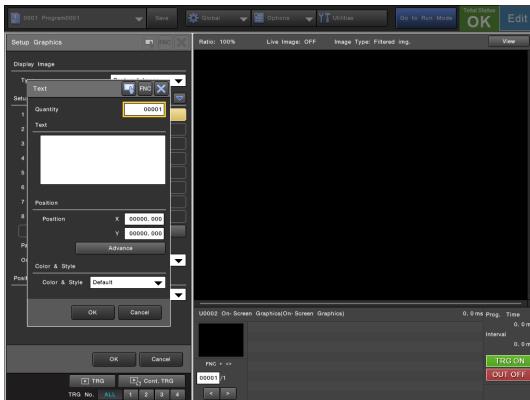
Choose the display style specified in the [Display Options] menu (Page 2-434) from [Default] or [Alternative].

Reference If the unit is assigned to the system variable %JgAll, the display style will be switched according to the total judgment status: [Default] for OK (Pass) and [Alternative] for NG (Fail).

Text

Text display settings.

Display



Quantity

Specify the number of text strings to display at the same time (0 to 10000).

Text

Input the characters (up to 100 single byte characters, 50 2-byte characters) to be displayed.



- Tab and line feed cannot be used.
- Spaces can be used and count as one character.

Position

Specify the X, Y position coordinates of the top left corner of the text display area.

Color & style

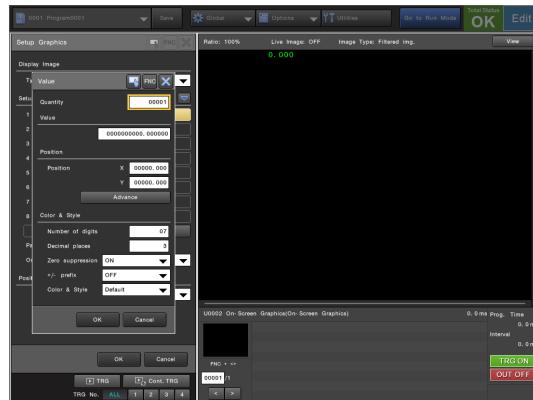
Choose the display style specified in the [Display Options] menu (Page 2-434) from [Default] or [Alternative].



If the unit is assigned to the system variable %JgAll, the display style will be switched according to the total judgment status: [Default] for OK (Pass) and [Alternative] for NG (Fail).

Value

Value display settings.



Quantity

Specify the number of values to display at the same time (0 to 10000).

Value

Specify the numerical value to display as a graphic.

Position

Specify the X, Y position coordinates of the top left corner of the value display area.

Number of digits

Specify the number of digits for the integer portion (10 digits max.).

Decimal places

Specify the number of decimal places (6 digits max.).



Due to other processes running, displaying all 16 digits (10 digits and 6 decimal places) may cause an error in the displayed value.

Zero suppression

Choose whether to remove preceding zeros from the number.

- **ON** (default): Remove the preceding zeros.

- **OFF**: Include preceding zeros.

Example, when the number of digits is set to 5 and the value is 500, "00500" will be displayed when zero suppression is [OFF], and "500" will be displayed when zero suppression is [ON].

+/- prefix

Choose whether to show a "+" symbol before a positive value.

- **ON**: Show the "+" symbol.
- **OFF** (default): Hide the "+" symbol.

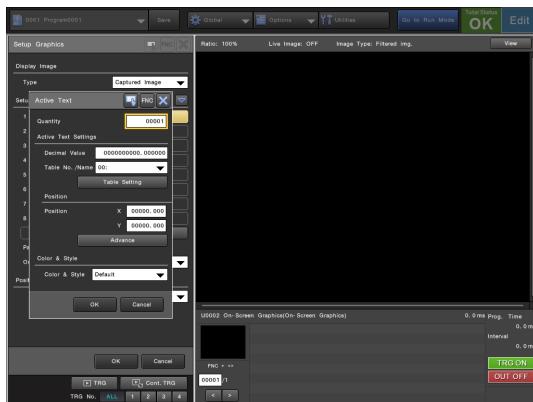
Color & style

Choose the display style specified in the [Display Options] menu (Page 2-434) from [Default] or [Alternative].

Reference If the unit is assigned to the system variable %JgAll, the display style will be switched according to the total judgment status: [Default] for OK (Pass) and [Alternative] for NG (Fail).

Active Text

Text display settings for text based on a lookup table.



Quantity

Specify the number of active text strings to display at the same time (0 to 10000).

Decimal Value

Specify a value to be referenced against the table settings.

Table No./name

Choose a table to be used from the user defined tables.

Table Setting

Show the [Table List] menu for editing a table which stores the different strings of text and associated displaying conditions. See "Creating the active text table" (Page 2-444) for more details.

Position

Specify the X, Y position coordinates of the top left corner of the text display area.

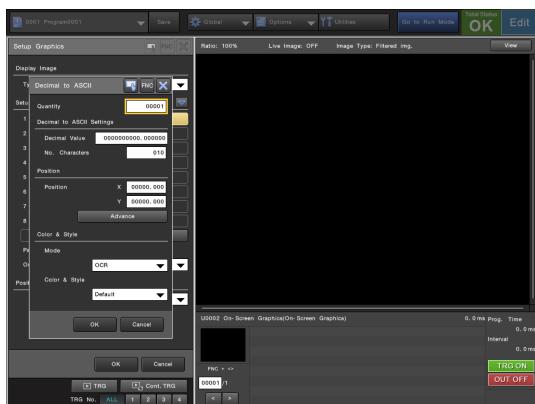
Color & style

Choose the display style specified in the [Display Options] menu (Page 2-434) from [Default] or [Alternative].

Reference If the unit is assigned to the system variable %JgAll, the display style will be switched according to the total judgment status: [Default] for OK (Pass) and [Alternative] for NG (Fail).

Decimal to ASCII

The ASCII code (decimal) value from the OCR unit (Page 2-255), OCR2 unit (Page 2-235), 2D Code Reader unit (Page 2-274), 1D Code Reader unit (Page 2-291), or other source is converted and displayed as text. Use this option to move the position to display the reading result of the OCR unit, OCR2 unit together with the inspection region.



Quantity

Specify the number of text strings to display at the same time (0 to 10000).

Decimal Value

Specify a decimal number or variable to be converted.



To display two or more characters, assign a scalar array variable containing the ASCII code (decimal) of each character.

No. characters

Specify the number of characters to be displayed in the text.

Position

Specify the X, Y position coordinates of the top left corner of the text display area.

Mode

Choose whether to convert decimal numbers to ASCII characters based on the OCR unit or OCR2 unit conversion which supports user-defined characters ((1) to (20)) or by using the conventional decimal to ASCII conversion.

- **OCR** (default): Use the conversion rules of the OCR unit or OCR2 unit.
- **ASCII**: Use the conventional ASCII code conversion rules.



- For details of the OCR unit or OCR2 unit conversion rules that are used when [OCR] is selected, see the XG-X2000 Series Communications Control Manual. When 32 is specified, "_" (underscore) is displayed rather than the standard " " (space).
- When set to [OCR], a 1-byte space is added in front of all numbers other than user-defined characters, and each 1-byte character is displayed in 2-byte fashion. When set to [ASCII], no space is inserted. Thus the displayed area is smaller when [ASCII] is selected even when the same text is displayed.
- When the data read by a 2D Code Reader or 1D Code Reader is stored in a scalar array variable, set to [ASCII] in order to display kanji, kana, and other 2-byte characters correctly.

Color & style

Choose the display style specified in the [Display Options] menu (Page 2-434) from [Default] or [Alternative].



If the unit is assigned to the system variable %JgAll, the display style will be switched according to the total judgment status: [Default] for OK (Pass) and [Alternative] for NG (Fail).

Using arrays to display multiple graphics

Multiple graphics can be displayed by using data from an array. This is useful when displaying multiple detection results or OCR text consisting of 2 characters or more as it is not necessary to make multiple individual settings.

1 In the [Quantity] field, set the number of graphics to display.

Reference

If the number of graphics fluctuates, assign a local or global variable which contains the quantity from a unit or calculation.

2 In the [Position] field, assign array result data or an array variable which contains the position coordinates to display the graphics.

Point

- When using an array the index should be empty (Example: #A[]). To make an index empty, select [Variable] or [Unit Results] in the [Reference Variable] menu (Page 4-9) and specify [*] for the index.
- If the [Quantity] specified is more than one, but no array result data or array variable has been set for the position, all graphics will be displayed at the same position.

3 If necessary, assign array result data or an array variable which contains any data to be referenced to [Eval. Value] or other fields in the same way as in step 2.

Point

- If an array is assigned, the number of displayed graphics will either be the number of elements of the assigned array or the number specified in [Quantity] whichever is the smaller.
- To display all results of a vision unit even if the detection count fluctuates, assign the result data of the detection count (number of targets detected) in the [Quantity] field.

Applying an offset or rotation to the display position

An offset or rotation can be applied to the specified display position. As the On-Screen Graphics supports the displaying of multiple graphics, so it is useful to apply the same level of offset to each.

Point

- The assignment of an array variable for the offset function is also supported. When using an array the index should be empty (Example: #A[]). To make an index empty, select [Variable] or [Unit Results] in the [Reference Variable] menu (Page 4-9) and specify [*] for the index.
- If an array is assigned the number of displayed graphics will either be the number of elements of the assigned array or the number specified in [Quantity] which is the smaller.

Offset

Specify the offset from the display position in pixels.

Rotation Center

Set the X, Y absolute position coordinates of the rotation center to apply [Rotation] to before the offset or any position adjustment is applied.

Rotation

Specify the rotation angle around the [Rotation Center].

Point

Text, Value, Active Text and Decimal to ASCII do not support rotated display and will remain horizontal regardless of the rotation setting.

Creating the active text table

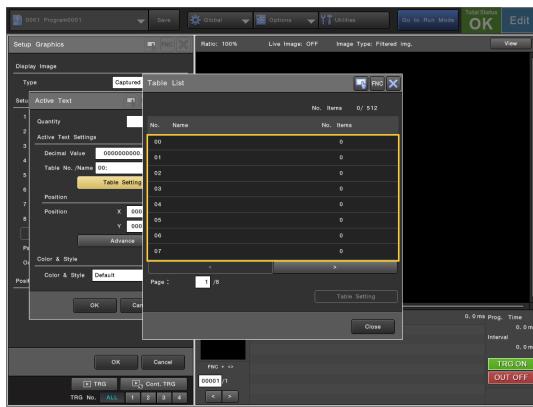
In the [Table List] menu, you can edit tables which store the different strings of text and associated displaying conditions.



- The active text table is the same active text table under display pattern parts (Page 4-31) used in creating custom screens.
- Settings in [Display Options] override the style settings (color inversion or outline) in the active text table.

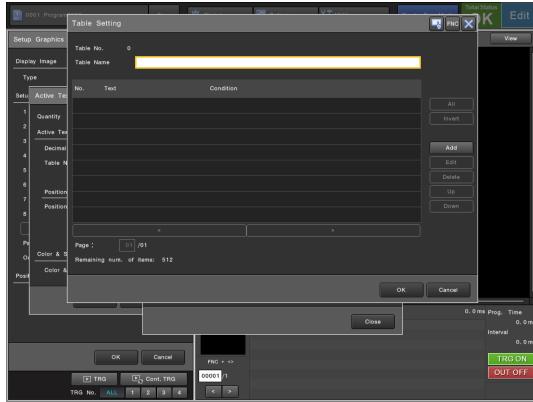
1 In the active text edit menu, select [Table Setting].

The [Table List] menu appears.



2 Select the line of the table No. to edit and then select [Table Setting].

The [Table Setting] menu of the selected table appears.



3 Select [Add].

The [Conditions] menu appears.

4 Edit the conditions for text display.

Text

Enter the text (up to 64 1-byte characters or 32 2-byte characters) that you want to display when the conditions are met.

Lower Value

Choose either [Enable] or [Disable] and then set the lower limit for the reference value to be greater than or equal to for the text to be displayed.

Upper Value

Choose either [Enable] or [Disable] and then set the upper limit for the reference value to be less than or equal to for the text to be displayed.



- When a value meets several conditions, such as "Display text "A" when the result is between lower limit 2 and upper limit 2 is set for condition 1" and "Display text "B" when the result is between lower limit 1 and upper limit 10 is set for condition 2" and the measurement value is "2", the smaller condition No. is used. In this example, "Display text "A" when the result is between lower limit 2 and upper limit 2" has higher priority therefore "A" is displayed. However, if the measurement value was not "2" but a value within the range 1 to 10, "B" would be displayed.

5 Select [OK].

The condition specified in step 4 is added.

6 Edit the table details as required.

- Table Name:** Enter a table name (up to 64 1-byte characters or 32 2-byte characters).
- All:** Select all conditions.
- Invert:** Invert the current selection.
- Edit:** Edit the selected condition.
- Delete:** Delete the selected condition.
- Up:** Move the selected condition up one line.
- Down:** Move the selected condition down one line.



You can change the order of conditions by selecting one condition, holding down the No. 1 (FUNCTION) button or No. 7 Back button and then moving up or down.



Two or more conditions cannot be moved simultaneously.

7 When editing is complete, select [OK].

The changes made to the [Table Setting] are reflected and the display returns to the [Table List] menu

8 To edit other tables, repeat steps 2 to 7.

9 When the editing of all tables is complete, select [Close].

Save

Save the current unit changes the program file.
The settings for all the units are saved in the current
program file in SD Card 1 or SD Card 2.



- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

Output

Output

Measurement Condition Setting

Image Acquisition

Vision Tools

Position Adjustment

Flowchart Functions

Operations

Timing

Display

► **Output**

Commands

Common Setting Items

Parallel Terminal Output Unit

Parameters and settings for outputting data on the parallel I/O connector and terminal block.

Point A parallel terminal output unit must be executed to synchronize the output of %JAHold with %Sto. In this case, the terminal output unit does not have to be set with output data if there is no other data to output to the parallel port.

Main execution results

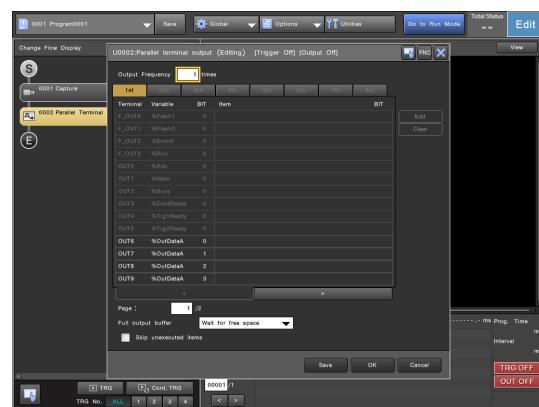
The standard results and data returned by the parallel terminal output unit are as follows:

Buffer Output Space	The remaining space (0 to 100%) of the output buffer after unit execution
Buffer Output Overflow	The overflow status of the output buffer can be referenced, 1 being output when the buffer is full during execution of the unit. The behavior of the unit when the buffer overflows is dependent on the unit settings.
Transfer Finished	The status of the transfer of data by the Parallel Terminal Output unit to the output buffer can be referenced, 1 being output when the transfer has been completed and 0 if the transfer fails.

Point If the remaining buffer decreases every time a flowchart unit is executed, the buffer may eventually overflow.

Parallel terminal output

Specify the settings for outputting data on the parallel and or terminal I/O. Terminal assignment and settings are linked to the [Terminal Block & Parallel Port] settings (Page 6-11). Complete the terminal block and parallel port settings first before configuring the output data settings.



Output Frequency

Specify the Output Frequency from Parallel terminal output (Max: 8 times).

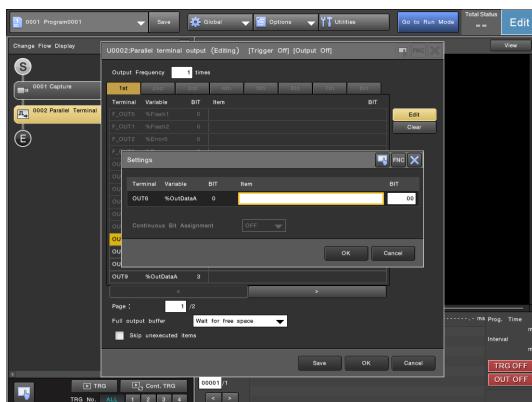
Output List

Displays a list (256 lines maximum) of the current output data setup in the unit.

Edit

Add/Edit an output item.

When the [Settings] screen is displayed, specify the output item.



- Terminal:** Indicates the Terminal name to be edited. For more details on the terminal names and assignment, see "Changing the Terminal Input / Output Settings (Terminal Block & Parallel Port)" (Page 6-11).
- Variable/BIT:** Indicates the output system variable assigned to the terminal and its bit position.
- Item:** Specify the result data, variable, or numerical value to output.
- BIT:** Specify the bit position of the data to be output.
- Continuous Bit Assignment:** the output subject data can be specified when values other than 0/1 are possessed. If they are enabled, even after specified terminals are set, the continuous bits that were specified are assigned based upon the information which is specified here.

Point

- In the [Item] field, set Specify Index (e.g.: #a[1]) (for array variables), or set Specify Member (e.g.: #b.X) (for types other than numerical types).
- A floating point value specified in the [Item] field will be converted into an integer.
- If the [Item] field is empty, 0 is processed.
- When executed with an invalid result data specified in the [Item] field, an execution error (setting range error) occurs, and the value of the output item is considered to be 0.
- When [Continuous Bit Assignment] is selected, the subsequent bit settings which have been set will be overwritten.

Full output buffer

Specify which should have priority when the output buffer becomes full: Image processing or data output.

- Skip output item:** Give priority to image processing and skip the current data waiting to be output.
- Wait for free space:** Give priority to the waiting data and resume image processing after data output is complete.

Reference The skipping of data can be checked with the [Transfer Finished]. If the result remains 0 after the output unit execution, data was skipped.

Skip unexecuted items

Skip outputting data for items referencing units which were not executed.

Save

Save the current unit changes the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

Point

- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

Data Output Unit

Parameters and settings for outputting data through the following means:

- **SD card**: Specify data to be saved to an SD card.
- **RS-232C**: Specify data to be output via RS-232C no-protocol communication.
- **Ethernet (TCP/IP)**: Specify data to be output via Ethernet no-protocol communication.
- **PLC link**: Specify data to be output via PLC link.
- **CC-Link**: Specify data to be output via CC-Link.
- **EtherNet/IP**: Specify data to be output via EtherNet/IP.
- **PROFINET**: Specify data to be output via PROFINET.
- **EtherCAT**: Specify data to be output via EtherCAT.
- **PC Program**: Specify data to be output to XG-X VisionTerminal software or for ActiveX control.
- **FTP**: Specify data to be output to the FTP server specified in [Target FTP Server Settings] (Page 4-23).
- **USB HDD**: Specify data to be output to the USB HDD connected to the controller.

Main execution results

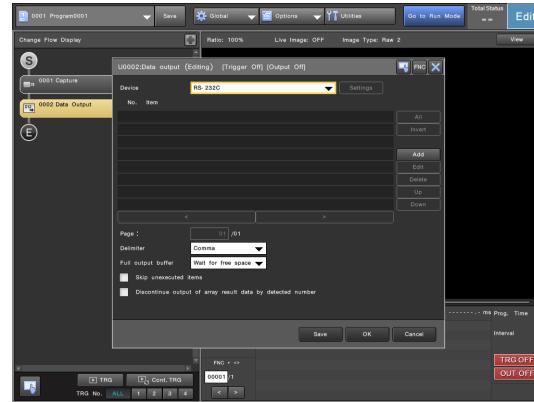
The standard results and data returned by the data output unit are as follows:

Buffer Output Space	The remaining space (0 to 100%) of the output buffer after unit execution
Buffer output overflow	Outputs 1 when the output buffer of the destination becomes full during execution of the data output unit. Behavior of the data output unit when the output buffer becomes full depends on the unit settings.
Transfer Finished	The status of the transfer of data by the Data Output unit to the output buffer can be referenced, 1 being output when the transfer has been completed and 0 if the transfer fails.

Point If the remaining buffer decreases every time a flowchart unit is executed, the buffer may eventually overflow.

Data output

Specify the settings for outputting data.



Point

- An execution error will occur if invalid result data is specified in the [Item] field, and the value of the output with the invalid result data is set to 0.
- When [PLC link], [CC-Link], [EtherNet/IP], [PROFINET] or [EtherCAT] is selected for [Device], and when [Ln String] or [Ln Reference String] is selected for the OCR unit (Page 2-255) or OCR2 unit (Page 2-235) results data, then changing the character count of the block mode setting in the Unit Properties menu may change the destination address of the text data and subsequent output items.
- If [Readout], [Split n Readout], or [Reference n] is selected for the 2D Code Reader or 1D Code Reader results data, then setting [Fixed Length] to [OFF] in the output settings on the Unit Properties menu may change the destination address of the text data and subsequent output items depending on the number of characters that were read.

Device

Specify the destination of the data output.

- **SD Card:** Outputs data to an SD card.
- **RS-232C:** Outputs data to RS-232C.
- **Ethernet (TCP/IP):** Outputs data to Ethernet.
- **PLC-Link:** Outputs data via PLC-Link.
- **CC-Link:** Outputs data via CC-Link.
- **EtherNet/IP:** Outputs data via EtherNet/IP.
- **PROFINET:** Outputs data via PROFINET.
- **EtherCAT:** Outputs data via EtherCAT.
- **PC Program:** Outputs the data to the XG-X VisionTerminal or for use with ActiveX Control.
- **FTP:** Outputs data to the FTP server specified in [Target FTP Server Settings] (Page 4-23).
- **USB HDD:** Outputs data to the USB HDD connected to the controller.

- Point**
- The available destination varies depending on [Communications & I/O] in the [Global] menu (Page 6-2).
 - To use the CC-Link, you need to attach the CA-NCL20E CC-Link module to the controller. For more details, see the XG-X2000 Series Communications Control Manual.
 - To use EtherCAT, you need to attach the CA-NEC20E EtherCAT unit to the controller. For more details, see the XG-X2000 Series Communications Control Manual.
 - To output the data of the data output unit to the FTP server, the FTP command [APPE] is used. Data cannot be output if the FTP server in use does not support the [APPE] command.

Reference

Some setting items in the [Data output] menu change depending on the specified destination.

Settings

Display the detailed settings menu for the selected data destination.

Output List

Displays a list (256 lines maximum) of the current output data setup in the unit.

Add

Add an item to be output.

When the [Output Item] menu is displayed, choose the type of data or variable to be output and then select the output item or variable.

Edit

Edit the settings of the selected output item.

When the [Edit] menu is displayed, choose the type of data or variable to be output and then select the output item or variable.

Item

Specify the data to be output such as a variable, unit result data, a string or special characters. To assign a variable or unit result data from an array, specify the index number of the item.

Format

Choose the format for data to be output.

- **Auto:** Output data using the format of the referenced result data.
- **Format 1 to 16:** Output data using the format setting defined in the [Data output format setting] dialog.
- **Character:** Output a fixed string.
- **Non ASCII:** Output special characters.
- **ASCII Code:** Output content is converted to 1-byte ASCII code values (0x01 to 0x7F) and output. You can use this to output STX, ETX, and other control codes.

Point

- If [PLC-Link], [CC-Link], [EtherNet/IP], [PROFINET] or [EtherCAT] is selected for [Device], the settings are limited as follows.
 - If characters, symbols, or ASCII code is selected as the format, the applicable line is grayed out and is not available for output.
 - If [Format 1 to 16] is selected as the format, data is output but not using the pre-determined format setting.
- If [Auto] is selected, variables are set to "use +/- prefix", "zero suppression: OFF", and "7 integer digits, 3 decimal places".

Reference

For a list of system variables, setting parameters, and result data, refer to the XG-X2000 Series Communications Control Manual.

Format Setting

Define the format of the data to be output.

When the Format Setting menu is displayed, combine the following setting items to define formats 1 to 16.

- **+/- prefix:** Use this option to add a + sign to a positive value when output.
- **Zero suppress.:** Use this option to suppress leading zeros.
- **No. digits:** Specify the number of digits (1 to 10) to use.
- **Decimal Places:** Specify the number of decimal places (0 to 6) to use.

Number

If array data is specified, specify the number of items to be output.

Point

- Scalar variable can be referred to only when output data are user-defined array variables (except when [Device] is [SD Card], [PC Program], [FTP], or [USB HDD]).
- When a scalar variable is referred to for number, previous output result may remain in the output destination due to the change of number (in case of [PLC-Link], [EtherNet/IP], [CC-Link], [PROFINET] or [EtherCAT]).

Preview (only available when the [Device] selection is not [PLC-Link], [CC-Link], [EtherNet/IP], [PROFINET] or [EtherCAT])

Check the data that will be output based on the quantity and format settings.

DM Address ([PLC-Link] only)

Displays the data memory address of the output device.

RWr Address ([CC-Link] only)

Displays the register address of the destination.

Address ([EtherNet/IP], [PROFINET] or [EtherCAT] only)

Displays the address of the output device.

Item Name ([SD Card], [PC Program], [FTP], or [USB HDD] only)

Add an identification header to the output data as desired (40 bytes maximum).

Auto ([SD Card], [PC Program], [FTP], or [USB HDD] only)

Use the definition in [Item] as the [Item Name].

Clear ([SD Card], [PC Program], [FTP], or [USB HDD] only)

Clear settings in [Item Name].

Delete

Delete the selected output item.

Select [OK] on the confirmation message.

Up/Down

Move the selected output item up/down to change the order of items being output.

Reference

You can change the order of the output data by holding down the No.1 (FUNCTION) button or No. 7 Back button and then moving up or down.

Point

Two or more output items can not be moved simultaneously.

Delimiter

Select the character to separate the output data and header from either a comma, tab, space, or none (no delimiter).

Point

- A delimiter is not used when [Character] or [Non ASCII] is selected for [Format] (Page 2-450).
- If it is necessary to use a delimiter for [Character] or [Non ASCII], specify a delimiter (TAB, CR, LF, or CR+LF) as a separate item in the output data

Full output buffer

Specify which should have priority when the output buffer becomes full: Image processing or data output.

- Skip output item:** Give priority to image processing and skip the current data waiting to be output.
- Wait for free space:** Give priority to the waiting data and resume image processing after data output is complete.

Skip unexecuted items

Skip outputting data for items referencing units which were not executed

Point

Skip unexecuted items is disabled when [PC Program] is chosen for [Device].

Discontinue output of array result data by detected number

The output of unnecessary data can be controlled by linking the number of output items to the number of detected items in situations where the number of items in array results data changes.

Check the [Discontinue output of array result data by detected number] option to cut off the array results data by the number of detected items (data output by the results (count) of !U[n].RSLT.N and !U[n].RSTN.STN is cut off).

Example: When the number of detected blobs is set to 100 and you only wish to output data in the amount detected

When [Discontinue output of array result data by detected number] is enabled, the output number for the data output unit is set to 100, and the number of detected items is 60, only 60 items worth of X coordinates are output (when disabled, 40 undetected items worth of X coordinates are output as 0.000).



- This function outputs data according to [Number] configured in the data output unit without being applied to the following results data.
 - Calibration unit: CALIB[]
 - 1D/2D Code Reader unit: ID_DATA[]
 - Profile Position unit: N[], XY[], X[], Y[], T[], P[], RW[], I[]
 - Profile Width unit: N[] W[], XY1[], X1[], Y1[], T1[], P1[], I1[], XY2[], X2[], Y2[], T2[], P2[], I2[]
 - Profile Defect unit: N[], XY[], X[], Y[], T[], DIFF[], BFXY[], BFX[], BFY[]
 - Multi-Profile Defect Unit: STG[], STL[], STW[], STX[], STY[], STXY[], STT[], STTX[], STTY[], STTXY[], STBX1[], STBY1[], STBXY1[], STBX2[], STBY2[], STBXY2[], STSN[], STTN[], STEN[], RGNO[], BFXY[], BFX[], BFY[]
- This function is only applied when the output destination is the following.
 - Ethernet
 - RS-232C
 - PLC-Link
 - EtherNet/IP
 - PROFINET
 - CC-Link
 - EtherCAT
- This function cannot be applied when the results data output destination is an SD card, PC application, FTP, or USB HDD.

Save

Save the current unit changes the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

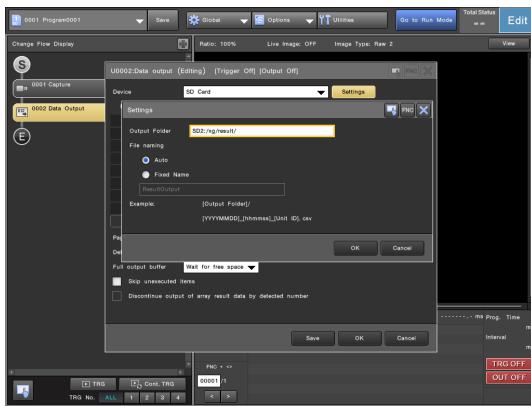


- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

Settings

SD Card

If [SD Card] is chosen for [Device] in the [Data output] menu (Page 2-449), additional settings can be set for controlling data output to the SD card.



Output Folder

Specify the folder path to save the data to.

[Reference] It is possible to change the destination folder via a command from an external device. For more details, see the explanation of OPW commands in the XG-X2000 Series Communications Control Manual.

File naming

Choose the file naming rule for the file saved.

- **Auto** (default): Name the file as "Data output day (YYMMDD)_Time (hhmmss)_Unit ID.csv".
- **Fixed Name**: Name the file with a user-specified file name. If this option is selected, the most recent data is added to the file every time data output is repeated. If [Fixed Name] is selected, input the filename (up to 64 single-byte characters).

Point Illegal filename characters (such as space or period) can not be specified at the beginning of the filename.

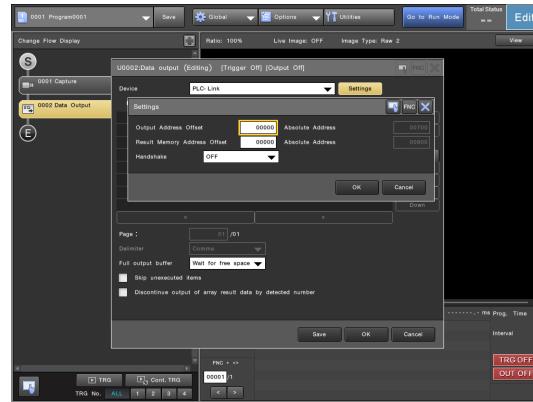
- [Reference]**
- If [Fixed Name] is selected, the file naming rule can be changed via a command. For more details, see the explanation of OW commands in the XG-X2000 Series Communications Control Manual.
 - When [Auto] is selected, the output file is created at the time of the first trigger input after:
 - The controller is tuned on.
 - The controller is reset.
 - The program No. is changed.
 - The destination folder is not available at the destination.

PLC-Link

If [PLC-Link] is chosen for [Device] in the [Data output] menu (Page 2-449), additional settings can be set for controlling data output to PLC-Link.

[Reference]

For more details on the PLC link, refer to "Changing the PLC-Link Settings (PLC-Link)" (Page 6-19) and "Control/Data Output via PLC-Link" in the XG-X2000 Series Communications Control Manual.



Output Address Offset

Specify the offset from "Data Memory Address" (Page 6-22) for the address to output the result data to. The address to which the result data is output is displayed in the [Absolute Address] field.

Point

If this address is the same as the output address of other data output units, the data will be overwritten.

Result Memory Address Offset

Specify the offset from "Data Memory Address" (Page 6-22) for the address to output the completion data to. The address to which the output completion data is output is displayed in the [Absolute Address] field.

Point

If this address is the same as the output address of other data output units, the data will be overwritten.

Handshake

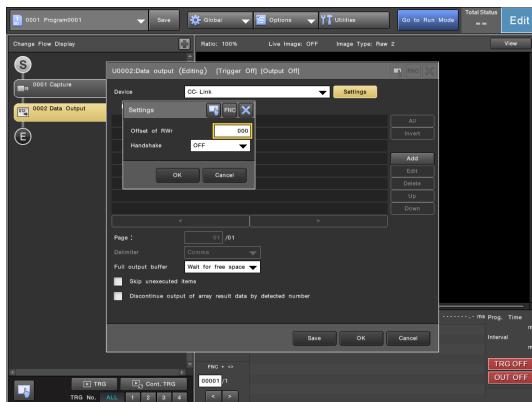
Choose whether to use handshaking between devices before outputting result data.

- **ON**: Output result data after the handshaking process has been confirmed.
- **OFF** (Default): Output result data without using the handshaking process.

Data Output Unit

CC-Link

If [CC-Link] is chosen for [Device] in the [Data output] menu (Page 2-449), additional settings can be set for controlling data output to CC-Link.



Offset of RWr

Specify the offset from RWr address (RWr000) to output the result data to.



If this address is the same as the address used by the other data output units or commands used, the operation may be affected. For details, see "Control/Data Output via CC-Link" in the XG-X2000 Series Communications Control Manual.

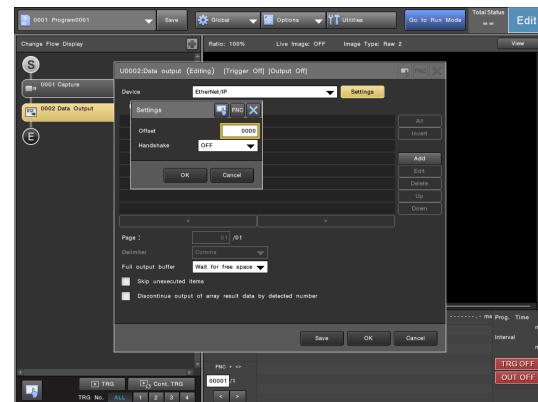
Handshake

Choose whether to use handshaking between devices before outputting result data.

- **ON:** Output result data after the handshaking process has been confirmed.
- **OFF** (Default): Output result data without using the handshaking process.

EtherNet/IP

If [EtherNet/IP] is chosen for [Device] in the Data Output menu (Page 2-449), additional settings can be set for controlling data output to EtherNet/IP.



Offset

Specify the offset value of the address to output the result data from the [Starting address of output data] (Page 6-30) set in the [Global] menu. The address which the results data is actually output to is the address where the [Offset] was added to [Starting address of output data].



If this address is the same as the output address of another data output unit, the data will be overwritten. For details, see "Control/Data Output via EtherNet/IP" in the XG-X2000 Series Communications Control Manual.

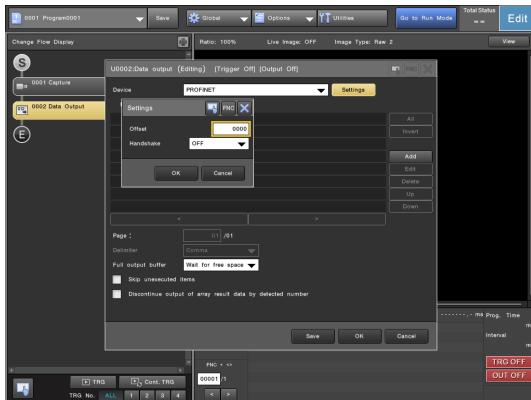
Handshake

Select whether to output result data after the output completion data is confirmed.

- **ON:** Output result data after the handshaking process has been confirmed.
- **OFF** (Default): Output result data without using the handshaking process.

PROFINET

If [PROFINET] is chosen for [Device] in the Data Output menu (Page 2-449), additional settings can be set for controlling data output to PROFINET.



Offset

Specify the offset value of the address to output the result data from the [Starting address of output data] (Page 6-33) set in the [Global] menu. The address which the results data is actually output to is the address where the [Offset] was added to [Starting address of output data].

Point If this address is the same as the output address of another data output unit, the data will be overwritten. For details, see "Control/Data Output via PROFINET" in the XG-X2000 Series Communications Control Manual.

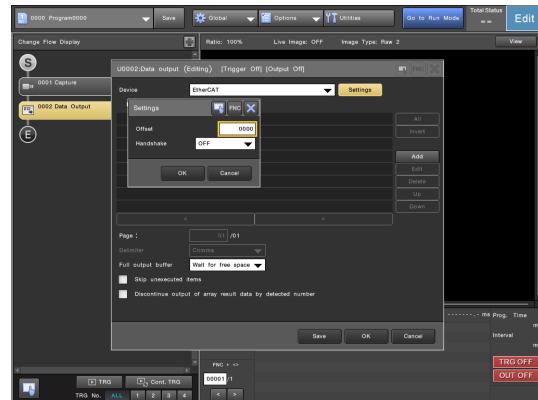
Handshake

Select whether to output result data after the output completion data is confirmed.

- **ON:** Output result data after the handshaking process has been confirmed.
- **OFF** (Default): Output result data without using the handshaking process.

EtherCAT

If [EtherCAT] is chosen for [Device] in the Data Output menu (Page 2-449), additional settings can be set for controlling data output to EtherCAT.



Offset

Specify the offset value of the address to output the result data from the [Starting address of output data] (Page 6-36) set in the [Global] menu. The address which the results data is actually output to is the address where the [Offset] was added to [Starting address of output data].

Point If this address is the same as the output address of another data output unit, the data will be overwritten. For details, see "Control/Data Output via EtherCAT" in the XG-X2000 Series Communications Control Manual.

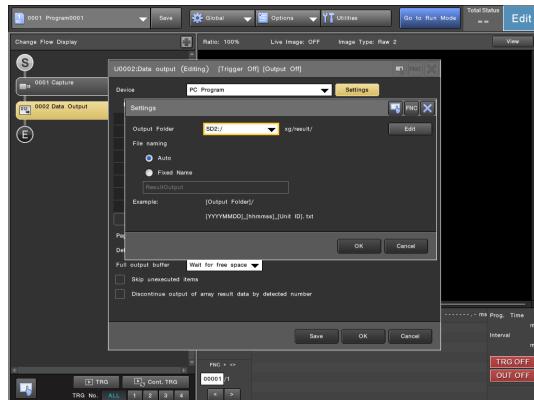
Handshake

Select whether to output result data after the output completion data is confirmed.

- **ON:** Output result data after the handshaking process has been confirmed.
- **OFF** (Default): Output result data without using the handshaking process.

PC Program

If [PC Program] is chosen for [Device] in the [Data output] menu (Page 2-449), additional settings can be set for controlling data output to the PC Program.



Output Folder

Specify the folder path to save the data to.

Reference It is possible to change the destination folder via a command from an external device. For more details, see the explanation of OPW commands in the XG-X2000 Series Communications Control Manual.

File naming

Choose the file naming rule for the file saved.

- Auto** (default): Name the file as "Data output day (YYMMDD)_Time (hhmmss)_Unit ID.txt".
- Fixed Name**: Name the file with a user-specified file name. If this option is selected, the most recent data is added to the file every time data output is repeated. If [Fixed Name] is selected, input the filename (up to 64 single-byte characters).



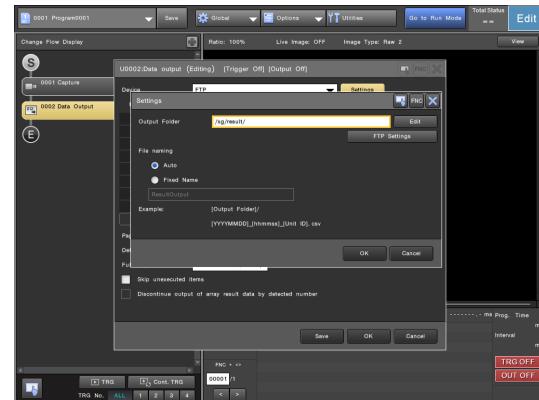
Illegal filename characters (such as space or period) cannot be specified at the beginning of the filename.



- If [Fixed Name] is selected, the file naming rule can be rewritten externally by running a reset after issuing the OW command. For more details, see the explanation of OW commands in the XG-X2000 Series Communications Control Manual.
- When [Auto] is selected, the output file is created at the time of the first trigger input after:
 - The controller is tuned on.
 - The controller is reset.
 - The program No. is changed.
 - The output file is not available at the destination.

FTP

If [FTP] is specified as the output destination in the [Data output] menu (Page 2-449), other conditions that can be specified for results output to FTP are specified as necessary.



- To output the data of the data output unit to the FTP server, the FTP command [APPE] is used. Data cannot be output if the FTP server in use does not support the [APPE] command.
- If there is a firewall on the FTP server or on the network route to the FTP server, connection may fail. You need to disable the firewall or find another way to connect to the FTP server. For details, check with your network administrator or computer manufacturer.

Output Folder

Input the folder path to save the data to.



The destination can be overwritten externally with a command. For details, refer to the description of the OPW command in the XG-X2000 Series Communications Control Manual.

FTP Settings

Specify the FTP server as the output destination for results output. See "Setting the Server Information for FTP Output (Target FTP Server Settings)" (Page 4-23) for more details.

File naming

Choose the file naming rule for the file saved.

- Auto** (default): Name the file as "Data output day (YYMMDD)_Time (hhmmss)_Unit ID.csv".
- Fixed Name**: Name the file with a user-specified file name. If this option is selected, the most recent data is added to the file every time data output is repeated. If [Fixed Name] is selected, input the filename (up to 64 single-byte characters).



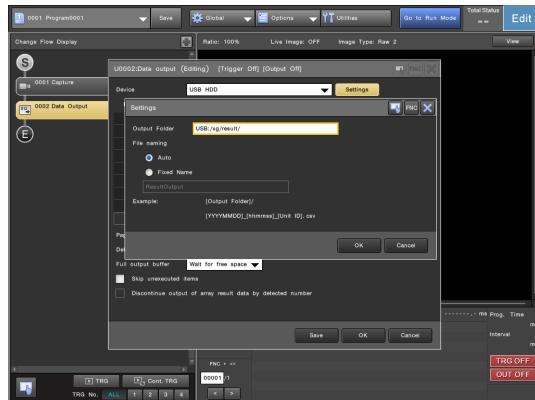
Prohibited filename characters (such as a space or period) cannot be specified at the beginning of the filename.

Reference

- If [Fixed Name] is selected, the file naming rule can be rewritten externally by running a reset after issuing the OW command. For details, refer to the description of the OW command in the XG-X2000 Series Communications Control Manual.
- When [Auto] is selected, the output file is created at the time of the first trigger input after:
 - Power on
 - Reset operation
 - Program No. switched
 - When output files do not exist in the destination

USB HDD

If [USB HDD] is chosen for [Device] in the [Data output] screen (Page 2-449), you can set the other conditions that can be specified for result output to the USB HDD connected to the controller as necessary.

**Output Folder**

Enter the folder path to save the data output to.

Reference

It is possible to change the output folder via a command from an external device. For details, refer to the description of the OPW command in the XG-X2000 Series Communications Control Manual.

File Naming

Choose the file naming rule for the file saved.

- **Auto** (default): Name the file as "Data output day (YYYYMMDD)_Time (hhmmss)_Unit ID.csv".
- **Fixed Name**: Name the file with a user-specified file name. If this option is selected, the most recent data is added to the file every time data output is repeated. If [Fixed Name] is selected, input the filename (up to 64 single-byte characters).

Point

Illegal filename characters (such as space or period) can not be specified at the beginning of the filename.

Reference

- If [Fixed Name] is selected, the file naming rule can be changed externally by performing a reset after issuing the OW command. For details, refer to the description of the OW command in the XG-X2000 Series Communications Control Manual.
- When [Auto] is selected, the output files are created with the initial trigger input after the following events:
 - Power on
 - Reset operation
 - Program No. switched
 - When output files do not exist in the destination

Image Output Unit

Parameters and settings for outputting images.

Main execution results

The standard results and data returned by the image output unit are as follows:

Buffer Output Space	The remaining space (0 to 100%) of the output buffer after unit execution
Buffer output overflow	Outputs 1 when the image output unit is executed while another image from the image output unit with the same unit ID is being output through the output port. Behavior of the image output unit outputting an image, depends on the unit settings.
Transfer Finished	The status of the transfer of data by the Image Output unit to the output destination can be referenced, 1 being output when the transfer has been completed and 0 if the transfer fails.



Since the image output unit always occupies the output buffer for each unit, this value is always 0%.

Image Output

Specify the settings for outputting images.

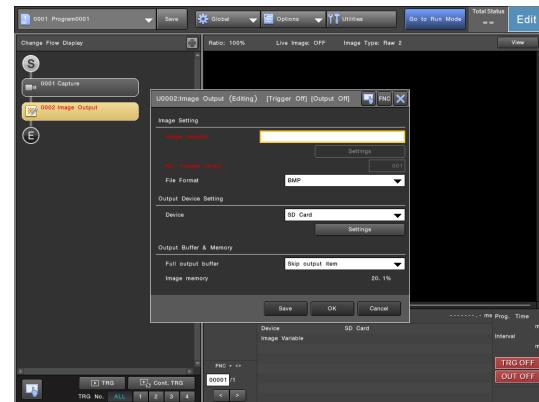


Image Setting

Image Variable

Specify the image variable to be output.

To specify an image from an array specify the index of the image.

No. Images (array)

If an image array is selected, specify the number of images to be output sequentially from the index number specified.



- If this number exceeds the number of elements of the array an error will occur.
- If the memory is insufficient, specifying a number exceeding the capacity will result in an error.

File format

Choose the file format of the image to be output.

- **BMP** (default): Output the image in Windows bitmap format (24-bit color for a color camera, 8-bit grayscale for a monochrome camera).
- **BMP (1/2 Resolution)**: Shrink the image to 50% (reducing the number of pixels in the vertical and horizontal directions to half), and then output the image in Windows bitmap format (24-bit color for a color camera, 8-bit grayscale for a monochrome camera).
- **BMP (1/4 Resolution)**: Shrink the image to 25% (reducing the number of pixels to one quarter), and then output the image in Windows bitmap format (24-bit color for a color camera, 8-bit grayscale for a monochrome camera).
- **BMP (1/8 Resolution)**: Shrink the image to 12.5% (reducing the number of pixels to one eighth), and then output the image in Windows bitmap format (24-bit color for a color camera, 8-bit grayscale for a monochrome camera).
- **JPEG**: Compress and output the image in JPEG format.

Output Device Setting

Device

Choose the destination of the image output.

- **SD Card** (default): Outputs image data to an SD card.
- **PC Program**: Outputs image data to the XG-X VisionTerminal or for use with ActiveX Control.
- **FTP**: Outputs image data to the FTP server specified in [Target FTP Server Settings] (Page 4-23).
- **USB HDD**: Outputs image data to the USB HDD connected to the controller.



- Output by no-protocol communication is not supported.
- To output the data of the image output unit to the FTP server, the FTP command [APPE] is used. Data cannot be output if the FTP server in use does not support the [APPE] command.
- If there is a firewall on the FTP server or on the network route to the FTP server, connection may fail. You need to disable the firewall or find another way to connect to the FTP server. For details, check with your network administrator or computer manufacturer.

Settings

Displays detailed settings in the [Settings] menu for configuring the image output destination. See "Settings" (Page 2-460) for more details.

Output Buffer & Memory

Full output buffer

Specify which should have priority when the output buffer becomes full: Image processing or image output.

- **Skip output item**: Give priority to image processing and skip the current image waiting to be output.
- **Wait for free space**: Give priority to image output and resume image processing after the image output is complete.

Image memory

The current image memory usage is displayed.

Save

Save the current unit changes the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



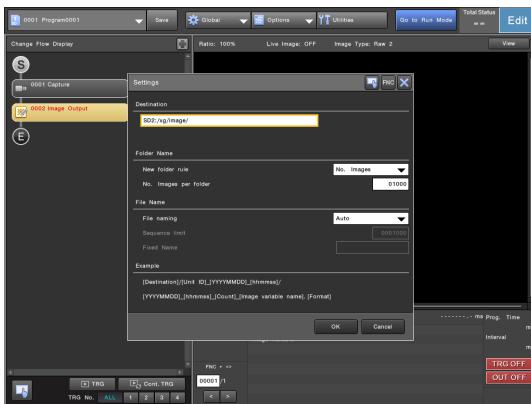
- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

Image Output Unit

Settings

SD Card

If [SD Card] is chosen for [Device] in the Image Output menu (Page 2-458), specify other available conditions for image output to the SD card as required.



Destination

Specify the folder path to save the image to.

Reference

It is possible to change the destination folder via a command from an external device. For more details, see the explanation of OPW commands in the XG-X2000 Series Communications Control Manual.

New folder rule

Specify the method and settings for creating folders to store images into.

- **None:** Save all images to the specified destination folder.
- **No. Images** (default): When image output starts, a new folder is created and named as "Unit ID_YYYYMMDD_hhmmss" in the folder specified in [Destination]. When the number of files stored in the folder exceeds the value specified in [No. Images per folder], a new folder is created and the destination of the image output changes accordingly.
- **Date:** When image output starts a new folder is created and named "Unit ID_YYYYMMDD" in the folder specified in [Destination]. Images are saved here until the date changes. When the date changes, a new folder is created and the destination of the image output changes accordingly.

Point

When [No. Images] is selected, the output folder is created at the time of the first trigger input after:

- The controller is tuned on.
- The controller is reset.
- The program No. is changed.
- The destination folder is not available at the destination.

File naming

Specify the file naming rules for images being output.

- **Auto** (default): Sets the filename as "Image output date (YYYYMMDD)_Time (hhmmss)_Measurement count_Image variable name.Format".
- **Sequential:** Sets the filename as "Sequential number_Fixed name_Image variable name.Format". Specify the maximum sequential number in the [Sequence limit] field and the name in [Fixed Name] (up to 64 single-byte characters) respectively. When the sequential number exceeds the maximum value, the number returns to 0. If [New folder rule] is set to [None] or [Date], or the value set for [No. Images per folder] is larger than the maximum sequential number, the old output data file may be overwritten.
- **Specified:** Names the file as "Fixed name.extension". A desired file name (up to 64 single-byte characters) can be entered into the [Fixed Name] field. Note that the file will always overwrite the old existing file during output as they have the same file name.

Point

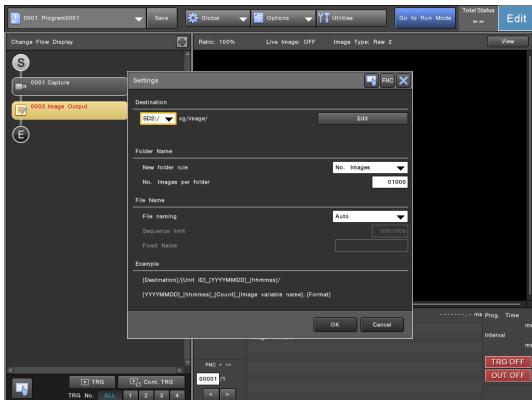
- If [Auto] is selected and the image output is repeated within 1 s, the output file is overwritten.
- If the [Sequence limit] is smaller than the value set for [No. Images] of [New folder rule], a new folder will not be created regardless of the [New folder rule] setting.

Reference

If [Sequential] or [Specified] is selected, the fixed name for the file naming rule can be changed via a command. For more details, see the explanation of OW commands in the XG-X2000 Series Communications Control Manual.

PC Program

If [PC Program] is chosen for [Device] in the [Image output] menu (Page 2-458), specify other available conditions for image output to the PC Program as required.



Point Settings in the Settings menu are applied to the virtual SD drive, controlled by the PC programs XG-X VisionTerminal and ActiveX Control.

Destination

Specify the folder path to save the image to.

Reference It is possible to change the destination folder via a command from an external device. For more details, see the explanation of OPW commands in the XG-X2000 Series Communications Control Manual.

New folder rule

Specify the method and settings for creating folders to store images into.

- **None:** Save all images to the specified destination folder.
- **No. Images** (default): When image output starts, a new folder is created and named as "Unit ID_Date (YYYYMMDD)_Time (hhmmss)" in the folder specified in [Destination]. When the number of files stored in the folder exceeds the value specified in [No. Images per folder], a new folder is created and the destination of the image output changes accordingly.
- **Date:** When image output starts a new folder is created and named "Unit ID_Date (YYYYMMDD)" in the folder specified in [Destination]. Images are saved here until the date changes. When the date changes, a new folder is created and the destination of the image output changes accordingly.

Point When [No. Images] is selected, the output folder is created at the time of the first trigger input after:

- The controller is tuned on.
- The controller is reset.
- The program No. is changed.
- The destination folder is not available at the destination.

File naming

Specify the file naming rules for images being output.

- **Auto** (default): Sets the filename as "Image output date (YYYYMMDD)_Time (hhmmss)_Measurement count_Image variable name.Format".
- **Sequential:** Sets the filename as "Sequential number_Fixed name_Image variable name.Format". Specify the maximum sequential number in the [Sequence limit] field and the name in [Fixed Name] (up to 64 single-byte characters) respectively. When the sequential number exceeds the maximum value, the number returns to 0. If [New folder rule] is set to [None] or [Date], or the value set for [No. Images per folder] is larger than the maximum sequential number, the old output data file may be overwritten.
- **Specified:** Names the file as "Fixed name.extension". A desired file name (up to 64 single-byte characters) can be entered into the [Fixed Name] field. Note that the file will always overwrite the old existing file during output as they have the same file name.

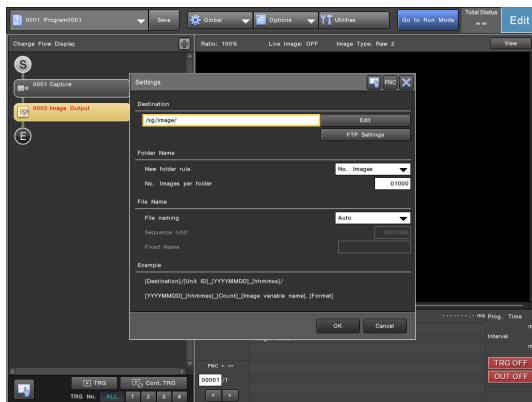
- Point**
- If [Auto] is selected and the image output is repeated within 1 s, the output file is overwritten.
 - If the [Sequence limit] is smaller than the value set for [No. Images] of [New folder rule], a new folder will not be created regardless of the [New folder rule] setting.

Reference If [Sequential] or [specified] is selected, the fixed name for the file naming rule can be changed via a command. For more details, see the explanation of OW commands in the XG-X2000 Series Communications Control Manual.

Image Output Unit

FTP

If [FTP] is chosen for [Device] in the [Image Output] menu (Page 2-458), as necessary, specify other parameters that can be specified for image output to the connected FTP server.



Destination

Enter the folder to save the image output.

Reference

The destination can be changed externally with a command. For details, refer to the description of the OPW command in the XG-X2000 Series Communications Control Manual.

Point

For outputting images to the FTP server of the image output unit, the FTP command [APPE] is used. Data cannot be output if the FTP server in use does not support the [APPE] command.

New folder rule

Specify the method to divide folders for image output.

- **None:** Do not divide folders and save all output data to the specified destination folder.
- **No. Images** (default): Every time output starts, a new folder named "Unit ID_YYYYMMDD_hhmmss" is created in the folder specified as the destination folder and the actual output data files are saved in this folder. When the number of files stored in the folder exceeds the specified value in [No. Images per folder], the next new folder is created and the destination of the output data file is changed accordingly.
- **Date:** Every time output starts, a new folder named "Unit ID_YYYYMMDD" is created in the folder specified as the destination folder and the actual output data files are saved in this folder. When the date changes, a new folder is created and this becomes the new destination for the output data files.

Point

When [No. Images] is selected, the output folder are created with the initial trigger input after the following events.

- Power on
- Reset operation
- Prog. No. switched

File naming

Select the file naming rule for the files saved during image output.

- **Auto** (default): Names the file as "Image output date (YYYYMMDD)_Time (hhmmss)_Measurement count_Image variable name.Format".
- **Sequential**: Names the file as "Sequential number_Fixed name_Image variable name.Format". Specify the maximum sequential number in the [Sequence limit] field and the characters used for the fixed name (up to 64 single-byte characters) in the [Fixed Name] field respectively. When the sequential number exceeds the maximum value, the number returns to 0. Consequently, if [New folder rule] is set to [None] or [Date], or if the value set for [No. Images per folder] is larger than the maximum sequential number, the old output data file may be overwritten.
- **Specified**: Names the file as "Fixed name.extension". A desired file name (up to 64 single-byte characters) can be entered into the [Fixed Name] field. Note that the file will always overwrite the old existing file during output as they have the same file name.

Point

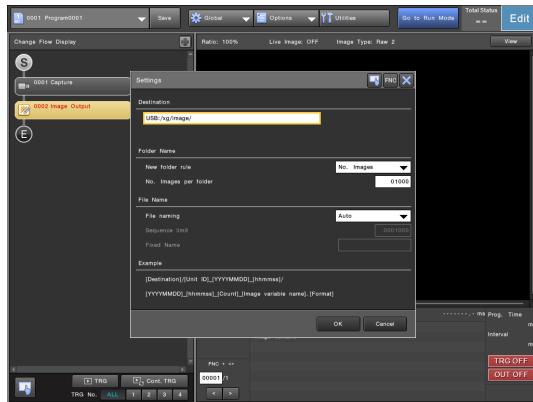
- When [Auto] is selected and the output is repeated within 1 s, the output file is overwritten.
- If [Sequence limit] is smaller than the value set for [No. Images] of [New folder rule], the folder will not be divided regardless of the [New folder rule] setting.

Reference

When [Sequential] or [Specified] is selected, the fixed name for the file naming rule can be overwritten externally with a command. For details, refer to the description of the OW command in the XG-X2000 Series Communications Control Manual.

USB HDD

If [USB HDD] is chosen for [Device] in the [Image output] screen (Page 2-458), you can set the other conditions that can be specified for image output to the USB HDD connected to the controller as necessary.



Destination

Enter the folder to save the image output to.

Reference It is possible to change the output folder via a command from an external device. For details, refer to the description of the OPW command in the XG-X2000 Series Communications Control Manual.

New folder rule

Specify the method to divide folders for image output.

- **None:** Do not divide folders and save all output data to the specified destination folder.
- **No. Images** (default): Every time output starts, a new folder named "Unit ID_YYYYMMDD_hhmmss" is created in the folder specified as the destination folder and the actual output data files are saved in this folder. When the number of files stored in the folder exceeds the specified value in [No. images per folder], the next new folder is created and the destination of the output data file is changed accordingly.
- **Date:** Every time output starts, a new folder named "Unit ID_YYYYMMDD" is created in the folder specified as the destination folder and the actual output data files are saved in this folder. When the date changes, the next new folder is created and this becomes the new destination for the output data files.

Point When [No. Images] is selected, the output folder are created with the initial trigger input after the following events:

- Power on
- Reset operation
- Program No. switched

File naming

Select the file naming rule for the files saved during image output.

- **Auto** (default): Names the file as "Image output date (YYYYMMDD)_Time (hhmmss)_Measurement count_Image variable name.Format".
- **Sequential:** Names the file as "Sequential number_Fixed name_Image variable name.Format". Specify the maximum sequential number in the [Sequence limit] field and the characters used for the fixed name (up to 64 single-byte characters) in the [Fixed Name] field respectively. When the sequential number exceeds the maximum value, the number returns to 0. Consequently, if [New folder rule] is set to [None] or [Date], or if the value set for [No. Images per folder] is larger than the maximum sequential number, the old output data file may be overwritten.
- **Specified:** Names the file as "Fixed name.extension". A desired file name (up to 64 single-byte characters) can be entered into the [Fixed Name] field. Note that the file will always overwrite the old existing file during output as they have the same file name.

Point

- When [Auto] is selected and the output is repeated within 1s, the output file is overwritten.
- If [Sequence limit] is smaller than the value set for [No. Images] of [New folder rule], the folder will not be divided regardless of the [New folder rule] setting.

Reference When [Sequential] or [Specified] is selected, the fixed name for the file naming rule can be overwritten externally with a command. For details, refer to the description of the OW command in the XG-X2000 Series Communications Control Manual.

Commands

Measurement Condition Setting

Image Acquisition

Vision Tools

Position Adjustment

Flowchart Functions

Operations

Timing

Display

Output

► Commands

Common Setting Items

Command Execution Unit

The command execution unit is used to issue commands from the flowchart to cause a controller based operation.

Main execution results

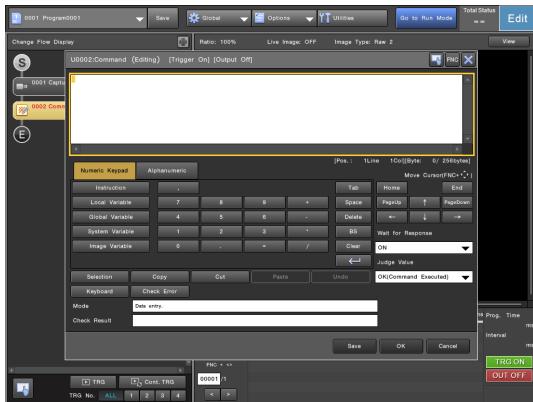
The standard results and data returned by the command execution unit are as follows:

Command Result:	If an error occurs during processing a command, 1 is generated, all other times 0 is generated.
------------------------	---

Point The output is only available when [ON] is set for [Wait for Response] and [Judge Value] is set to [Command Response]. When other settings are used, the output is always 0.

Command

Specify the command and condition for the response.



Command

Select a command.

- A standard instruction or a user-defined custom instruction can be used. For more details, see the XG-X2000 Series Communications Control Manual.
- Numerical values or variables can be specified as arguments for instructions.
- To use two or more standard instructions, separate them with a line feed.
- In a single command execution unit, up to 16 standard instructions or one custom instruction can be issued.
- The overall command can be a maximum of 256 characters. A line feed is counted as 2 characters.

Reference

- For details about the commands which can be used with the Command Execution unit, see the XG-X2000 Series Communications Control Manual.
- For details on custom instructions, see "List of Custom Instructions" (Page 6-42).

Instruction

Select this option to enter a standard or custom instruction. When the [Select Instruction] menu is displayed, select the type of instruction required. For details about the parameters that are associated with these commands, refer to the XG-X2000 Series Communications Control Manual.

Local Variable

Select this option to use a local variable in the command. When the [Select Local Variable] menu is displayed, select the local variable to be used.

Global Variable

Select this option to use a global variable in the command. When the [Select Global Variable] menu is displayed, select the global variable to be used.

System Variable

Select this option to use a system variable in the command. When the [Select System Variable] menu is displayed, select the system variable to be used.

Image Variable

Select this option to use an image variable in the command. When the [Select Image Variable] menu is displayed, select the image variable to be used.

Selection

Highlight characters to be edited by selecting the first and last characters.

Command Execution Unit

Copy

Copy selected characters.

Cut

Cut selected characters.

Paste

Paste selected characters.

Undo

Undo the last operation.

Keyboard

[Hiragana], [Katakana], [Alphanumeric Characters], and [Kanji] can be entered.

Check Error

Check and locate any errors. If several errors are found, the cursor moves to the first character of the error closest to the start of the command.

Wait for Response

Specify whether to wait or not for the completed processing of the command unit before moving on and processing the next unit in the flowchart.

- **ON** (Default): Wait for a completed response from commands in the unit before continuing to process the flowchart. Use [ON] for conditional based processing and branching of the operation.
- **OFF**: Continue to process units in the flowchart without waiting for a response from the command being processed.

 When [ON] is selected, the variation in command execution time may affect the measurement time.

Judge Value

When [ON] is set for [Wait for Response] set the judgment value to be output from the command execution unit.

- **OK (Command Executed)** (default): Sets the judgment value of the command execution unit to be [OK] regardless of the actual result of the instruction processed.
- **Command Response**: Sets the judgment value of the command execution unit according to the actual results of the instructions processed. Use [Command Response] for conditional processing and branching of the flowchart.



If two or more instructions are set in the command execution unit, they are executed in the order in which they are specified. If a command execution error occurs midstream, subsequent instructions are cancelled and the process moves to the next unit. If the result of the command execution affects subsequent image processing, it is recommended to set [Wait for Response] to [ON] and [Judge Value] to [Command Response].

Save

Save the current unit changes the program file. The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved in XG-X VisionEditor are excluded from the saving operation. For example, variable values changed in the current program or the default display, and display parts, can be excluded when saving.

Common Setting Items

Measurement Condition Setting

Image Acquisition

Vision Tools

Position Adjustment

Flowchart Functions

Operations

Timing

Display

Output

Commands

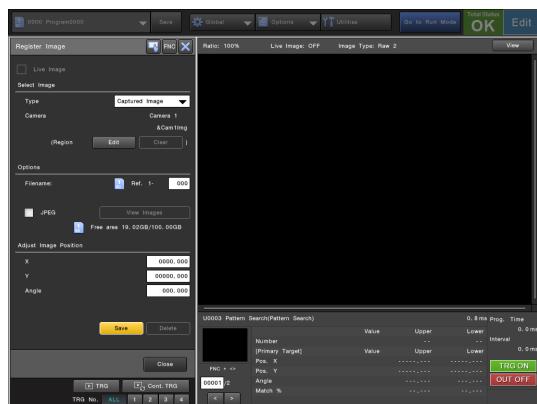
► **Common Setting Items**

Register Image

An image can be saved to the controller to be used as a template for measurements and settings. The environment should be optimized and stable before registering an image to reduce problems when used as part of an inspection.

Some features in the Register Image Menu and the sub menu [Register Image] of the Edit Unit Menu work and behave differently. Refer to "Difference Between Sub Menus of the Edit Unit Menu and Other Built-in Menus" (Page 2-15) for further details.

Example: [Register Image] Screen in Pattern Search Measurement



Live Image

Check this box to display live images through a continuous feed.



- A live feed is only available while the unit is being edited.
- If the capture on trigger input is disabled in the trigger settings (Page 2-30), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when registering as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is set to custom and the capture unit which was most recently executed is being edited, the images collected in the buffer will still be displayed even if the capture unit is not presently capturing images.
- Live Image is not available in the case of LumiTrax Mode (Page 7-8), LumiTrax Specular Reflection Mode (Page 7-29), MultiSpectrum Mode (Page 7-59), or when HDR capture is enabled, or when a line scan camera is used.

Select Image

Type

Select an image to register.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** The registered image specified in [Options] is displayed.

Camera

Select the number of the camera used for registration. Choose from Camera1 - Camera4, and select only the camera number used for the capture unit being edited.

Region

To register only part of an image, select [Edit] then specify the region to register. To cancel the selected region, select [Clear].

Options

Filename

Specify the registered image number used for image registration in the form "(Camera No.)-(User-specified No.)".

Reference

The name of the saved file is "ref (Camera No.)_(Specified No.)" (for full screen image registration) or "ref (Camera No.)(Specified No.)_XXX_YYY" (for partial image registration).

JPEG

Check this box to save the image in JPEG format. When this box is not checked, the image will be saved in BMP format as either a 24-bit color bitmap image (when a color camera is used) or an 8-bit grayscale bitmap image (when a monochrome camera is used).

Point

Using image compression may result in some image deterioration, thus results from a compressed image may differ to those when using non compressed images.

View Images

View all registered images in a list.

Adjust Image Position

Adjust the position of the image being captured.

X

-Adjust the movement in the X (horizontal) direction between -8191.000 and 8191.000 pixels.

Y

-Adjust the movement in the Y (vertical) direction between -16383.000 and 16383.000 pixels.

Angle

Adjust the position angle (rotation) around the center of the image between -999.999° and 999.999°.

Reference

When [Captured Image] is selected as the [Type] and a [Position Adjustment ID] is selected in [Region] (Page 2-46), [Pos. Adjust. value] can be selected in addition to [Number Input]. This option is useful because even when the image capture position deviates, the current image is automatically adjusted using the adjustment value based on the reposition unit. However, note that when [Pos. Adjust. value] is selected in the state where a correct adjustment value cannot be measured for the current image, the position used for registration may be incorrect.

Point

Position adjustment may cause missing peripheries (black areas) due to image movement or jagged edges (jaggies) due to rotation in the registered image.

Save

Save the displayed image as a registered image under the conditions specified in the [Register Image] menu.

Delete

When [Registered Image] is selected for [Type], you can delete the registered image specified in [Options].

Registering Images

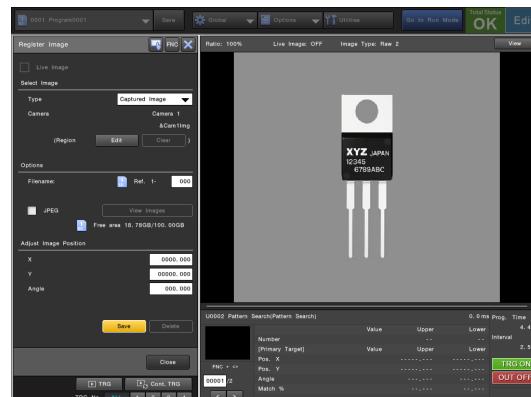
1 Select the image display and camera to be used as a reference.

2 Choose the image type in [Select Image].

- **Captured Image:** Displays the latest captured image from the specified camera (image variable).
- **Registered Image:** Displays the registered image currently registered.
- **Archived Image:** Displays an image from the image archive for the specified camera (image variable). This is only used in the Registered Image Menu when activated. Toggle through the image archive by using the No.1 (FUNCTION) or No.7 (BACK) button and left or right.

Point

Current and archive images will be adjusted if the [Position Adjustment] option is enabled for the Register Image menu and the unit selected uses position adjustment. For more information on the [Position Adjustment] setting of the Register Image Menu, refer to the XG-X VisionEditor Reference Manual.



3 Press the No. 3 (TRIGGER) button on the handheld controller.

The image captured by the specified camera (image variable) will be displayed.

4 Specify the image number filename to save to in [Options].

Reference

Select [View All] to view current registered images.

5 If necessary put a check mark next to [JPEG].

The registered image will be compressed using the JPEG format when saved to memory.

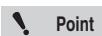
Point

Using image compression may result in some image deterioration, thus results from a compressed image may differ to those when using non compressed images.

Register Image

6 If necessary adjust the position of the image to be registered.

- **X:** Adjusts image in the X (horizontal) direction.
- **Y:** Adjusts image in the Y (vertical) direction.
- **Angle:** Adjusts the angle (rotation) of the image.



- Point**
- Re-adjusting images that have already been adjusted may result in the loss of image data and blank areas around the perimeter.
 - If position adjustment has been disabled or refers to the adjustment used by units the X, Y and Angle cannot be changed.

7 Select [Save] to register the image.

The displayed image is saved and registered to the controller.

Registering multiple images

Up to 1000 images can be registered for a single program in the controller. However the actual number available may be less depending on the available memory.

To register multiple images, specify the registered image number (000 - 999) in step 4 before selecting [Register].

Registering part of an image (partial registration)

By selecting a region, it is possible to register only a part of an image as a registered image. By using partial registration, it is possible to reduce the memory required by the registered images and shorten the time required for settings changes.

1 In the Register Image menu select [Edit] from [Select Image] - [Region].

The [Edit] menu appears.

2 Select the range of the image to register.

A rectangle appears. Move the rectangle and change its size so that it encloses the part of the image to be registered.



The values of the region can be manually entered by selecting the item and changing the value.

3 To finish editing, select [Close].

4 The Edit menu closes and the image can be registered.

Select [Save] to registered the part of the image that is within the region.

To cancel partial registration

Select [Clear] under [Select Image] on the Image Registration menu, then select [OK] on the confirmation screen.

Deleting registered images

1 In the [Register Image] Menu select [Registered Image] from the [Type] drop down menu.

2 Specify the number of the image to delete in [Options].

The specified registered image is displayed.

3 Select [Delete].

A confirmation screen appears.

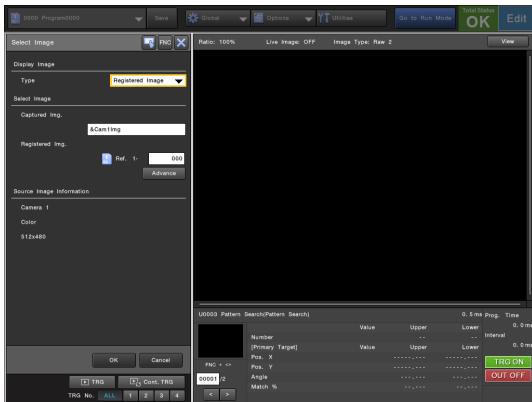
4 Select [OK].

The registered image is deleted from the controller.

Select Image

Specify the registered image and captured image to use as reference for measurement and setting.

Example: [Select Image] Screen in Pattern Search Measurement



Point The items that can be displayed/set differ depending on the measurement type.

Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** The registered image specified under [Select Image] is displayed.

Select Image

Captured Image

Set an image variable to be used as a current image for the unit. The "Select Image Variable" screen will appear. Select an image variable to be used as the current image.

- On the [Select Image Variable] screen, you can preview the content of the currently selected image variable.
- If you select [Variable Settings] on the [Select Image Variable] screen, a variables list screen will appear, and you can manage variables on that screen. For details on the variables list screen, refer to "Defining and editing image variables" (Page 4-8).

Registered Image

Specify the registered image No. for the registered image to be used.

- The registered images are managed as "ref (Camera No.) - (Registered image No. 0 to 999)".
- The "Camera No" is fixed to the number of the camera associated to the image variable specified for the current image.

Advance

Set advance options for the switching of registered images as necessary.

- Use numerical variable for registered image No.:** To use a variable for the registered image No., check this box and assign a numerical or numerical array variable reference. By using a variable for the registered image No. and then issuing a variable reference value apply command (NU), the image is switched to the specified registered image in the variable and the reference image information is updated. For more details, see the XG-X2000 Series Communications Control Manual.
- Process variable when changing programs:** Use this option to switch to the registered image based on the initial value of the variable referenced when the program is changed or the controller is next turned on.
- Use image variable for registered image:** To directly reference an image variable as a registered image, use this option and assign an image variable to be referenced.

- Point**
- Note that the registered image No. does not switch synchronously with a change in the variable value.
 - Only an image variable set to [use for processing] can be assigned to [Use image variable for registered image].
 - When [Use image variable for registered image] is enabled while [Registered Image] (Page 2-49) has been set to [Fixed (fast)], the [Registered Image] setting is automatically changed to [Updated each process (slow)]. This option can still set it to [User updated (fast)] in the [Parameters] menu.
 - When [Use numerical variable for registered image No.] is enabled, [Use image variable for registered image] cannot be used.
 - The resultant image variable assigned to [Use image variable for registered image] must use the same camera type as the current image.
 - When the registered image is referenced with an image variable and while [Registered Image] is set to [User updated (fast)], the process uses the resultant image variable at the time the reference image information is updated. To update the reference image information immediately, update reference image information or issue the RU command.

Resultant Image (Defect or Grayscale Blob Unit Only)

In a case such as below, check the [Contrast Image Output] box and then specify the image variable for outputting the contrast image in the [Specify Image Variable for Processing] field.

- If you wish to use the contrast image in other measurement units
- If you wish to output the contrast image as image file

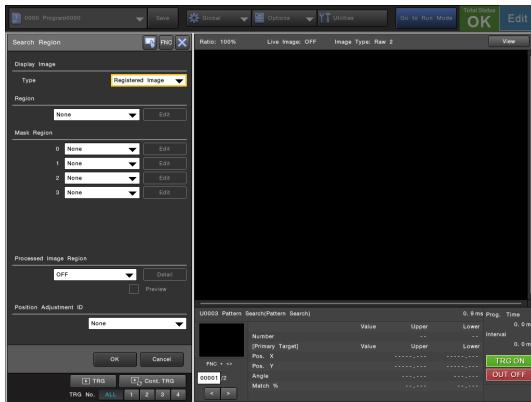
Source Image Information

The camera No., type (color / monochrome), and resolution of the camera associated to the image variable specified is displayed.

Region Settings

Outline the region on the captured image to be used for inspection. A range can be specified for the pattern region and search region in the same manner.

Example: [Search Region] Screen in Pattern Search Measurement



Point The items that can be displayed/set differ depending on the measurement type.

Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image.

Region

Select a shape and then draw the region, or select [Edit] and specify the region with numerical values. See "Drawing a Region" (Page 2-474) for more details.

Mask Region

A mask region is an area which can be defined in the inspection region and will be excluded from the inspection. Up to four mask regions can be set per inspection region. A mask region is typically used for hiding an area that does not require inspection.

Select a shape and then draw the region, or select [Edit] and specify the region with numerical values.

Reference If you want to define a region which can not be set through the available masks, draw an inspection region as a composition region (Page 2-479).

Processed Image Region

Use processed image region to generate a region for inspection based on an image (Page 2-382), select [ON] and then select [Detail] for configuration.



Refer to "Generating a Region from an Image (Processed Image Region)" (Page 2-482) for more details on processed image region.

Image

Specify the image variable to be used for generating the region.

Area

Specify the area and border color for the region based on the image specified in the image variable. Select either [Black] (Level 0) or [White] (Level 255, default).

Preview

Use this checkbox to display the specified image. When the checkmark is removed, the display returns to its normal state.

Position Adjustment ID

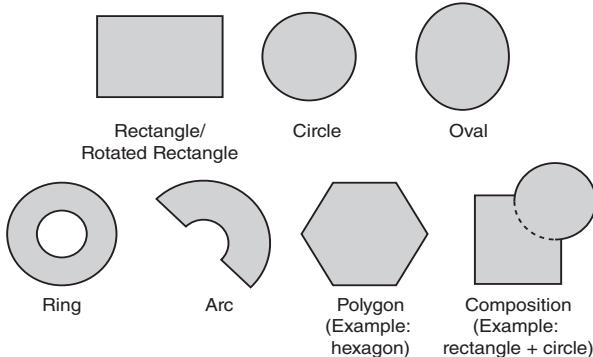
To use position adjustment for the region, select the position adjustment unit to be referenced.



The position adjustment is applied to all inspection, mask, and image regions.

Drawing a Region

This menu is used to edit the size and position of the regions used in a unit. This includes inspection, mask, search, pattern, calibration, and trapezoid correction regions. The following regions shapes are supported by the XG-X2000 Series.



- Point**
- Depending on the content of the program, it may not be possible to change all or some of the region settings.
 - In addition to the shapes above, [Multiple Area] (Page 2-481) is supported for the mask regions of ShapeTrax3, ShapeTrax2 or PatternTrax pattern regions only.

Some functions in the Inspection Region Menu and the sub menu [Inspection Region] of the Edit Unit Menu work and behave differently. Refer to "Difference Between Sub Menus of the Edit Unit Menu and Other Built-in Menus" (Page 2-15) for further details.

Selecting the Inspection Region

Open the Inspection Region Menu, then select the display image and regions to work on.

Unit (Only displayed in the Inspection Region Menu)

Select the unit with the region to be adjusted.

Region (Only displayed in the Inspection Region Menu)

Select the type of region to be adjusted. The type of region will differ depending on the selected unit and the menu settings.

Display Image

- Captured Image:** Displays the latest captured image from the set measurement unit.
- Registered Image:** Displays the registered image from the set measurement unit.
- Archived Image:** Displays an image from the image archive. This is only displayed in the Inspection Region Menu when activated. Toggle through the image archive by using the No.1 (FUNCTION) or No. 7 (BACK) button and left or right.

Areas (Only displayed in the Inspection Region Menu)

- Single:** Displays only the selected inspection region.
- All:** Displays all the regions of units that reference the same image variable or registered image if [Display Image] is set to [Registered Image].

- Point**
- When all or part of the inspection region is outside the imaging region (Page 2-29), the part of the region outside the imaging region is always removed from the process area.

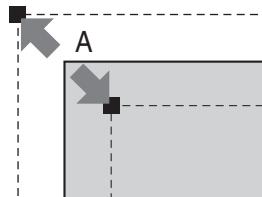
Drawing a Rectangle

1 Select [Edit] under [Region].

This allows the region to be drawn on the image.

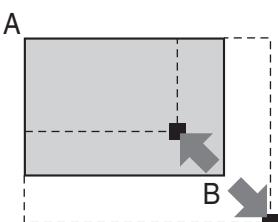
2 Set the upper left node of the rectangle.

Use the 8-way key to set point A, then press the No. 0 (ENTER) button.



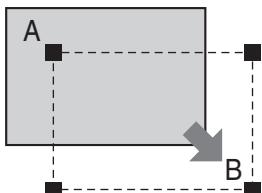
3 Set the lower right node of the rectangle.

Use the 8-way key to set point B, then press the No. 0 (ENTER) button.



4 Position the rectangle.

Use the 8-way key to move the entire rectangle, then press the No. 0 (ENTER) button. Each press of the No. 0 (ENTER) button will cycle through steps 2 to 4.



5 To finish editing, press the No. 2 (ESCAPE) button.

Reference

The positions of the nodes can also be input as values. For more details, refer to "Drawing Regions by Using Values" (Page 2-479).

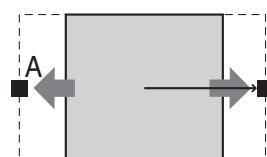
Drawing a Rotated Rectangle

1 Select [Edit] under [Region].

This allows the region to be drawn on the image.

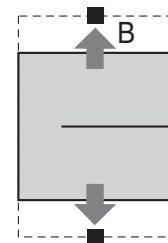
2 Set the width of the rotated rectangle.

Move the 8-way key up and down to adjust the width, then press the No. 0 (ENTER) button.



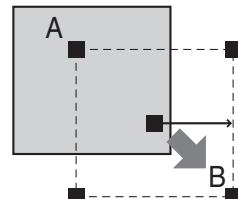
3 Set the height of the rotated rectangle.

Move the 8-way key up and down to adjust the height, then press the No. 0 (ENTER) button.



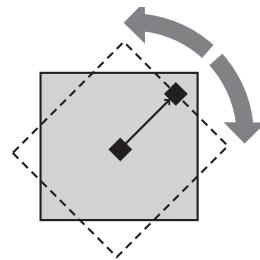
4 Position the rotated rectangle.

Use the 8-way key to move the entire rotated rectangle, then press the No. 0 (ENTER) button.



5 Set the angle of the rotated rectangle.

Move the 8-way key up and down to adjust the angle, then press the No. 0 (ENTER) button. Each press of the No. 0 (ENTER) button will cycle through steps 2 to 5.



6 To finish editing, press the No. 2 (ESCAPE) button.

Reference

The height, width, and angle can also be input as values. For more details, refer to "Drawing Regions by Using Values" (Page 2-479).

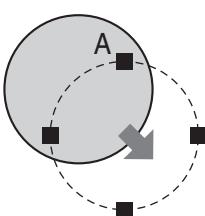
Drawing a Circle

1 Select [Edit] under [Region].

This allows the region to be drawn on the image.

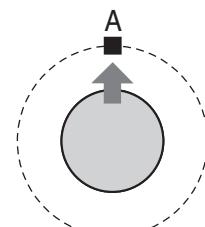
2 Position the circle.

Use the 8-way key to move the entire circle, then press the No. 0 (ENTER) button.



3 Set the size of the circle.

Move the 8-way key up and down to set the size of the circle then press the No. 0 (ENTER) button. Each press of the No. (ENTER) button will cycle through steps 2 and 3.



4 To finish editing, press the No. 2 (ESCAPE) button.

Reference

The position of the center of the circle and the radius of the circle can also be input as values. For more details, refer to "Drawing Regions by Using Values" (Page 2-479).

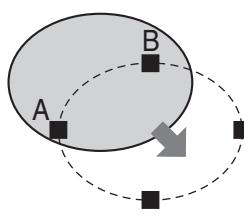
Drawing an Oval

1 Select [Edit] under [Region].

This allows the region to be drawn on the image.

2 Position the oval.

Use the 8-way key to move the entire oval, then press the No. 0 (ENTER) button.



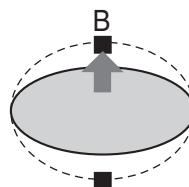
3 Set the horizontal size of the oval.

Move the 8-way key up and down to set the horizontal size of the oval then press the No. 0 (ENTER) button.



4 Set the vertical size of the oval.

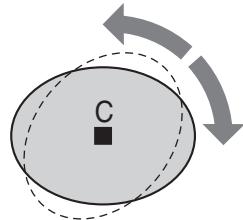
Move the 8-way key up and down to set the vertical size of the oval and press the No. 0 (ENTER) button.



5 Set the angle of the oval.

Move the 8-way key up and down to adjust the angle, then press the No. 0 (ENTER) button.

Each press of the No. (ENTER) button will cycle through steps 2 through 5.



6 To finish editing, press the No. 2 (ESCAPE) button.

Reference

The position of the center, rotation angle, and the radius (in X and Y) can also be input as numeric values. For more details, refer to "Drawing Regions by Using Values" (Page 2-479).

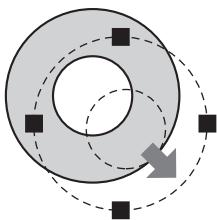
Drawing a Ring

1 Select [Edit] under [Region].

This allows the region to be drawn on the image.

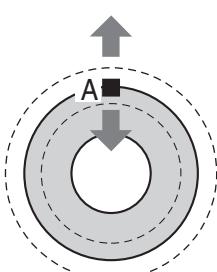
2 Position the ring.

Use the 8-way key to move the entire ring, then press the No. 0 (ENTER) button.



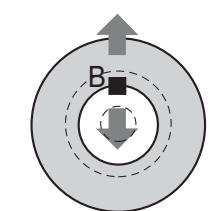
3 Set the size of the outer circle of the ring.

Move the 8-way key up and down to set the size of the circle and press the No. 0 (ENTER) button.



4 Set the size of the inner circle of the ring.

Move the 8-way key up and down to set the size of the circle and press the No. 0 (ENTER) button. Each press of the No. 0 (ENTER) button will cycle through steps 2, 3 and 4.



5 To finish editing, press the No. 2 (ESCAPE) button.

Reference

The position of the center and the radius of the inner and outer circles can also be input as values. For more details, refer to "Drawing Regions by Using Values" (Page 2-479).

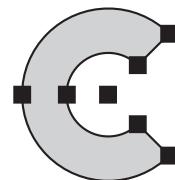
Drawing an Arc

1 Select [Edit] under [Region].

This allows the region to be drawn on the image.

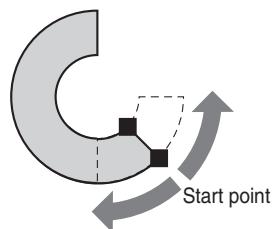
2 Position the arc.

Use the 8-way key to move the entire arc, then press the No. 0 (ENTER) button.



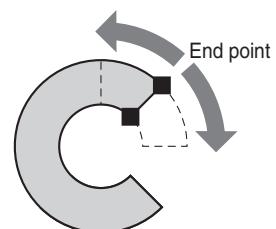
3 Set the starting point of the arc.

Move the 8-way key up and down to set the starting point, then press the No. 0 (ENTER) button.



4 Set the ending point of the arc.

Move the 8-way key up and down to set the ending point, then press the No. 0 (ENTER) button.



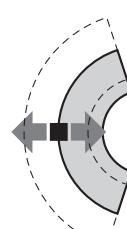
5 Set the curvature of the arc.

Move the 8-way key up and down to set the curvature, then press the No. 0 (ENTER) button.



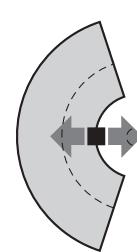
6 Set the size of the outer arc.

Move the 8-way key up and down to set the size of the outer arc, then press the No. 0 (ENTER) button.



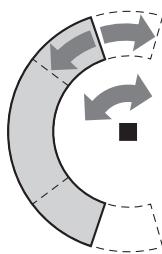
7 Set the size of the inner arc.

Move the 8-way key up and down to set the size of the inner arc, then press the No. 0 (ENTER) button.



8 Adjust the angle of the arc.

Move the 8-way key up and down to adjust the angle, then press the No. 0 (ENTER) button. Each press of the No. 0 (ENTER) button will cycle through steps 2 to 8.

**9 To finish editing, press the No. 2 (ESCAPE) button.****Reference**

The position of the center, the angle of the starting and ending points, and the radius of the inner and outer arc can also be input as values. For more details, refer to "Drawing Regions by Using Values" (Page 2-479).

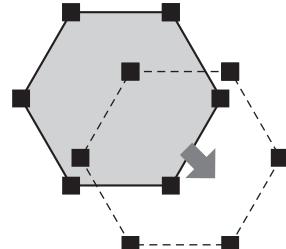
Drawing a Polygon

1 Select [Edit] under [Region].

This allows the region to be drawn on the image.

2 Position the polygon.

Use the 8-way key to move the entire polygon, then press the No. 0 (ENTER) button. Each time the No. 0 (ENTER) button is pressed, the function alternates between adjusting points or moving the polygon.

**3 Set the position of a node of the polygon.**

Use the 8-way key to set a point, then press the No. 0 (ENTER) button.

Repeat this step until all the required nodes are set.

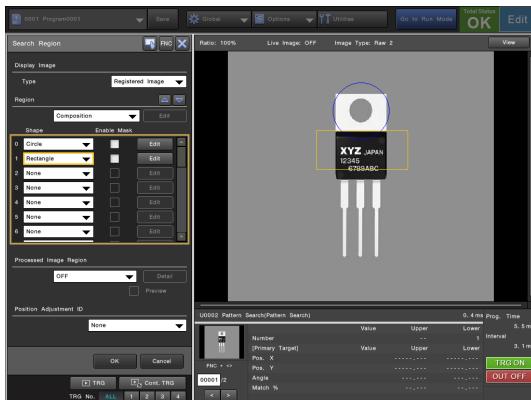
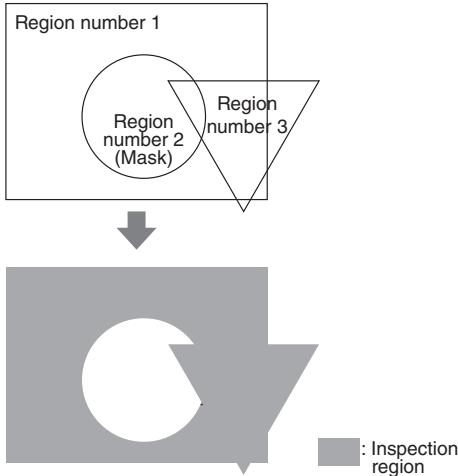
4 To finish editing, press the No. 2 (ESCAPE) button.**Reference**

- The position of each node can also be input as values. For more details, refer to "Drawing Regions by Using Values" (Page 2-479).
- Nodes can only be added or deleted via the Inspection Region sub menu when editing a unit.
- A four point polygon can be used for the regions in a calibration unit and [Trapezoid Correction] in Image Operations (Page 2-380).
- If using [Trapezoid Correction] (Page 2-380) an arrow indicates the order of specifying points.

Drawing a Composition Region

A maximum of 32 regions and masks of differing shapes can be combined to form a complex region.

Point If the regions overlap, the region with the higher number takes precedence.



1 Choose the region from the list to edit and select [Edit].

The [Edit] menu appears.

2 Edit the selected region.

Refer to the editing instructions for each region shape.

3 Repeat steps 1 and 2 until all the necessary regions have been edited.

4 Putting a check mark in the [Enable Mask] check box defines the region as a mask.

Point The mask option can only be edited via the Inspection Region sub menu when editing a unit.

5 To finish editing, press the No. 2 (ESCAPE) button.

Reference The positions and sizes of each region can also be input as values. For more details, refer to "Drawing Regions by Using Values" (Page 2-479).

Point Regions can only be added, deleted or have their shape changed via the Inspection Region sub menu when editing a unit.

Drawing Regions by Using Values

The position and size of a region can also be set by specifying values.

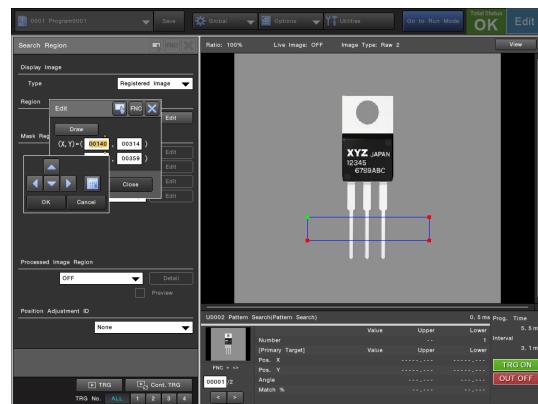
Point Values that can be entered differ depending on the region shape.

1 While drawing regions, press the No. 2 (ESCAPE) button.

The [Edit] menu appears.

2 Select the value of the item to change.

The part of the region associated to the selected value is highlighted.



3 Specify the value.

The region position, size and shape changes as the value changes.

4 To finish editing, select [Close].

Reference From the [Edit] menu, select [Draw] to draw the region on the image.

Region Settings

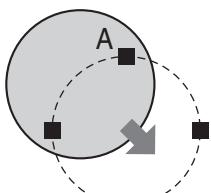
When Using the Mouse or Touch Panel

Select the region type on the Inspection Region menu, then tap [Edit] to enable region drawing.

 Values can be entered directly in the Edit menu by tapping the desired number.

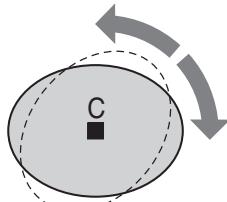
Changing the location of a region

Tap inside the region, then slide it to the desired location on the screen.



Changing the size

Tap the location (green node) to change, then slide it to change the size.

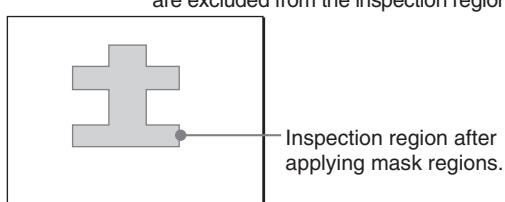
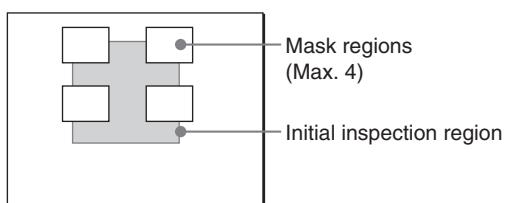
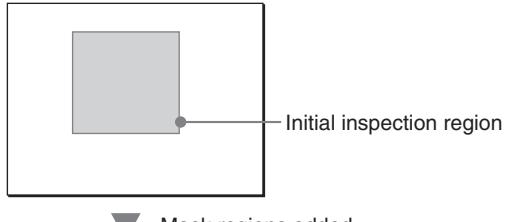


Changing the angle

Tap the center of the region (green node), then slide it up or down to change the angle.

Excluding Part of the Region (Mask Region)

A region can have up to four mask regions (or up to 31 for composition regions) for excluding areas. This is useful when the target has a complicated shape or when an area needs to be excluded from the inspection.



1 Select [Edit] next to the mask to use.

The mask region drawing menu appears. Draw the mask region as desired.

2 Select [Close].

 The position and size of each mask region can also be input as values. For more details, refer to "Drawing Regions by Using Values" (Page 2-479).

Editing Multiple Area

For the mask region of a ShapeTrax3, ShapeTrax2, and PatternTrax pattern region only, up to 15 circles or rectangles can be edited.

- Point** From the Inspection Region menu, adding, deleting, and changing the shapes of multiple shapes may not be supported depending on the settings.

Adding multiple shapes

1 Select [Edit] next to the Multiple Area to edit.

The [Edit] menu appears.

2 Select [Add] on the Edit menu.

The regions are added by copying the last region that was selected.

3 Move the 8-way key and select the region center position.

When the No. 0 (ENTER) button is pressed, the position is confirmed, and the next region is added. Keep repeating this procedure until the necessary number of regions is added.

4 When editing is finished, press the No. 2 (ESCAPE) button then select [Close].

Changing the positions of multiple shapes

1 Select [Edit] next to the Multiple Area to edit.

The [Edit] menu appears.

2 Select [Edit] on the Edit menu.

Reference You can also directly select the coordinate fields and enter values to specify the positions of the necessary multiple shapes.

3 Change the region position.

Pressing the No. 0 (ENTER) button switches the individual selected region up 1 in ascending order and then to select-all.

4 When editing is finished, press the No. 2 (ESCAPE) button then select [Close].

Deleting multiple shapes

1 Select [Edit] next to the Multiple Area to edit.

The [Edit] menu appears.

2 Select [Delete] on the Edit menu.

The Delete menu appears.

3 Select the region to delete.

4 After editing is completed, select [Close].

Changing the shape or size of multiple regions

The same shape and size will be applied to all of the multiple regions. Sizes are as follows. For a circle, the diameter is the designated value $\times 2 + 1$ pixel. For a rectangle, the designated value $\times 2 + 1$ pixel is the length of one side of the square.

1 Select [Edit] next to the Multiple Area to edit.

The [Edit] menu appears.

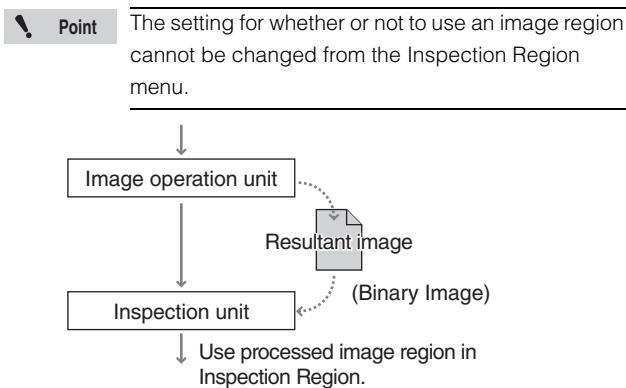
2 When changing the shape, select [Circle] or [Rect] for the [Shape] item.

3 When changing the size, specify the size from 3 – 100 in the [Size] field.

4 After editing is completed, select [Close].

Generating a Region from an Image (Processed Image Region)

The white (grayscale value 255) or black (grayscale value 0) area of a binary image created from the image operation unit (Page 2-373) can be used to define a region. This function is very useful for automatically creating an inspection region for complicated shapes based on a grouping of pixels.



- In the [Inspection region] field, select a shape to use as the processing region.



Point

Regions can only have their shape changed via the Inspection Region sub menu when editing a unit.

- Draw a region large enough to cover the entire inspection target.

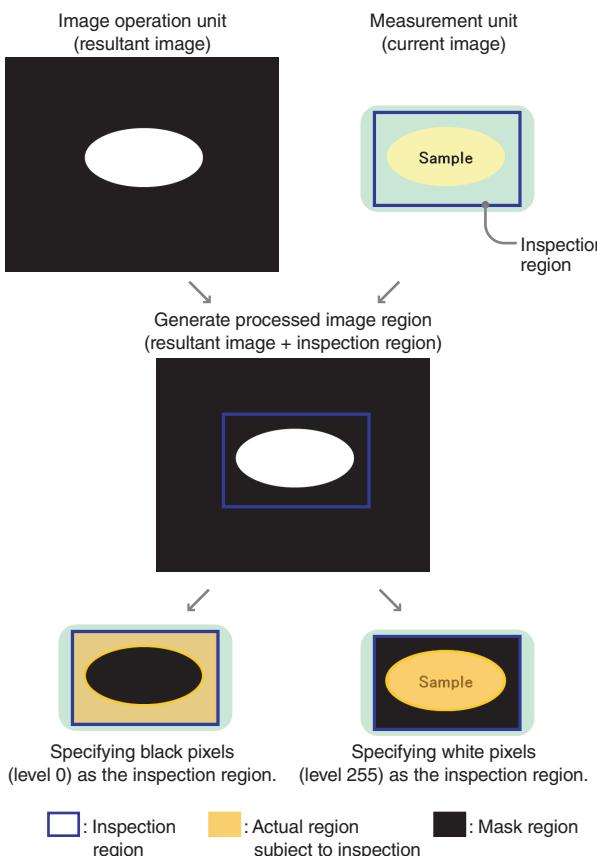
- In the [Area] field, choose the area to be used as the inspection region.

- White:** Sets areas with "white" (grayscale value 255) as the inspection region.
- Black:** Sets areas with "black" (grayscale value 0) as the inspection region.

- Use preview to confirm the region.

- To finish settings, select [OK].

Processing image

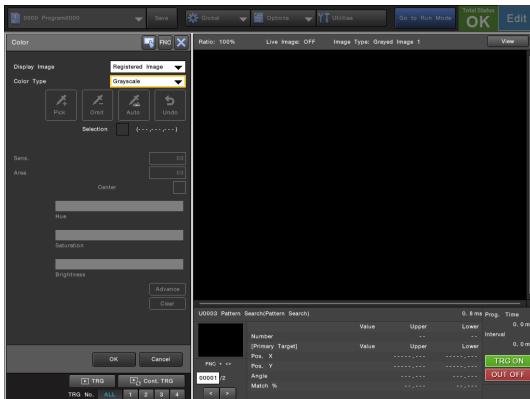


Color Extraction

If you are using a color camera, captured color images are automatically processed with [Grayscale] color extraction and converted into monochrome images. You can also specify a different color extraction process as desired.

- **Color to Binary** (Page 2-484): Converts a color image into a binary image by setting the specified color to white and all other colors to black.
 - **Color to Grayscale** (Page 2-484, 2-486): Converts a color image into a grayscale image by setting the specified color as the maximum contrast level.
 - **Grayscale** (Page 2-484): Converts the color information into RGB and use its average to convert a color image into a grayscale image with 256 shades.
 - **Fine Color** (Page 2-142): Performs intensity comparison using the H (Hue), S (Saturation) and B (Brightness) information directly, without converting into a grayscale image (for defect tool only).

Example: [Color Extraction] Screen in Pattern Search Measurement

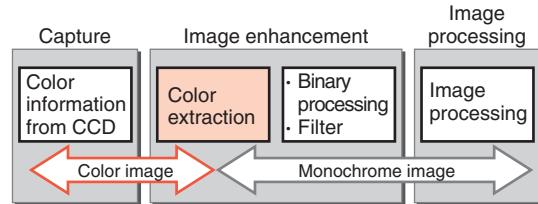


- The items that can be displayed/set differ depending on the measurement type.
 - Color extraction cannot be set if you are using a monochrome camera or the result image variable (Page 2-382) is used as the current image.
 - If MultiSpectrum mode is selected in Capture Mode, refer to "Extracting Colors in MultiSpectrum Mode" (Page 7-79)

Some functions in the Color Extraction menu and the sub menu [Color] of the Edit Unit menu work and behave differently. Refer to "Difference Between Sub Menus of the Edit Unit Menu and Other Built-in Menus" (Page 2-15) for further details.

What is Color Extraction?

The color extraction process converts the captured raw color image to a monochrome (grayscale or binary) image. All the image processing (excluding HSB and RGB measurement) is performed on the converted monochrome image.

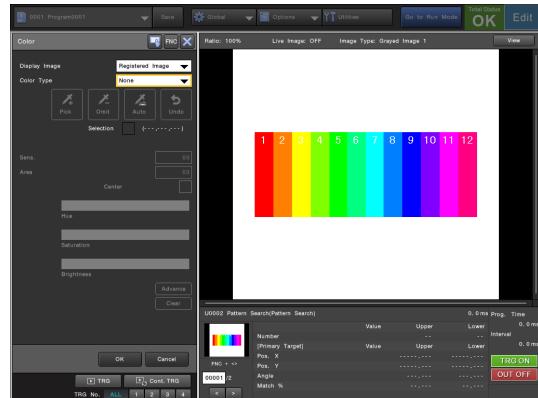


Color extraction is performed by using the color extraction operation in the vision, image operation and C Plug In units.

Color Extraction Methods

The following three processes are available for the extraction or conversion of color information.

- Conversion to a binary image by selecting the color range (Color to Binary)
 - Conversion to a grayscale image with the focus on the selected color range (Color to Grayscale)
 - Conversion to a grayscale image (Grayscale, RGB Grayscale, R Grayscale, G Grayscale, B Grayscale)

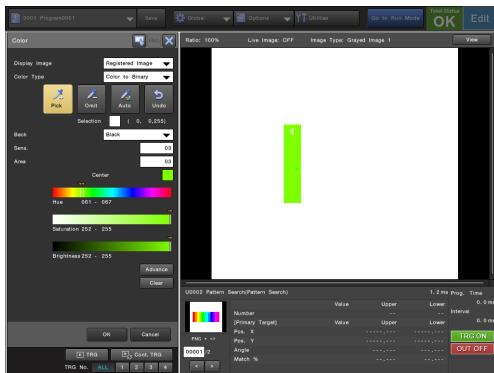


(Example of an image before color extraction)

Color Extraction

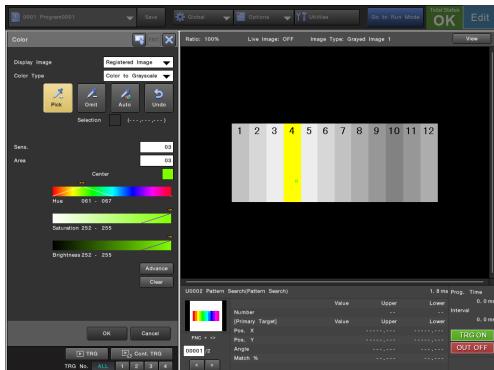
Color to Binary

This process creates a binary image by setting the pixels that fall within the selected color range to "white" (grayscale value 255). All pixels that fall out of the selected color range will be set to "black" (grayscale value 0). This binary image can then be used for operations such as pixel counting of a specified color (Area tool) or blob analysis of a grouping of pixels of a specified color (Blob tool).



Color to Grayscale

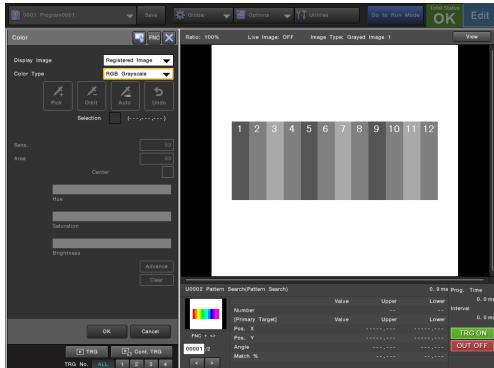
The pixels that fall within the selected color range are set to "white" (grayscale value 255) while other colors are grayed respectively (grayscale values 0 to 254). This type of image processing is used for inspections that require high accuracy such as measurement or defect detection, as slight color variations can be accounted and adjusted for.



Grayscale (Grayscale, RGB Grayscale, R Grayscale, G Grayscale, B Grayscale)

This process creates a traditional grayscale image by extracting only the brightness from the color image. This option can be used to treat a color image as a monochrome image.

Point No additional settings are available when using Grayscale or RGB Grayscale.



Conversion to a Binary Image by Selecting the Color Range

Point

The color extraction menu supports the selection of the unit for the color extraction process if enabled. If the menu allows selection, first select the unit to set in the [Unit] field.

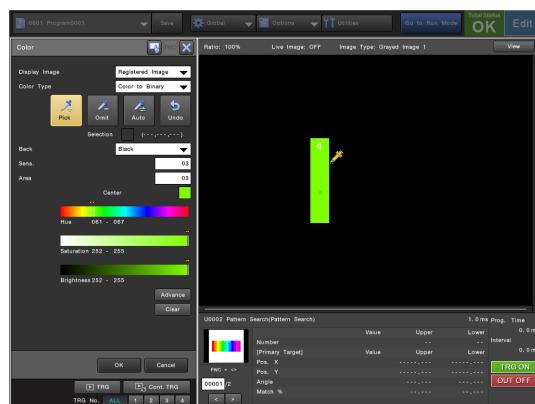
1 Select the image type from the [Display Image] drop down menu.

- **Captured Image:** Displays the latest captured image from the set measurement unit.
- **Registered Image:** Displays the registered image from the set measurement unit.
- **Archived Image:** Displays an image from the image archive (only displayed in the Color Extraction Menu). Toggle through the image archive by using the No.1 (FUNCTION) or No.7 (BACK) button and left or right.

2 Select the button.

3 Use the 8-way key and No. 0 (ENTER) button to select the color to be white (255).

Only the color that has been extracted is displayed in color.



4 Enlarge the range of extraction color as required.

- If the No. 0 (ENTER) button is pressed consecutively, the neighboring colors of the first selected color are incrementally selected.
- If is selected, the range of colors can be automatically enlarged, on the [Sens.] value.

To omit colors from the extraction:

Press the No. 2 (ESCAPE) button to exit the color extraction and select . Here colors to be omitted can be selected using the 8-way key and the No. 0 (ENTER) button.

5 To finish the selection / omission process, press the No. 2 (ESCAPE) button.

6 Select [OK].

Reference

- During the color extraction process the image can be changed using the View toolbar (Page 1-13).
- During color extraction the selection / omission functions can be toggled between by using the No.1 (FUNCTION) button. The  on the right side of the screen is selected while color exclusion is in progress. Press the No. 1 (FUNCTION) button again to return to the color selection operation.

Viewing the extracted color

To view the extracted color press the No.4 (SCREEN) button. Each time the button is pressed the screen cycles through raw image → extracted color only → extracted color in the region → raw image ...

Point

While the controller is running, all the extracted colors are displayed in white on the process screen.

Clearing color extraction

Choose [Clear] in the [Color] menu.

Point

Once the color extraction has been cleared the [OK] button is disabled and the menu cannot be closed until color extraction has been performed.

Changing the color extraction settings

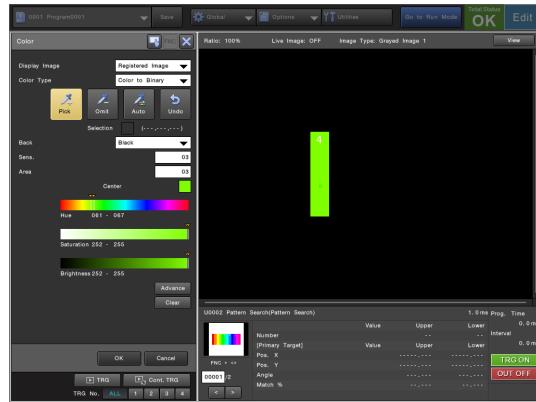
Changing the background color

To properly see the extraction of colors it is useful to change the background color.

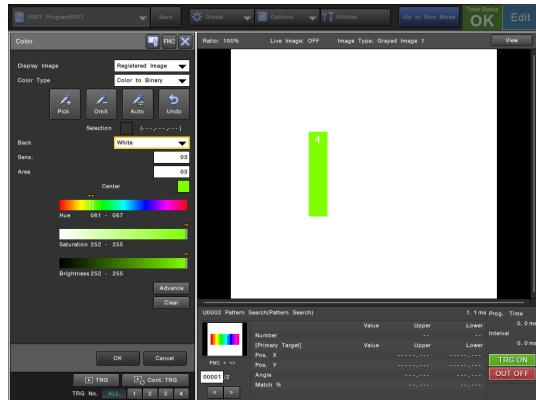
The background color for the extracted image after color extraction can be selected from either white or black via [Back] in the [Color] menu.

It is convenient to choose Black if the extraction target is a bright color, and to choose White if the extraction target is a dark color.

Background color [Black]



Background color [White]



Adjusting the extraction sensitivity of neighboring colors

The sensitivity of the color extraction can be adjusted via [Sens.] in the [Color] menu.

Adjusting the size of the color extraction selection region

The size of the color extraction area when selecting / omitting colors can be adjusted via [Area] in the [Color] menu. All colors that fall within the area will be extracted when the No. 0 (ENTER) button is pressed.

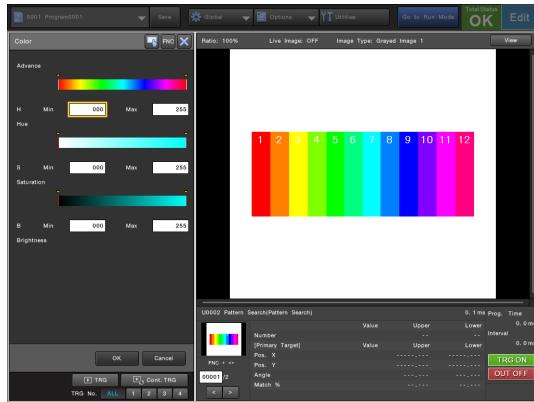
Color Extraction

Specifying the color range to be extracted with numerical values

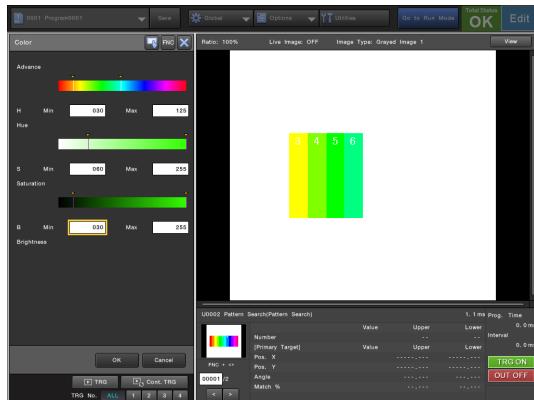
The extracted color range can also be set by inputting numerical values for the Hue, Saturation and Brightness ranges.

1 From the [Color] menu select [Advance].

The right side of the [Color] menu changes to the advanced settings screen.



2 Specify the color range by setting minimum and maximum values for H, S, and B, respectively.



Color is controlled by the following three elements.

- **H (Hue):** Indicating the color.
- **S (Saturation):** Indicating the saturation of the color.
- **B (Brightness):** Indicating the brightness of the color.

When the maximum and minimum values are specified, the color extraction range on the screen changes accordingly, and the position of the ▼ mark shifts on the color bar.

Point H (Hue) is a clockwise hue circle starting from red. As a result, the lower limit value may exceed the upper limit value.

3 Select [OK].

The right side of the [Color] menu reverts to normal.

Conversion to a Grayscale Image with the focus on the selected color range (Color to Grayscale)



Point

The color extraction menu supports the selection of the unit for the color extraction process if enabled. If the menu allows selection, first select the unit to set in the [Unit] field.

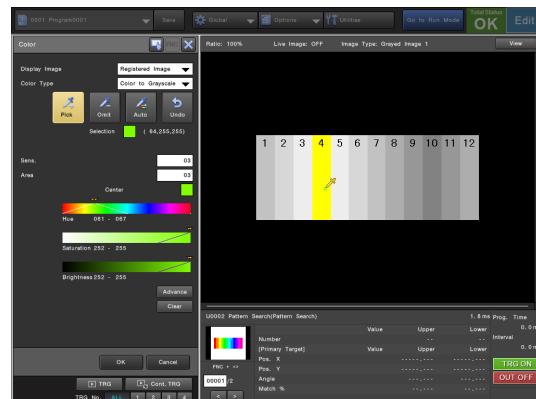
1 Select the image type from the [Display Image] drop down menu.

- **Captured Image:** Displays the latest captured image from the set measurement unit.
- **Registered Image:** Displays the registered image from the set measurement unit.
- **Archived Image:** Displays an image from the image archive (only displayed in the Color Extraction Menu). Toggle through the image archive by using the No.1 (FUNCTION) or No.7 (BACK) button and left or right.

2 Select the button.

3 Use the 8-way key and No. 0 (ENTER) button to select the color to be white (255).

The displayed image is converted to grayscale with the selected color as white (255). The pixels that represent the level of 255 are displayed in yellow.



4 Enlarge the range of extraction color as required.

- If the No. 0 (ENTER) button is pressed consecutively, the neighboring colors of the first selected color are gradually converted to a color approaching full white (255).
- If is selected, the range of colors can be automatically enlarged, on the [Sens.] value.

To omit colors from the extraction:

Press the No. 2 (ESCAPE) button to exit the color extraction and select . Here colors to be omitted can be selected using the 8-way key and the No. 0 (ENTER) button.



If too many omissions are applied, the levels of contrast change across the image will be lost resulting in a binary like image. In such a case the results from tools which use contrast information (such as edge or Pattern Search) may deteriorate.

5 To finish the selection / omission process, press the No. 2 (ESCAPE) button.

6 Select [OK].



- During the color extraction process the image can be changed using the View toolbar (Page 1-13).
- During color extraction the selection / omission functions can be toggled between by using the No.1 (FUNCTION) button. The  on the right side of the screen is selected while color exclusion is in progress. Press the No. 1 (FUNCTION) button again to return to the color selection operation.

Viewing the extracted color

To view the extracted color press the No.4 (SCREEN) button. Each time the button is pressed the screen cycles through raw image → grayscale image after conversion (with white highlighted as yellow) → grayscale image after conversion → raw image ...

Clearing color extraction

Choose [Clear] in the [Color] menu.



Once the color extraction has been cleared the [OK] button is disabled and the menu cannot be closed until color extraction has been performed.

Changing the color extraction settings

Adjusting the extraction sensitivity of neighboring colors

The sensitivity of the color extraction can be adjusted via [Sens.] in the [Color] menu.

Adjusting the size of the color extraction selection region

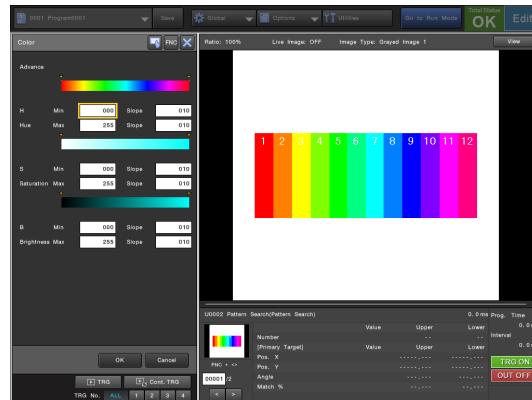
The size of the color extraction area when selecting / omitting colors can be adjusted via [Area] in the [Color] menu. All colors that fall within the area will be extracted when the No. 0 (ENTER) button is pressed.

Specifying the color range to be extracted with numerical values

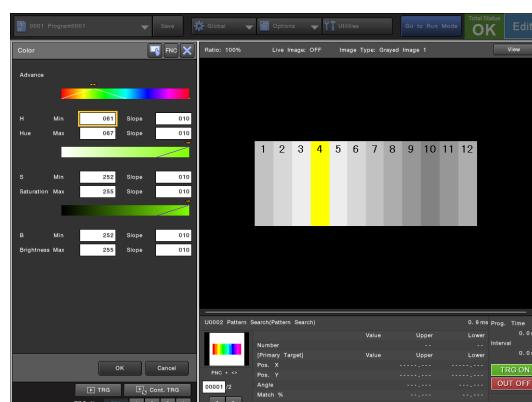
The extracted color range can also be set by inputting numerical values for the Hue, Saturation and Brightness ranges.

1 From the [Color] menu select [Advance].

The right side of the [Color] menu changes to the advanced settings screen.



2 Specify the color range by setting minimum and maximum values for H, S, and B, respectively.

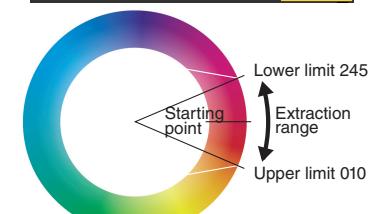
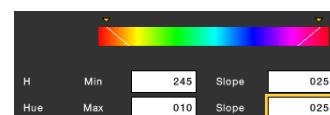


Color is controlled by the following three elements.

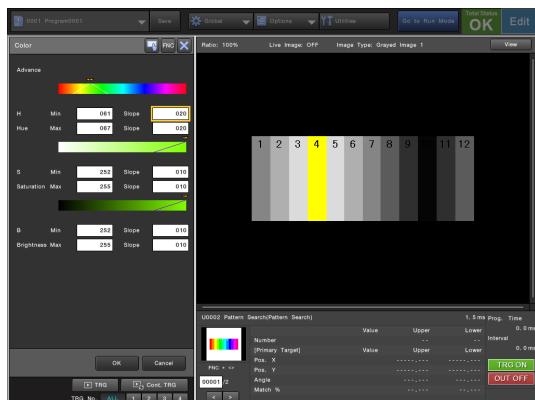
- H (Hue): Indicating the color.
 - S (Saturation): Indicating the saturation of the color.
 - B (Brightness): Indicating the brightness of the color.
- When the maximum and minimum values are specified, the color extraction range on the screen changes accordingly, and the position of the ▼ mark shifts on the color bar.



H (Hue) is a clockwise hue circle starting from red. As a result, the lower limit value may exceed the upper limit value.



3 Specify the rate of contrast change for H, S, and B, on the grayscale image.



The contrast slope can be individually set for the upper and lower limits. As the slope is changed so the contrast levels are changed on screen to assist with setting the desired range.

- **As the slope is increased (up to 100):** The difference in contrast between the selected color range and non-color range increases, resulting in an image that is more focused on the exact color range and approaching a binary like image.
- **As the slope is decreased (min. 10):** The image becomes more robust against lighting or color variation, as more contrast levels are allowed around the specified color range.



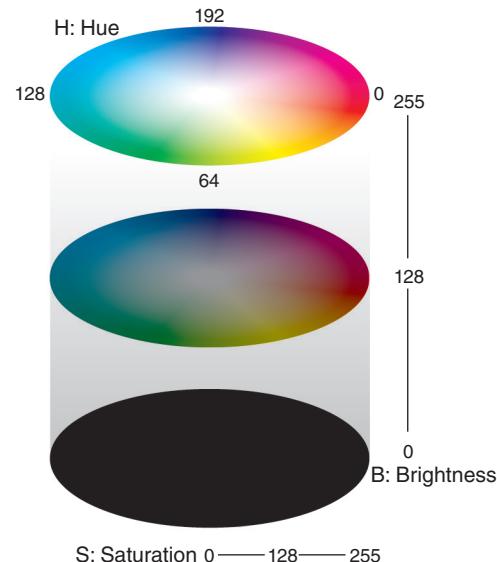
Point As with the case of exclusion, if the slope is increased, the contrast information outside the selected area decreases. Therefore, sharp slopes may impact the accuracy of measurements that reference the contrast information.

4 Select [OK].

The right side of the [Color] menu reverts to normal.

The HSB Color System

The HSB color system is a way of representing a color based on H (hue), S (saturation), and B (brightness). The ranges for the H, S, and B values are automatically determined when selecting the color via the color menu.



By specifying numerical values for the H, S, and B ranges via [Advance] menu, a more precise color extraction can be performed.

Tips for specifying numerical values

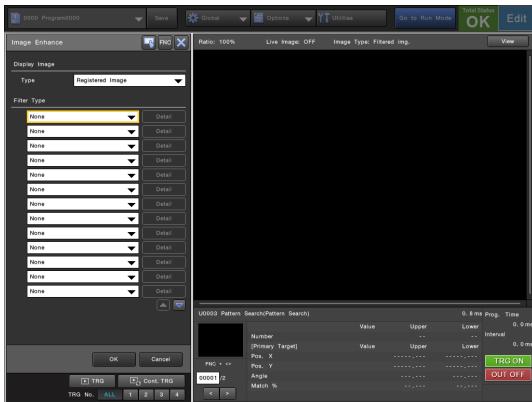
Consider the following points when specifying the color range to be extracted using numerical values.

- **H (Hue):** The most important parameter to determine the color to be extracted. The other parameters (Saturation and Brightness) are applied to the same area specified for Hue. Be sure to specify the H value accurately.
- **S (Saturation):** This is essentially the quantity of color contained in the color. Changing this value can be useful when trying to eliminate glare and hot spots from detection. By excluding the range with low saturation (little color and nearing white) from the color extraction, the white portions of the color caused by glare and hot spots can be excluded.
- **B (Brightness):** This sets the level of black contained in the selected color. If the brightness level is enlarged, the color extraction and inspection will remain stable as lighting deteriorates.

Image Enhance

Specify the filter processing to apply to the image.
When a color camera is used, the filter is applied to the images converted using color extraction.

Example: [Image Enhance] Screen in Pattern Search Measurement



Point The items that can be displayed/set differ depending on the measurement type.

Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified under [Select Image].

Filter type

Select the [Filter Type] field and then select the filter to apply. See "Filter List" (Page 2-489) for more details of each filter processing.

Point

- Up to 13 types of filters can be stacked according to application requirements. When multiple filters are set, they are processed one by one from the top.
- Use [Detail] to apply more detailed filter settings.
- The binary and blob filters cannot be used more than once in the same unit.

Reference The order of the filters can be changed by selecting a filter in one of the [Filter Type] fields, holding down the No. 1 (FUNCTION) button of the handheld controller, and then moving the 8-way key up or down.

Filter List

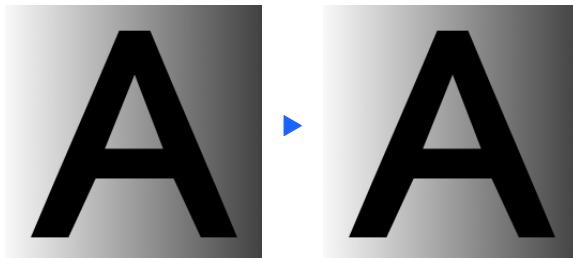
Details of the [Image Enhance] available for vision tools are listed below. These filters can be applied via the [Image Enhance] menu.



- If a color image is selected, the resultant image after the filter is applied is not displayed until color extraction has been performed.
- Image enhancement filters can only be added or deleted through [Image Enhance] under the Edit Unit menu.
- A filter can be skipped during execution by setting the [Count] to 0. However, the measurement time will still be longer than if no filter is used.

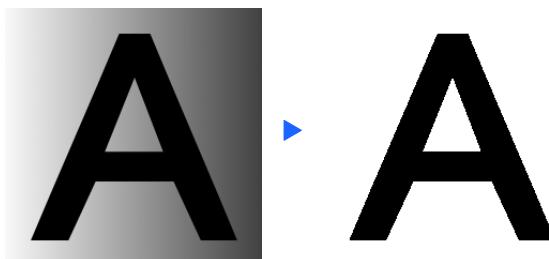
None

No filter is applied.



Binary

Converts the image to binary.



- Select [Detail] to adjust the Binary level and Count (1: ON, 0: OFF).
- Put a check mark in [Update histogram on the input image] option to update the histogram as the image changes.

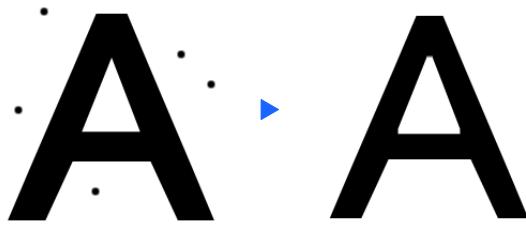


Adjustments can also be made by manually entering Lower and Upper limit values on the histogram display.

Image Enhance

Expand

Removes dark noise by adjusting pixels to the highest grayscale intensity from a group of pixels.



Select [Detail] to set the processing shape (Square, Circle), filter size (3 x 3 to 31 x 31: default, 5 x 5: stronger), direction (X, Y, XY), count (number of times to apply the filter, 0 to 9, where 0 turns the filter off), and borders.

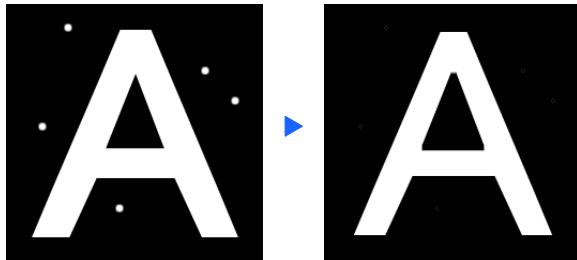
Border processing

The way the filter uses pixel data outside of the region for pixels on the border can be selected between

- **ON** (default): Uses the pixel data outside of the region for pixels on the border.
- **OFF**: Extrapolates the pixels on the border for the pixel data.

Shrink

Removes light noise by adjusting pixels to the lowest grayscale intensity from a group of pixels.



Select [Detail] to set the processing shape (Square, Circle), filter size (3 x 3 to 31 x 31: default, 5 x 5: stronger), direction (X, Y, XY), count (number of times to apply the filter, 0 to 9, where 0 turns the filter off), and borders.

Border processing

The way the filter uses pixel data outside of the region for pixels on the border can be selected between

- **ON** (default): Uses the pixel data outside of the region for pixels on the border.
- **OFF**: Extrapolates the pixels on the border for the pixel data.

Average

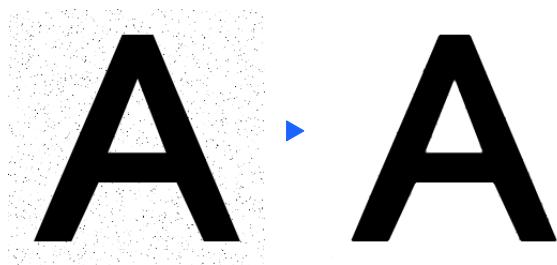
Removes noise by taking the average intensity across a group of pixels.



Select [Detail] to set the Count (number of times (0 to 9) to apply the filter, where 0 turns the filter off).

Median

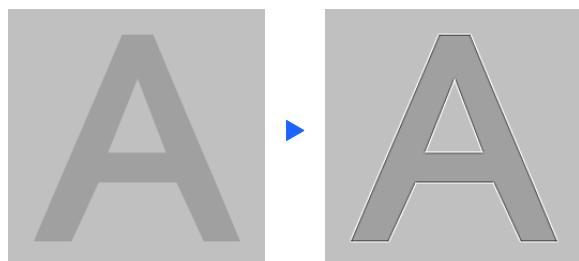
Removes noise yet maintains definition by taking the median (most common) intensity across a group of pixels.



Select [Detail] to set the processing shape (Square, Circle), filter (3 x 3 to 31 x 31: default, 5 x 5: stronger) and count (number of times to apply the filter, 0 to 9, where 0 turns the filter off).

Sharpen

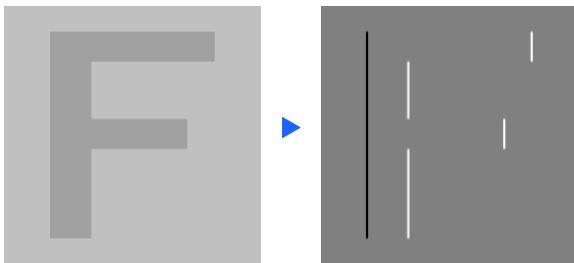
Extracts the boundary where there is a change in intensity.



Select [Detail] to set the Count (number of times (0 to 9) to apply the filter, where 0 turns the filter off).

Sobel X

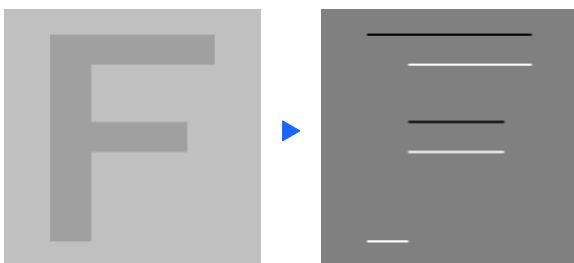
Applies a Sobel filter in the X horizontal direction, enhancing intensity changes.



Select [Detail] to set the Count (number of times (0 to 9) to apply the filter, where 0 turns the filter off).

Sobel Y

Applies a Sobel filter in the Y vertical direction, enhancing intensity changes.



Select [Detail] to set the Count (number of times (0 to 9) to apply the filter, where 0 turns the filter off).

Sobel

Applies a Sobel filter for extracting and enhancing changes in intensity based on a linear comparison.

Extracts low-contrast shading variation and emphasizing it rather stronger than Prewitt.



Select [Detail] to set the Count (number of times (0 to 9) to apply the filter, where 0 turns the filter off).

Prewitt

Applies a Prewitt filter for extracting changes in intensity based on a linear comparison.

It is the edge extraction processing that composes the results of shading variation extraction done individually in the X and Y directions.



Select [Detail] to set the Count (number of times (0 to 9) to apply the filter, where 0 turns the filter off).

Roberts

Applies a Roberts filter for extracting changes in intensity based on an angular comparison.

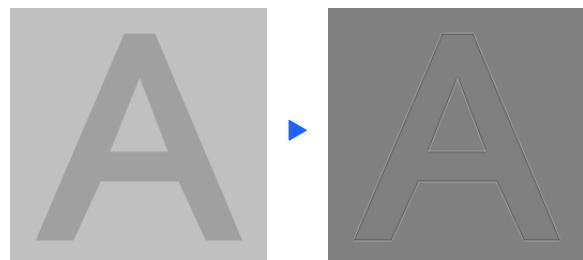
It has a little weaker extraction in X and Y directions than Prewitt, but is suitable for extraction of shading variation in oblique directions.



Select [Detail] to set the Count (number of times (0 to 9) to apply the filter, where 0 turns the filter off).

Laplacian

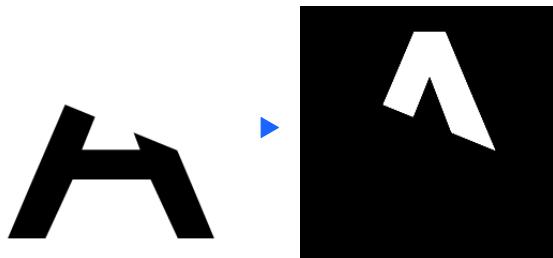
Applies a Laplacian filter for extracting changes in intensity. Extracts edge uniformly without depending on the direction.



Select [Detail] to set the Count (number of times (0 to 9) to apply the filter, where 0 turns the filter off).

Subtract

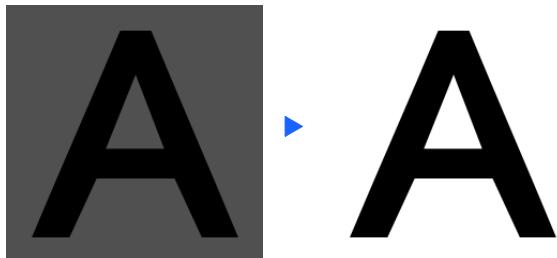
Outputs the image for tone difference obtained by overlapping the reference image with the current image.



See "Extracting Defects" (Page 2-494) for more details.

Preserve Intensity

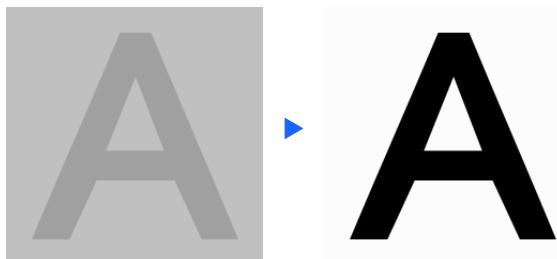
Adjusts brightness according to the intensity on the reference image.



See "Reducing the Impact of Changes in Intensity" (Page 2-496) for more details.

Contrast Conversion

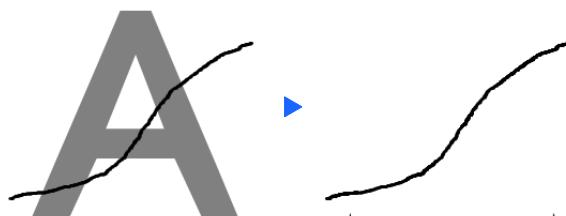
Adjusts brightness of the overall image.



See "CCD Settings" (Page 2-28) for more details.

Image Extraction

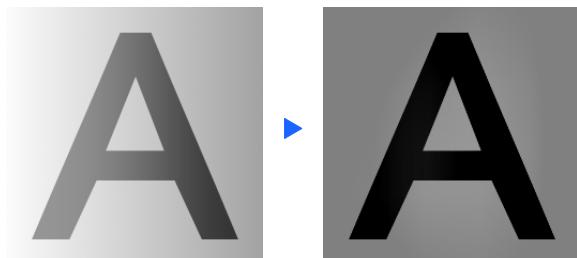
The background of a target can be removed with the Image Extraction filter, by subtracting the current image from a processed version.



See "Removing Background Information" (Page 2-497) for more details.

Shading Correction

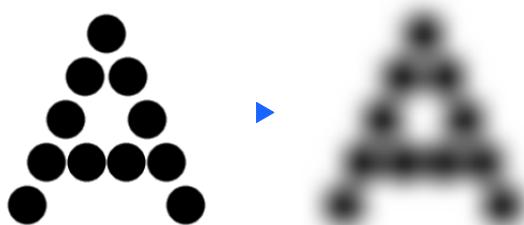
Using this filter leaves areas where there is a sharp contrast while removing smooth change in contrast for the rest of the background.



See "Eliminating Shading and Gradation" (Page 2-497) for more details.

Blur

Blurs the image.



Select [Detail] to set the filter strength (1 to 99), direction (X, Y, XY), and count (1: ON, 0: OFF).

Custom

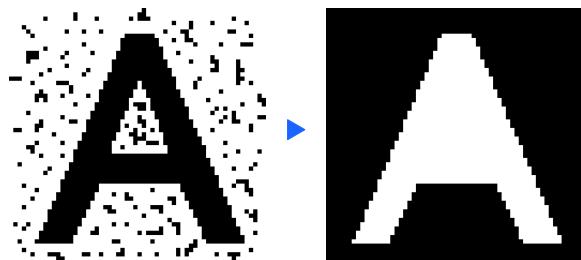
See "Using Basic Custom Filters" (Page 2-499) for more details.

Custom (Advance)

See "Using Advance Custom Filters" (Page 2-500) for more details.

Blob

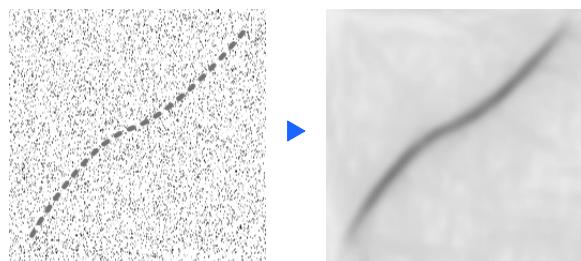
Extracts the desired target by processing the binary image.



See "Extracting Desired Parts of the Image" (Page 2-502) for more details.

Scratch Defect Extraction

Extracts only linear defects by removing the shading variation in the background.



See "Highlighting only scratch defects using the scratch defect extraction filter" (Page 2-502) for more details.

Noise Isolation

Extracts or removes clusters of bright or dark pixels.



See "Removing/extracting clusters of bright/dark pixels using the noise isolation filter" (Page 2-503) for more details.

Contrast Expansion

Improves the image contrast by correcting the brightness distribution in the image.



- **Expansion Width:** Adjusts the intensity of the contrast expansion. Increasing this value will expand the brightness distribution correction width.
- **Noise Cut:** Reduces the noise. Noise occurs especially in the dark areas of the image. Increasing the value will reduce the noise, but the image may become less sharp.

Extracting Defects

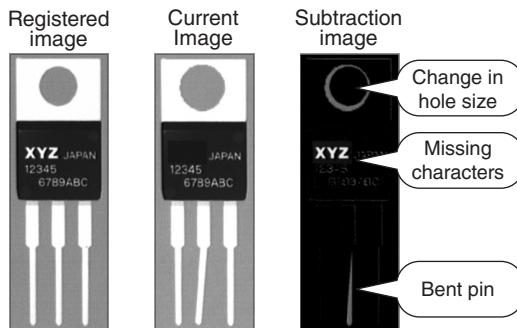
Subtraction Filter

Applying the subtraction filter results in an image which is the absolute difference between the current and registered image. This is useful for isolating differences such as dirt, cracks, and deformation, when comparing a target to a known standard. Using this filter with the defect (Page 2-130) and position adjustment tools makes it easy to find hard to recognize differences due to complex targets or regions.

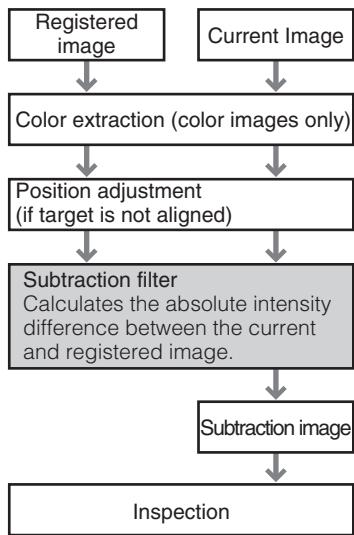
 Point

- The subtract filter cannot be used with Pattern Search, ShapeTrax3, ShapeTrax2, PatternTrax, OCR, OCR2, 2D Code Reader, 1D Code Reader, Image Operation, and C plugins.
- If there is no registered image or the registered image is not set correctly then the filter will not be processed correctly.

Processing image



Subtract filter process



Setting up the Subtract Filter

1 Setup a unit for which the subtract filter should be applied.

In this example, a defect unit is used.

For more details on how to setup a [Defect Unit], refer to "Defect" (Page 2-130).

2 Apply the [Subtract] filter.

From the [Image Enhance] menu select [Subtract].

 Point

When [Subtract] is selected, the currently displayed image is processed, which could cause the screen to go black.

3 Select [Detail].

Mask area

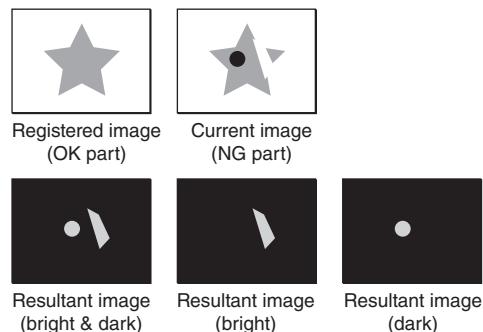
A mask area can be used to cancel noise around profiles that could occur due to differences in the registered image and the current image. Choose the number of repetitions (0 to 9, default 2). A larger number gives better noise suppression, yet reduces the sensitivity to smaller defects.

Extract

Choose a method for extracting areas based on intensity.

- Bright:** Displays areas that are lighter than the registered image.
- Dark:** Displays areas that are darker than the registered image.
- Bright & Dark** (Default): Displays areas that are either lighter or darker than the registered image.

Changes in the subtraction image based on extraction settings.



 Point

- To exclude random shiny areas and extract only dark areas, chose the [Dark] setting.
- To view the results of the filter, change the display image to [Captured Image].

Registered Image

Choose how to process the subtraction filter.

- **Fixed (fast)** (default): Use the processing memory to speed up the processing. In this mode, you cannot reference variables for region settings, color extraction, or image enhancement.
- **Updated each process (slow)**: Uses the image memory to re-calculate the image before subtraction, allowing for variables to be referenced for region, color extraction and image enhancement settings.
- **User updated (fast)**: Uses both the processing and image memory for the subtraction calculation allowing for variables to be referenced for region, color extraction and image enhancement settings. Any change in settings requiring the recalculation of image information needing to use the image memory is applied when the recalculation command (RU) is issued. Refer to the XG-X VisionEditor Reference Manual for more details.

Reference If [User updated (fast)] is selected, changes in settings made via the Region menu (Page 2-473), Color menu (Page 2-483) and Edit Unit menu are applied without the need of the recalculation (RU) command. (The recalculation of the registered image information is done immediately when using the Edit Unit menu, and when [OK] is used with other menus.)

Point

- If there is not enough memory for each operation, a setting error occurs.
- The [Registered Image] cannot be set to [Fixed (fast)] if a variable is assigned to settings that affect the recalculation of image information such as region, color extraction or image enhancement settings. In such cases, remove the referenced variable and change the setting.
- If there are any cameras where the captured image size is 26214400 pixels or larger, it is not possible to set [Registered Image] to [Updated each process (slow)].

Large Area Mode

Checking this box, which is displayed when any camera has a captured image size of 26214400 pixels or larger, will reduce the processing capacity consumed by the subtract filter by approximately half.

Point

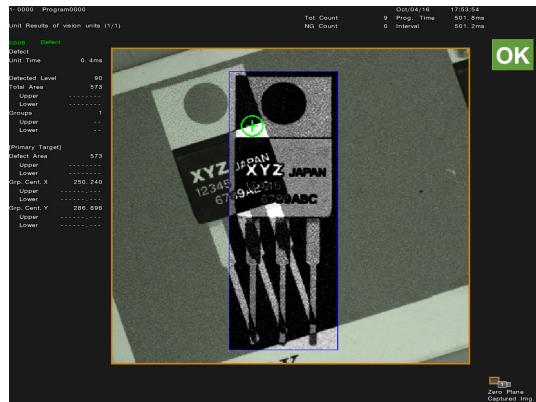
- Checking the box will increase the processing time.
- If the region size is larger than 33554432 pixels, it is necessary to check this box.

4 To apply settings, select [OK].

5 Set a Pattern Search unit to use as the position adjustment unit.

If there is a position change between the registered image and the current image, the subtraction filter will also show such differences. To ensure images align, use position adjustment with a position tool (such as Pattern Search). For more details on how to setup the Pattern Search unit, refer to "Pattern Search" (Page 2-44).

Example of error due to position mismatch



Reference Other tools can be used for position adjustment such as Edge Position (Page 2-88).

6 In the position adjustment unit, choose the Pattern Search unit set in step 5 as the reference.

Refer to "Position Adjustment" (Page 2-306) for more details.

7 In the [Inspection Region] menu set the [Position Adjustment ID] for the position adjustment unit set in step 6.

Reference In addition to position correction intensity correction can also be applied to fix changes in lighting and differences between the images. To reduce the effects of changes in intensity, use the preserve intensity filter before the subtraction filter. Refer to "Reducing the Impact of Changes in Intensity" (Page 2-496) for more details.

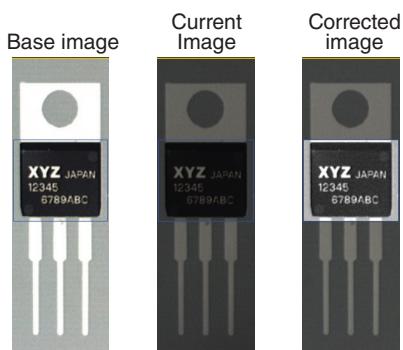
Reducing the Impact of Changes in Intensity

The impact of lighting fluctuations can be reduced by using the Preserve Intensity filter to correct the change in intensity from when the inspection was first configured.

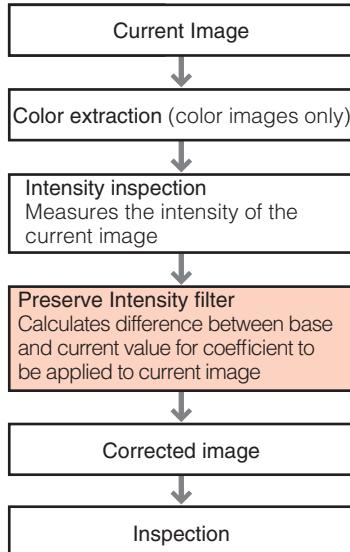
This is especially useful for inspections with a monochrome image where only contrast information is processed.

Point Preserve Intensity cannot be used for the Color unit and Color Grouping unit.

Processing image



Preserve Intensity Filter Process



Setting up the Preserve Intensity Filter



- Be sure to arrange the order on the flow chart so that the Intensity unit is processed before the Preserve Intensity filter is used.
- An image data that can serve as the basis for brightness or an environment where actual capture can be performed is required.
- Set the intensity region in a location with an average intensity level (around 128). If this region is set in a location that is too bright or too dark, adjustment may not be performed properly. Adjustment may be particularly unstable for images with high contrast through color extraction.

1 Apply the [Preserve Intensity] filter.

From the [Image Enhance] menu select [Preserve Intensity].

2 Select [Detail].

The [Preserve Intensity] menu appears.

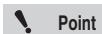
3 Choose the intensity unit in the [Reference Unit ID] and select [Refer unit results] under [Specify Base Value].

To use the current intensity value as the base brightness

Select [Set Base Value].

This registers the current intensity value from the specified unit as the base value.

4 To finish setting, select [OK].



Adjustment is not performed (a coefficient of 1 is used) in the following circumstances:

- The referenced intensity unit has an error,
- The execute condition of the referenced intensity unit is set to [Never Execute],
- The [Count] is set to 0.

Specifying a base value via [User set]

Specify an intensity (0.000 to 255.000) that will serve as the base value in the [Base Value].

Removing Background Information

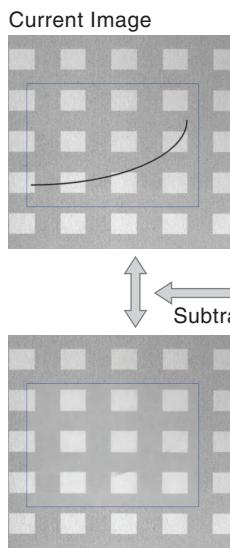
The background of a target can be removed with the Image Extraction filter, by subtracting the current image from a processed version. This filter is very useful for extracting small points or thin lines from a fluctuating background.

- 1 From the [Image Enhance] menu select [Image Extraction] and select [Detail].**
- 2 Choose the aspect to extract ([Dark] or [Bright]), the extraction size (3 to 39 pixels) (2 pixel increments, default: 5), and the direction (X, Y, XY).**



- Unlike the subtraction filter which requires a registered image, the image for subtraction is automatically generated. Thus this filter works in real-time accounting for any changes in the target.
- Increasing the extraction size will lengthen the processing time.
- Set the [Count] (1: ON, 0: OFF) and Border as necessary.

Processing image



Internally generated image
Image is automatically generated by using Expand and Shrink filters.

Border

The way the filter uses pixel data outside of the region for pixels on the border can be selected.

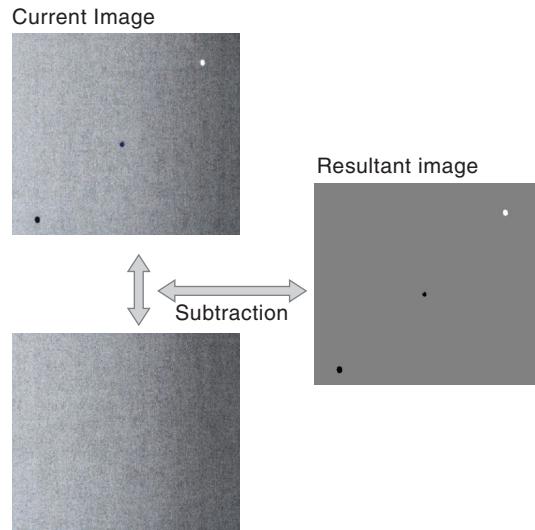
- **ON:** Uses the pixel data outside of the region for pixels on the border.
- **OFF** (default): Extrapolates the pixels on the border for the pixel data.

Eliminating Shading and Gradation

The shading variation across an image can be neutralized with the Shading Correction filter by subtracting the current image from a processed version. Using this filter leaves areas where there is a sharp contrast while the rest of the background is set to a constant value. The background can be smoothed based on using shading, averaging or median filters across the region.

Correction method and correction conditions can be configured by selecting [Detail].

Processing image



Internally generated image
Removes high contrast changes in an image leaving the background.

Changing the filter settings

- 1 Set the [Shading Correction] filter in the desired inspection unit.**

Select [Shading Correction] on the [Image Enhance] screen.

- 2 Select [Detail].**

The [Shading Correction] menu appears.

3 Change the settings as required.

Correction

The shading correction filter processes the current image against a corrected image to highlight areas of sharp contrast. This corrected image is created by removing sharp contrast changes, leaving the background to be processed against the current image.

- **Average Correction:** This method takes the average intensity from the entire inspection region and uses it as the reference to process with the current image.
- **Median Correction:** This method takes the median intensity from the entire inspection region and uses it as the reference to process with the current image.
- **Shading Correction (default):** This method extrapolates a shading curve based on the reduction size, and calculates the difference from the current image in order to correct the image.
- **Shading Correction (HSP):** Suppresses a portion of the shading elimination effect to perform correction faster than [Shading Correction].

Reduction Size

If [Shading Correction] was selected for [Correction], specify the size (4 to 2000, default: 16) of the target to extract (black points, white points, defects, etc.) and the direction (X, Y, XY).

Point Reducing the reduction size will increase the precision of the shading correction but will also lengthen the processing time.

Direction

Select the filter direction (X, Y, XY) (default: XY).

Extract color

Choose the areas to extract based on intensity.

- **Bright:** Displays points that are brighter than their respective background.
- **Dark:** Displays points that are darker than their respective background.
- **Bright & Dark (default):** Displays points that are either darker or lighter than their respective background.
- **Individual:** Choose individually how darker and lighter points should be displayed.

Point

- When [Bright] is selected, the background of the processed image becomes black (0). When [Dark] is selected, the background of the processed image becomes white (255).
- When [Bright & Dark] or [Individual] is selected, the background of the processed image becomes gray (128).

Gain

Set the gain used on the image after correction (0 to 10.0, default: 2.0). Increase the value to increase the contrast on the processed image.

Noise Cut

Eliminates slight noise components from the background (0 to 255, default: 0.0). This eliminates noise below the set level.

Uniform contrast

Use this option to compensate for backgrounds with large shading variations. This helps to keep the contrast in the image uniform and is useful for dealing with lighting fluctuations.

- **OFF** (default): Does not unify the contrast.
- **ON:** Unifies the contrast.

Border

Selects whether to reference the image outside of the inspection region for processing.

- **OFF** (default): Does not reference areas outside of the measurement area.
- **ON:** References areas outside of the measurement area.

4 Use [Count] to set the number of times to apply the filter.

- **1** (default): Use the shading correction filter (ON).
- **0:** Do not use the shading correction filter (OFF).

5 To apply settings, select [OK].

Using Basic Custom Filters

Custom filters can be created and applied to create effects not possible with the standard filters. The intensity of the current pixel is calculated from the coefficient sum of a 3×3 or 5×5 matrix of pixels (referred to as a kernel). This grayscale value can then be shifted accordingly to produce the desired intensity and image.

1 From the [Image Enhance] menu select [Custom].

2 Select [Detail].

The [Custom] menu appears.

3 Use [Size] to choose the filter size.

- **3 x 3** (default): Reference the intensity from a 3×3 matrix of pixels centered around the current pixel being processed.
- **5 x 5**: Reference the intensity from a 5×5 matrix of pixels centered around the current pixel being processed.

4 Use [Shift] to specify the shift value (-255 to 255).

Specify the shift in intensity (default 0).

Point If the calculation results in the grayscale value falling out of the 0 to 255 range the value will be capped at 0 or 255 respectively.

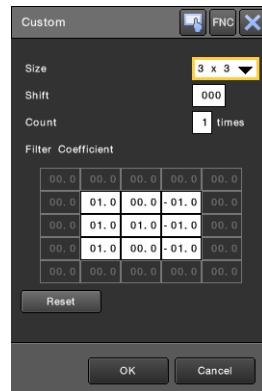
5 Enter the number of times to apply the filter (number of times to apply the filter, 0 to 9, where 0 turns the filter off) in the [Count] field as necessary.

6 Specify the pixel coefficient to be used (-32.0 to 32.0) (default: 1.0 (center pixel) or 0.0).

Point Select [Reset] to reset the kernel.

Basic Custom Filter Example

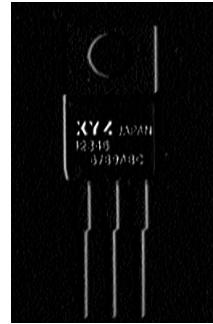
The example below shows how a custom filter can be used to extract light to dark edges in the X direction.



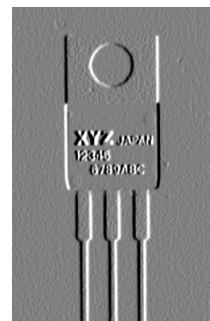
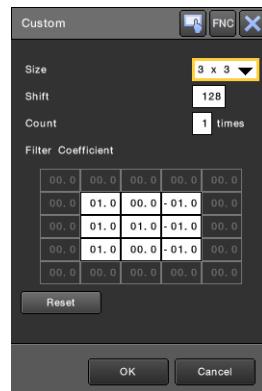
Raw image



Processed image



By setting the shift to 128, the pixels whose intensity was originally capped at 0 due to being a negative value are now adjusted with the rest of the image.



Using Advance Custom Filters

Custom filters can be created and applied to create effects not possible with the standard filters. The intensity of the current pixel is calculated based off of a matrix (3 x 3 to 21 x 21) of pixels (referred to as a kernel). You can choose an operation from expand, shrink, or convolution. This allows you to apply original filtering effects unlike normal filters.

1 From the [Image Enhance] menu select [Custom Advance].

2 Select [Detail].

The [Custom (Advance)] menu appears.

3 Use [Size] to choose the filter size.

- **3 x 3:** Reference the intensity from a 3 x 3 matrix of pixels centered around the current pixel being processed.
- **5 x 5:** Reference the intensity from a 5 x 5 matrix of pixels centered around the current pixel being processed.
- **7 x 7:** Reference the intensity from a 7 x 7 matrix of pixels centered around the current pixel being processed.
- **9 x 9:** Reference the intensity from a 9 x 9 matrix of pixels centered around the current pixel being processed.
- **11 x 11:** Reference the intensity from a 11 x 11 matrix of pixels centered around the current pixel being processed.
- **13 x 13:** Reference the intensity from a 13 x 13 matrix of pixels centered around the current pixel being processed.
- **15 x 15:** Reference the intensity from a 15 x 15 matrix of pixels centered around the current pixel being processed.
- **17 x 17:** Reference the intensity from a 17 x 17 matrix of pixels centered around the current pixel being processed.
- **19 x 19:** Reference the intensity from a 19 x 19 matrix of pixels centered around the current pixel being processed.
- **21 x 21:** Reference the intensity from a 21 x 21 matrix of pixels centered around the current pixel being processed.

Point If the filter size is changed after being set, a screen confirming the clearing of the filter coefficients will appear.

4 Use [Operation] to choose the kernel processing.

- **Convolution:** Performs the same operation as the custom filter (Page 2-499).
- **Expand:** Applies the expand filter (Page 2-490) by referencing intensity of pixels with a coefficient of 1 in the kernel.
- **Shrink:** Applies the shrink filter (Page 2-490) by referencing intensity of pixels with a coefficient of 1 in the kernel.

Point If the filter method is changed after being set, a screen confirming the clearing of the filter coefficients will appear. Moreover, if the filter is changed from [Convolution] to any other filter, convolution-related settings will also be cleared.

5 Specify a numerical variable array in the [Filter Coefficient] field and use [Coeff. Setting] to set the kernel.

The [Coeff. Setting] menu appears.

Refer to "Specifying the pixel coefficients (kernel)" (Page 2-501) for more details about using the [Coeff. Setting] menu.

Point Make sure the numerical array has more elements than required by the kernel (example: 225 or more elements for a 15 x 15 filter).

6 Specify a divisor in [Divisor] as necessary (0.001 to 99999.999).

Specify the value to divide the calculation result by, before shifting the resultant value.

Point This option is only available if [Convolution] is selected for [Operation].

7 Use [Shift] to specify the shift value (-255 to 255).

Specify a value to add to the calculation result. This value is added to all pixels.

Point This option is only available if [Convolution] is set for [Operation].

8 Choose how negative values should be handled with [Negative Pixel Correction].

This specifies how pixel values that become negative after calculation are handled.

- **Fixed to 0:** Clips values less than 0 to 0.
- **Absolute Value:** Converts negative values to their absolute value.

Point This option is only available if [Convolution] is set for [Operation].

9 Enter the number of times to apply the filter (0 to 9) in the [Count] field as necessary.

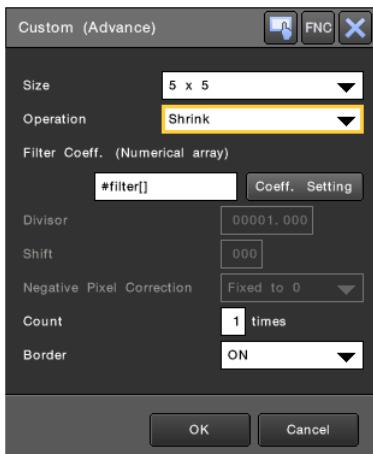
10 Specify the [Border] option as necessary.

Specify whether to apply the filter by referencing the image outside the inspection area.

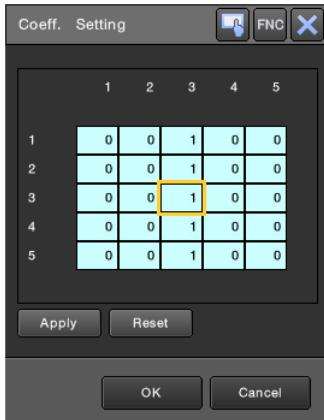
- **ON:** The image outside the area affects the filtering process.
- **OFF:** The image outside the area has no effect on the filtering process.

Advance Custom Filter Example

The example below shows how to apply a shrink filter of a specified size only in the Y direction.

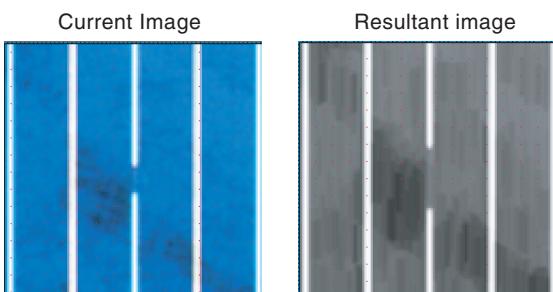


Use the [Coeff. Setting] menu to set the kernel.



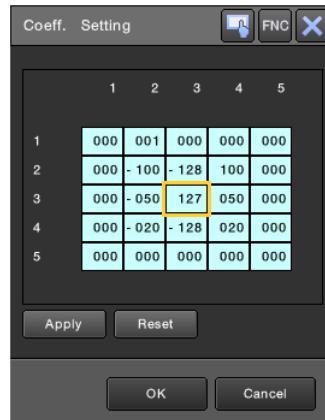
Processing result

The defect (gap) of the white line is widened in the Y direction but no change is made to the width in the X direction.



Specifying the pixel coefficients (kernel)

For the Convolution operation



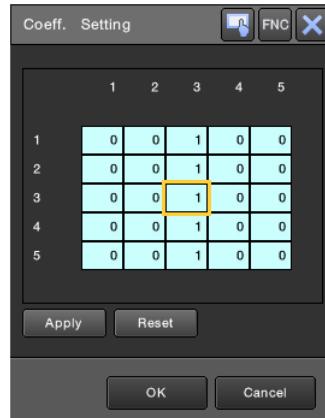
Available range is -128 to 127.



Point

Values outside the range will result in an error.

For the Expand or Shrink Operation



Available range is 0 or 1



Point

Values outside the range will result in an error.

Reset

Select [Reset] to reset the filter coefficient values.



The kernel is reset under the following conditions:

- Changes to the kernel [Size].
- Changes to the filter [Operation].
- [Reset] was selected on the [Coeff. Setting] screen.
- Changes to the scalar array used for the kernel.

Extracting Desired Parts of the Image

The blob filter enables the only the desired parts of a binary image to be extracted based on size, shape and other characteristics. While at the same time filling in holes and allowing for the inclusion / exclusion of blobs on the border.

-  **Point** Convert the image to a binary image using the Binary filter before setting the blob filter. Otherwise, the blob filter will not function properly.

1 From the [Image Enhance] menu select [Blob].

2 Select [Detail].

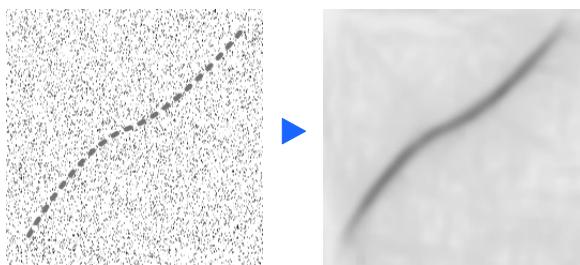
The [Blob] menu appears.

3 Select extraction criteria.

Change the parameters as required such as the blob color, count and so on. The image enhancement blob filter functions the same way as the blob filter of Image Operation Conversion does. Refer to "(9) Blob" (Page 2-387) for more details.

Highlighting only scratch defects using the scratch defect extraction filter

You can generate a reduced image from the current image for speedup and noise cut and create a background image representing the gradual shading change in the background. An image enhancement that highlights only scratch defects is applied on the image after background removal (in which gradual shading change has been removed), which has been obtained by calculating the differences between the background image and the original reduced image.



This section describes the operation example to emphasize only linear defects by using the Scratch Defect Extraction filter.

1 Select [Scratch Defect Extraction] on the [Image Enhance] screen.

2 Select [Detail].

3 Change the settings as required.

Processing Method

Select the method to perform the scratch defect extraction operation.

- **Scratch Defect Extraction:** Even if there is a lot of interference on the image, scratch defects can be stably extracted, but processing takes a great deal of time.
- **High-Speed Scratch Defect Extraction:** While processing can be performed at high speed, areas that are not defects may be mistakenly extracted if there is a lot of interference on the image.

Reduction

Increasing the reduction level will improve the processing speed, but thin scratch defects will become more difficult to extract.

Extract Size (Only when [Scratch Defect Extraction] is selected for [Processing Method])

Increasing the value will make it easier to extract thick scratch defects.

Extract Tone

Select the tone to be extracted as scratch defects.

- **Bright:** Only extracts the scratch defects that are brighter than the background.
- **Dark:** Only extracts the scratch defects that are darker than the background.
- **Bright & Dark:** Extracts both bright and dark scratch defects.

Gain

Increasing the gain will improve the image contrast. Contrast improvement will be applied to the image where the background has been removed.

Linearity

Increase the value when the scratch defect to be extracted is a straight line. Decreasing the value makes it easier to extract scratch defects with a large curvature.

Linear Length (Only when [Scratch Defect Extraction] is selected for [Processing Method])

Increasing the value will make it easier to extract long scratch defects. Reduce the value if you wish to extract short scratch defects.

Noise Cut (Only when [High-Speed Scratch Defect Extraction] is selected for [Processing Method])

Removes minute noise elements.

Extraction Direction

Specify the direction of the scratch defects to be extracted.

- **All Angles:** Extracts scratch defects in all directions.
- **Specify Angle:** You can increase the processing speed by limiting the direction of the scratch defects to be extracted. The direction is specified by setting the starting angle and the angle range.

Starting Angle

You can specify the range of directions for the scratch defects to extract using a combination of "Starting angle ± Angle range".

Angle Range

You can specify the range of directions for the scratch defects to extract using a combination of "Starting angle ± Angle range".

4 After completing the settings, select [OK].

-  **Point** In the following cases, you cannot set Registered Image of Pattern Search, ShapeTrax3, ShapeTrax2 and PatternTrax to [Fixed (fast)].
- In case the Processed Image Region is specified when the Scratch Defect Extraction filter is used
 - In case the search region is specified with a variable when the Scratch Defect Extraction filter is used

Removing/extracting clusters of bright/dark pixels using the noise isolation filter

You can generate a reduced image from the current image for speedup and noise cut and convert the grayscale values of the target tone according to the set area value. The cluster of pixels of the specified size or smaller will be marked as processing targets.

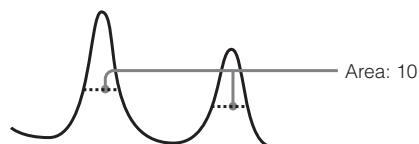


Processing image

Example 1

- Process Type: Remove
- Target Tone: Bright
- Area: 10
- Image profile

Before processing

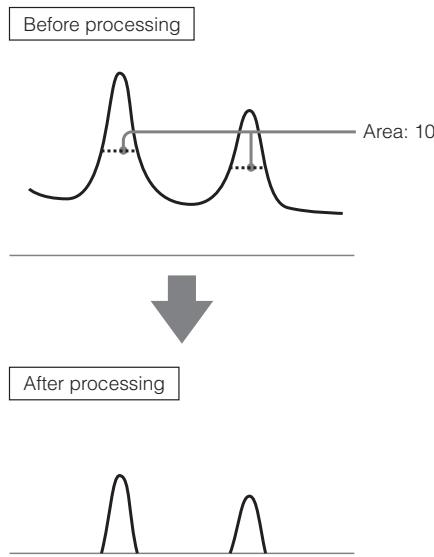


After processing



Example 2

- Process Type: Extract
- Target Tone: Bright
- Area:10
- Image profile

**Changing Filter Settings**

This section describes the operation example to remove/extract the bright/dark pixel clusters by using the Noise Isolation filter.

- 1 Select [Noise Isolation] on the [Image Enhance] screen.**
- 2 Select [Detail].**
The [Noise Isolation] screen appears.
- 3 Change the settings as required.**

Target Tone

Specifies the clusters of pixels of the specified tone as processing targets.

- **Bright:** Specifies the clusters of bright pixels as processing targets.
- **Dark:** Specifies the clusters of dark pixels as processing targets.

Process Type

Select how to process the specified clusters of pixels.

- **Remove:** Removes the specified clusters of pixels.
- **Extract:** Extracts only the specified clusters of pixels.

Area

Marks the clusters of pixels of the specified size or smaller as processing targets.

Reduction

Increasing the reduction level will reduce the calculation accuracy of the processing target area, but the processing speed will be faster.

- 4 After completing the settings, select [OK].**



In the following cases, you cannot set Registered Image of Pattern Search, ShapeTrax3, ShapeTrax2 and PatternTrax to [Fixed (fast)].

- In case the search region is specified with a variable when the Noise Isolation filter is used
- In case the Processed Image Region is specified when the Noise Isolation filter is used

Improving the image contrast by correcting the brightness distribution in the image using the Contrast Expansion filter

Improves the image contrast by correcting the brightness distribution in the image.



Point

- You cannot select the contrast expansion filter in the Pattern Search, ShapeTrax3, ShapeTrax2, and PatternTrax measurement.
- You cannot use the contrast expansion filter for several times in one measurement unit.
- You cannot use the contrast expansion filter for the height image (at 3D measurement).
- You cannot use the contrast expansion filter together with the Subtract filter.

1 Select [Contrast Expansion] on the [Image Enhance] screen.

2 Select [Detail].

The [Contrast Expansion] screen appears.

3 Change the settings as required.

Expansion Width

Adjusts the intensity of the contrast expansion. Increasing this value will expand the brightness distribution correction width.

Noise Cut

Reduces the noise. Noise occurs especially in the dark areas of the image. Increasing the value will reduce the noise, but the image may become less sharp.

4 After completing the settings, select [OK].

Chapter **3** Run

Features Available in Run Mode

This section explains the various built-in functions available during Run mode.

Run

Documentation for the installation and configuration methods of the controller, software, and CAD data can be downloaded from the following URL.

www.keyence.com/xgx_support

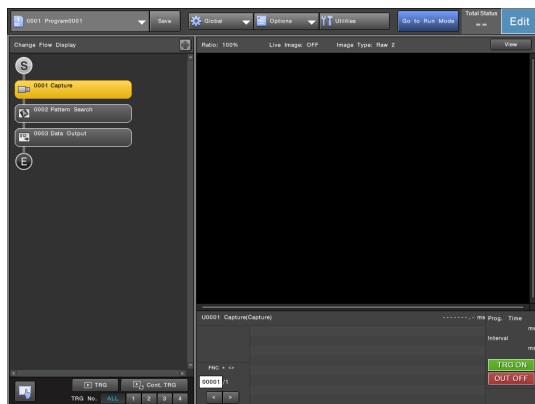
Starting/Ending Inspections

Run

Running Inspections

1 Turn on the controller.

The controller displays the startup screen, automatically loads the last saved program file (Page 2-17), and starts up in Setup mode.



- Depending on the settings, the controller may start up in Run mode and/or the startup screen may have been changed.
- To start up the controller in Run mode when it is turned on, change the [Startup Settings] (Page 6-6) in the system settings.

If the program to be loaded does not exist

If the specified program file cannot be loaded from the SD card, the controller will stop in the state where an error message is displayed without starting the inspection. Select [Close] on the error screen and choose an operation from the following menu options.

- Create a new program:** To create a new program.
- Change Programs:** Change to a different program.

2 Select [Go to Run Mode] at the top of the screen.

The controller switches to Run mode.

3 If using an external trigger, input trigger signals.

This starts capture and image processing.



- Depending on the settings, the controller may be configured to start capturing and processing images as soon as it is placed in Run mode without the need of an external trigger.

Changing Programs

This function allows the change of the inspection content to run to a different user specified program stored on an SD card in the controller.

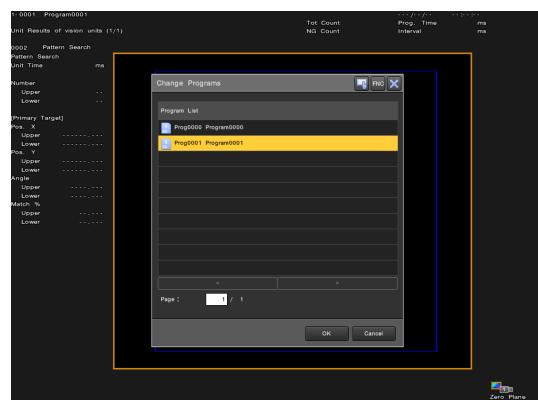
NOTICE	<p>During the program change, the controller will read from and write to the SD card where the program data is stored. The flash memory is used as the storage element in the SD card and it has a read/write life. Corruption and or loss of data may result if programs are frequently changed. It is strongly recommended that data stored on the SD card is backed up regularly to other storage media.</p>
---------------	---



- Changing the program will stop the inspection in progress and clear all archive and statistics data in the controller's memory. Any unsaved variables being used in the current program will also be cleared and returned to their initial values.
- If terminal outputs, measurement value outputs, and image outputs were being executed during switching operations, then the program setting switching cannot be performed until the data outputs can be interrupted. If the size of the data being output is large, such as image data, it may take several tens of seconds or more before the program can be switched. During this time, the controller will be inoperable. For more details, refer to "Output Units" in the XG-X VisionEditor Reference Manual.

1 From the [Function] menu (Page 3-4), select [Program] - [Change Programs].

The [Change Programs] menu appears with the current program selected.



- The icon to the left of the program indicates whether the program is stored on SD Card 1 or SD Card 2.
- Both SD Card 1 and SD Card 2 can individually manage up to 1000 programs each (0000 to 0999). The actual number of programs that can be set will depend on the available space on the SD card.

2 Select the program to change to from the list.

3 Select [OK].

The controller changes to the selected program.

Reference Program changes can also be made via an external command.

Loading a different program file immediately after turning power ON

The program file loaded when the controller is turned on is either the last saved program, or the startup program No. specified in XG-X VisionEditor. To change it, switch to the desired program (Page 3-2) to load immediately after startup, save it, and then switch the power back on.

Reference The file does not need to be saved if the program is being changed by the handheld controller.

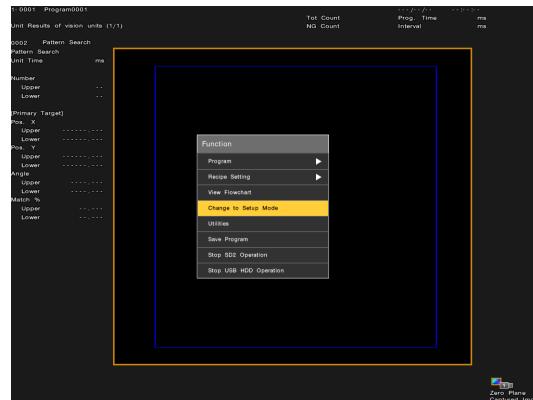
Stopping / Ending Inspections

Stopping Inspections

Switching to Setup mode stops the current operation.

From the [Function] menu (Page 3-4), select [Change to Setup Mode].

The controller switches to Setup mode.



When the controller switches to Setup mode

The measurement result output cancels the subsequent outputs after completing the data output for one measurement that has been executed at the point when the switching was started.

Returning to Run Mode

From the [Function] menu in Setup mode, select [Change to Run Mode].

The inspection will start.

Ending Inspections

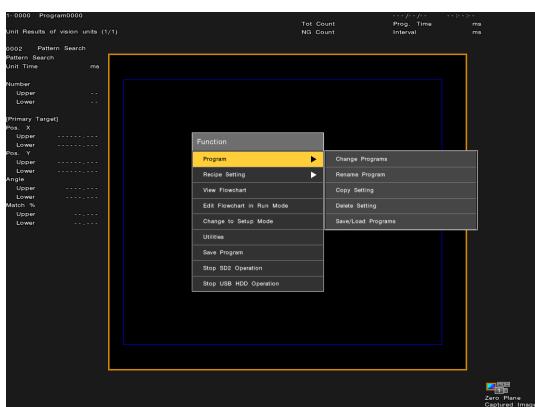
Make sure that the controller is not accessing an SD card or a USB HDD, and then turn off the controller.



Turning off the controller while it is accessing an SD card or USB HDD may damage and or corrupt the data being saved as well as the SD card or USB HDD.

Using the [Function] menu in Run Mode

The [Function] menu provides access to built-in functions of the system. Press the No. 1 (FUNCTION) button on the handheld controller to display the [Function] menu and then choose the function to use.



Some or all [Function] menu operations may be restricted depending on the user account settings (Page 5-41).

To close the [Function] menu

Press the No. 1 (FUNCTION) button or the No. 2 (ESCAPE) button.

[Function] menu Options



The [Function] menu displays different items based on the operating mode of the controller and item currently selected.

Program

- **Change Programs:** Switches the currently running program to the user specified program stored on the controller's SD card (Page 2-6).
- **Rename Program:** Change the name of a program. For more details, see "Renaming a Program" (Page 2-18).
- **Copy Setting:** Copy a program. For more details, see "Copying a Program" (Page 2-18) .
- **Delete Setting:** Delete a program. For more details, see "Deleting a Program" (Page 2-19).
- **Save/Load Programs:** Saves or loads a program. For more details, see "Saving/Loading Programs (Export/Import)" (Page 2-20).

Recipe Setting

For more details on the recipe function, see "Retaining and Using Different Settings for Each Type (Recipe Function)" (Page 8-194).

View Flowchart/End Viewing

The flowchart can be displayed or hidden.

Edit Flowchart in Run Mode

You can edit the flowchart content while the controller is running. For details, see "Editing the Flowchart in Run Mode (Edit Flowchart in Run Mode)" (Page 5-22).

Change to Setup Mode

The controller switches to Setup mode.

Utilities

Opens the [Utilities] screen (Page 5-2) to access various operation support functions.

Save Program

The present state is saved to the program file (Page 2-17).

Stop SD2 Operation

Performs the process of preparing the SD card 2 for removal.

Stop USB HDD Operation

Performs the process of preparing the USB HDD for removal if a USB HDD is being used.

Chapter 4

Options

Options

Documentation for the installation and configuration methods of the controller, software, and CAD data can be downloaded from the following URL.

www.keyence.com/xgx_support

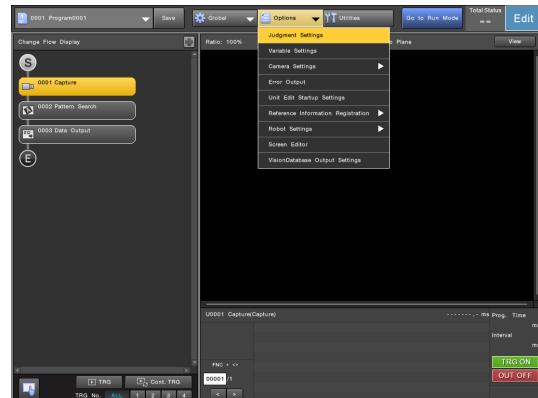
Measurement-Related Settings (Options Menu)

▶ Measurement-Related Settings (Options Menu)

Controller Display Screen Settings (Screen Editor)

Overview of the Options Menu

The following settings can be changed via the [Options] menu at the top of the Setup mode screen.



- Specifying the Unit(s) to be Used for Total Status and Camera Judgment Outputs (Judgment Settings) (Page 4-3)
- Changing the Variable Settings (Variable Settings) (Page 4-4)
- Specifying the Model of the Connected Camera (Camera Selection) (Page 4-11)
- Changing the Settings for Capturing Asynchronously to the Flow (Image Capture Buffer Settings) (Page 4-12)
- Setting the Scaling Correction Values for Each Camera (Scaling) (Page 4-18)
- Specifying the Units which Are to Be Used As Unit Total Error Output (Error Output) (Page 4-19)
- Changing Operations for When the Unit Is Being Set (Unit Edit Startup Settings) (Page 4-20)
- Registering All of the Registered Image Information which Is to Be Referenced from Registered Images (Update Registered Image Information) (Page 4-21)
- Registering the Reference Position Information of the Position Adjustment Units in the Program All at Once (Update Reference Position Information) (Page 4-22)
- Robot Settings: For more details about this function, contact your local KEYENCE office.
- Controller Display Screen Settings (Screen Editor) (Page 4-25)
- Setting the Server Information for FTP Output (Target FTP Server Settings) (Page 4-23)
- VisionDatabase Output Settings: For more details about this function, see the Database Software for the Image Processing System VisionDatabase User's Manual .
- Locking / Unlocking Group-Lock (Lock/Unlock Group-Lock) (Page 4-24)

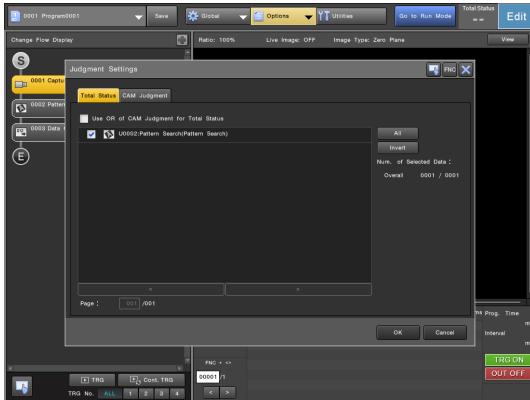
Specifying the Unit(s) to be Used for Total Status and Camera Judgment Outputs (Judgment Settings)

Specify the judgment conditions for the [Total Status Judgment] (%JgAll and %JAHold) and [Camera Judgments] (%Cam*Jg) statuses by specifying the [Total Status] and [CAM Judgment] conditions.

- Total Status Judgment:** The logical sum (OR function) of the judgment values of the specified units are used as the result for %JgAll and %JAHold. However, if [Use OR of CAM Judgment for Total Status] is checked in the [Total Status] tab, the logical sum of each camera judgment will be the result for %JgAll and %JAHold.
- Camera Judgments:** The logical sum (OR) of the judgment values (OK=0, NG=1) of the selected units in each camera. The judgment for a camera that is not set is treated as OK (0).

1 From the [Options] menu, select [Judgment Settings].

The [Judgment Settings] screen appears.



2 Select the [Total Status] tab and select and check the units to be used for total judgment status output.

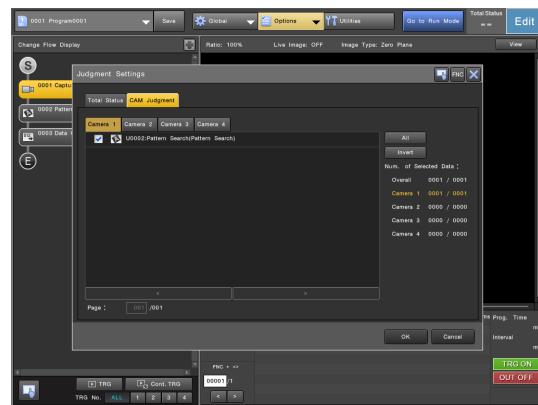
The logical sum (OR function) of the unit judgment values of the checked units is used as the result for %JgAll and %JAHold.

Use OR of CAM Judgment for Total Status

If this option is checked, the logical sum value of each camera judgment set in the [CAM Judgment] tab is used as the result for %JgAll and %JAHold.

3 Select the [CAM Judgment] tab and select and check the units to be used for camera judgment for each camera.

The logical sum (OR function) of the unit judgment values of the checked units is used as the camera judgment (%Cam*Jg) for each camera.



4 Select [OK].

Changing the Variable Settings (Variable Settings)

Variables are used for referencing result data from units results or for setting parameters and controlling a units operation.

- Variables can also be used to process data between units, programs and to store calculation results.
- Variables also cover system inputs, outputs and image control in the system.

XG-X2000 Series Variable Types

The following are the categories and types of variables supported by the controller along with their naming convention and processing rules.

Variable Categories

System variable

These are pre-defined, read only variables managed by the system.

These variables include I/O and some values can be controlled through the command functions. Refer to the XG-X2000 Series Communications Control Manual for the list of system variables provided in the controller.

User variable

These are user definable variables, divided into two categories depending on the scope of use.

- **Local Variables:** Variables that are only defined and available in the program. Up to 10000 can be defined and used.
- **Global Variables:** Variables that are defined and usable across multiple programs on a single controller. Up to 1024 can be defined and used.

Image variable

These are user definable variables for storing image data. Up to 512 image variables can be defined and used per program.

- **System image variables** (&Cam1Img to &Cam4Img): These are image variables managed by the system. A variable is pre-assigned to each camera and used in the capture unit (Page 2-25) and cleared at the start of the flowchart .
- **User image variables:** These are user managed image variables and the stored image is kept until it is overwritten or the system is reset.
By using a user defined image variable as a result image in a defect unit (Page 2-130), a grayscale blob unit (Page 2-153), a defect unit (Page 2-130), an image operation unit (Page 2-373), and a defect unit (Page 2-407) the process performed in the unit can be checked.

Temporary variables

A temporary variable can only be used in a calculation unit (Page 2-317), and does not require definition in the [Variables] menu. See "Temporary variables" (Page 2-321) for more details.

Point

- The number of variables available varies depending on the amount of resources currently used.
- The maximum number of image variables depends on the type of connected cameras set in the capture unit and the amount of free image memory. As the amount of image memory varies depending on the type of camera (color and resolution, capture range, and scanning method), changes to the type of connected camera set with the capture unit may result in an error due to insufficient image memory.
- The number of user defined image variables maybe changed through unit properties, image archive criteria, or other settings.

Types of variables

User variable

The type of user variables are as follows. All types also have the functionality to be set as an array.

Type	Naming Convention	Internal storage type
Numerical	Variable name	64-bit floating point number
Position	Variable name.X (X coordinate)	64-bit floating point number
	Variable name.Y (Y coordinate)	64-bit floating point number
Line*	Variable name.T (q)	64-bit floating point number
	Variable name.RH (r)	64-bit floating point number
Circle	Variable name.CX (center of circle X coordinate)	64-bit floating point number
	Variable name.CY (center of circle Y coordinate)	64-bit floating point number
	Variable name.CR (circle radius)	64-bit floating point number
3D Position	Variable name.TX (X coordinate)	64-bit floating point number
	Variable name.TY (Y coordinate)	64-bit floating point number
	Variable name.TZ (Z coordinate)	64-bit floating point number
Plane**	Variable name.PPA	64-bit floating point number
	Variable name.PPB	64-bit floating point number
	Variable name.PPC	64-bit floating point number

* Line variable notation

- T(θ): The clockwise angle from the 3 o'clock direction of the line perpendicular to RH (p) as 0°
- RH(p): The length of the perpendicular line that connects the straight line from the origin (0,0).

**The following is the plane-type notation.

PPA, PPB, PPC: The value of each factor when the plane is expressed as $z=PPAx+PPBy+PPC$

Image Variables

Image variables are associated by camera type and image area along with connected camera number. Image variables also have the functionality to be set as an array.

Point

- The camera type information is automatically determined by the camera settings (Page 4-11).
- A multi-camera type image variable is also available for use in the image stitching unit.

Initial Value

- The initial value of a variables can be defined when the variable is setup.
- The initial values are stored together with all variable settings in the following files.

Type	Save location
Local variables	Program files (inspect.dat) under each program folder Saved for each program.
Global variables	Global variable files (gvar.dat) on SD1

- An initialization is performed whenever the controller is turned on, reset, or a program is switched. The initialization of a variable on a reset or program switch can be set when defining the variable.

Reference When a program is saved, the current variable value can be copied over the initial value so when the program is used again the previous current value is used.

Variable naming rules

- A variable name can contain up to 32 alphanumeric characters (including the variable prefix).
- Variable prefixes are shown in the table below.

Variable type	Naming rule prefix
System variable	%
User variable	#
	\$
Image variable	&
Temporary variables (used in calculation units (Page 2-317) only)	@

- Variable names are case sensitive.
- Each variable name must be unique within its scope of use.
- Symbols other than the prefix symbols and underscore (_) cannot be used.

Save location of variables

Defined variables are saved in the program file.

The save location differs for local and global variables.

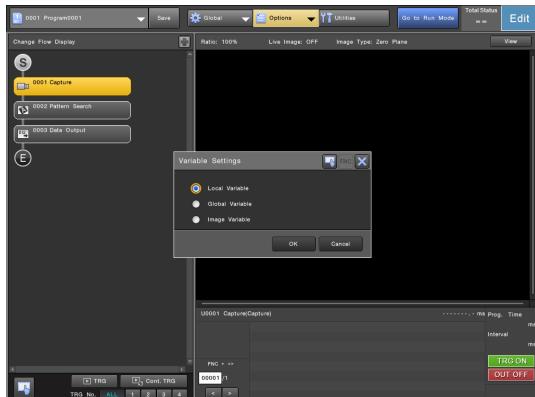
Type	Save location
Local variables	Program files (inspect.dat) under each program folder Saved for each program.
Global variables	Global variable files (gvar.dat) on SD1

Point The program file name is fixed, if a inspect.dat file is renamed, the system cannot reference the file.

Defining and editing local variables

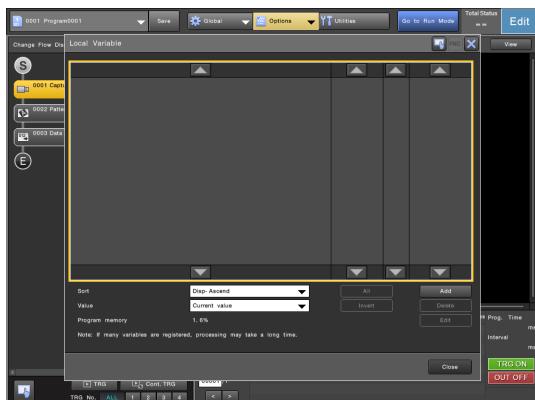
1 From the [Options] menu, select [Variable Settings].

The [Variable Settings] menu appears.



2 Select [Local Variable] and then select [OK].

The [Local Variable] menu appears.

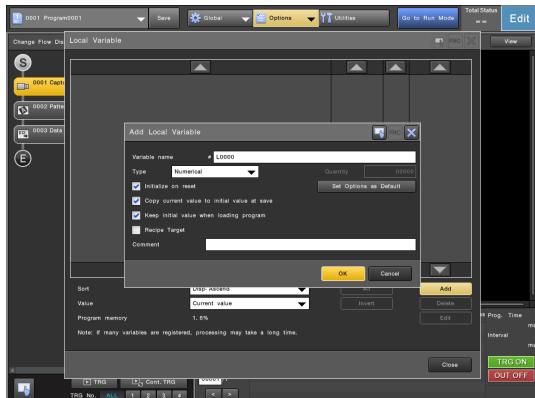


- Sort:** Choose the order to display the local variables.
- Value:** Choose the variable value to be displayed.
- Program memory:** Shows the current program memory usage.

Point If the program memory usage exceeds 100% after defining a variable, the definition is cancelled.

3 Select [Add].

The [Add Local Variable] menu appears.



4 Defining a local variable.

- Variable name:** Specify the name of the local variable.
- Type:** Choose the local variable type (Page 4-5).
- Quantity:** Specify the number of elements in an array based variable.
- Initialize on reset:** Choose whether to reset the variable value on reset. When this is checked, an initialization is performed on reset.
- Copy current value to initial value at save:** Choose whether to copy the current value to the initial value when the program is saved. When this is checked, the initial value on the controller can be kept without being overwritten depending on the setting at the time of uploading.
- Keep initial value when loading program:** Choose whether to keep the initial value of the variable on the controller when uploading a program from XG-X VisionEditor. When this is checked, the current value is copied to the initial value at save.
- Comment:** Enter any comments (up to 64 single-byte characters) to associate with the variable. To aid developments comments are shown when variables are referenced in unit parameters and calculations (Page 2-317).
- Set Options as Default:** Setting status of [Initialize on reset], [Copy current value to initial value at save], and [Keep initial value when loading program] of the variables which are currently specified will be used as default setting when variables are added.



If the variable is edited and [Copy current value to initial value at save] is selected, the current value is set as the initial value.

5 Select [OK].

Editing a local variable

Select the local variable to edit and select [Edit].

To edit the current value or initial value, change the item shown in the [Value] field and then change the value in the right column.



Two or more variables can not be selected simultaneously.

Deleting a local variable

Select the local variable to delete and select [Delete].

Select [OK] on the confirmation message.

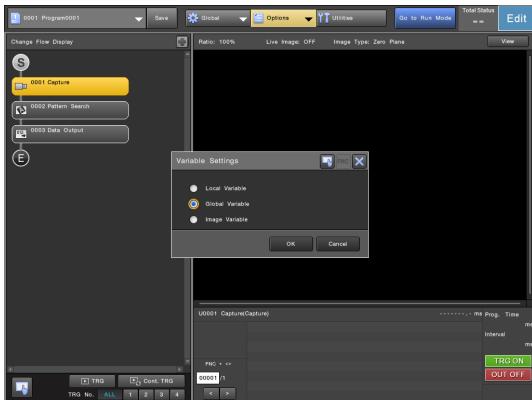


Two or more variables can be selected for mass deletion.

Defining and editing global variables

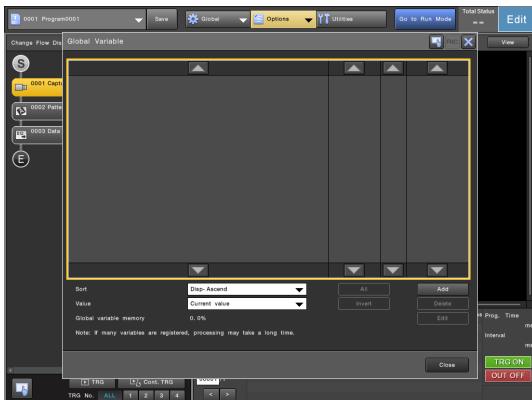
1 From the [Options] menu, select [Variable Settings].

The [Variable Settings] menu appears.



2 Select [Global Variable] and then select [OK].

The [Global Variable] menu appears.

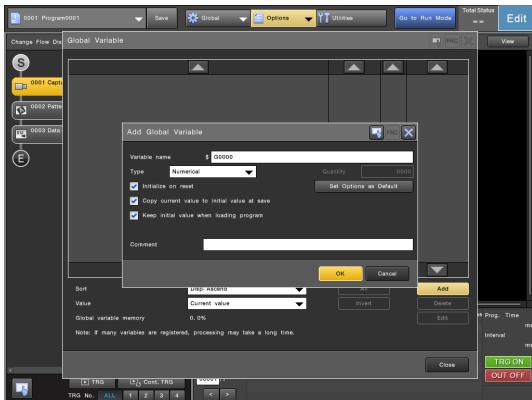


- Sort:** Choose the order to display the global variables.
- Value:** Choose the variable value to be displayed.
- Global variable memory:** Shows the current global variable memory usage.

Point If the global variable memory usage exceeds 100% defining a variable the definition is cancelled.

3 Select [Add].

The [Add Global Variable] menu appears.



4 Defining a global variable.

- Variable name:** Specify the name of the global variable.
- Type:** Choose the global variable type (Page 4-5).
- Quantity:** Specify the number of elements in an array based variable.
- Initialize on reset:** Choose whether to reset the variable value on reset. When this is checked, an initialization is performed on reset.
- Copy current value to initial value at save:** Choose whether to copy the current value to the initial value when the program is saved. When this is checked, the initial value on the controller can be kept without being overwritten depending on the setting at the time of uploading.
- Keep initial value when loading program:** Choose whether to keep the initial value of the variable on the controller when uploading a program from XG-X VisionEditor. When this is checked, the current value is copied to the initial value at save.
- Comment:** Enter any comments (up to 64 single-byte characters) to associate with the variable. To aid developments comments are shown when variables are referenced in unit parameters and calculations (Page 2-317).
- Set Options as Default:** Setting status of [Initialize on reset], [Copy current value to initial value at save], and [Keep initial value when loading program] of the variables which are currently specified will be used as default setting when variables are added.

Point If the variable is edited and [Copy current value to initial value at save] is selected, the current value is set as the initial value.

5 Select [OK].

Editing a global variable

Select the global variable to edit and select [Edit].

To edit the current value or initial value, change the item shown in the [Value] field and then change the value in the right column.

Point Two or more variables can not be selected simultaneously.

Deleting a global variable

Select the global variable to delete and select [Delete].

Select [OK] on the confirmation message.

Reference Two or more variables can be selected for mass deletion.

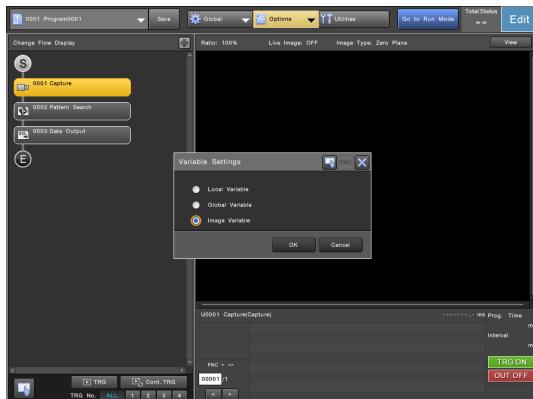
Defining and editing image variables



In image variables, &Cam1Img to &Cam4Img are defined as system image variables by default and cannot be edited.

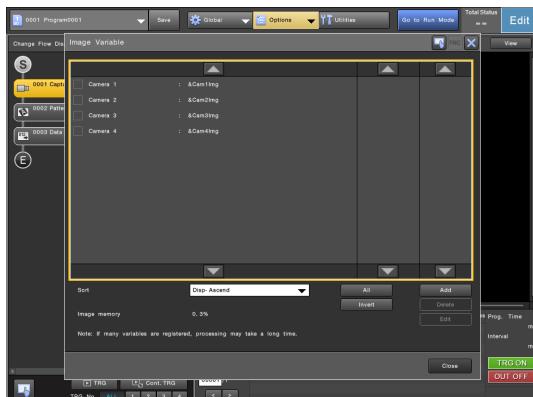
1 From the [Options] menu, select [Variable Settings].

The [Variable Settings] menu appears.



2 Select [Image Variable] and then select [OK].

The [Image Variable] menu appears.



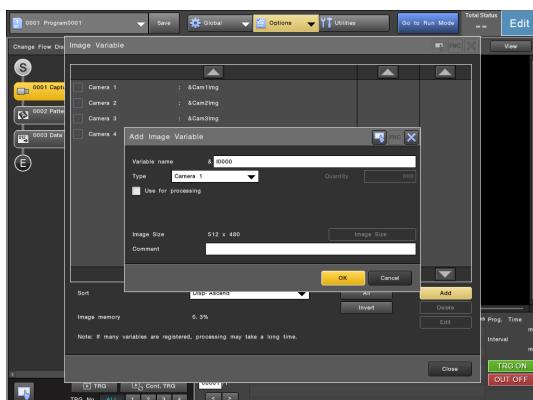
- Sort:** Choose the order to display the image variables.
- Image memory:** Shows the current image memory usage.



If the image memory usage exceeds 100%, after defining a variable the definition is cancelled.

3 Select [Add].

The [Add Image Variable] menu appears.



4 Define an image variable as required.

- Variable name:** Specify the name of the image variable.
- Type:** Choose the camera No. associated with the image variable.
- Quantity:** Specify the number of elements in an array based variable.
- Use for processing:** Choose whether to make this image variable available for unit processing (defect unit (Page 2-130), grayscale blob unit (Page 2-153), image operation unit (Page 2-373) and calibration unit (Page 2-407)) or as a display image variable. Image variables can also be used for defining regions based on image data. Refer to "Generating a Region from an Image (Processed Image Region)" (Page 2-482) for more details.
- Comment:** Enter any comments (up to 64 single-byte characters) to associate with the variable. To aid development comments are shown when image variables are referenced in image operation (Page 2-373).

5 Select [OK].

Editing a image variable

Select the image variable to edit and select [Edit].

Deleting a image variable

Select the image variable to delete and select [Delete]. Select [OK] on the confirmation message.

Assigning variables to Parameters

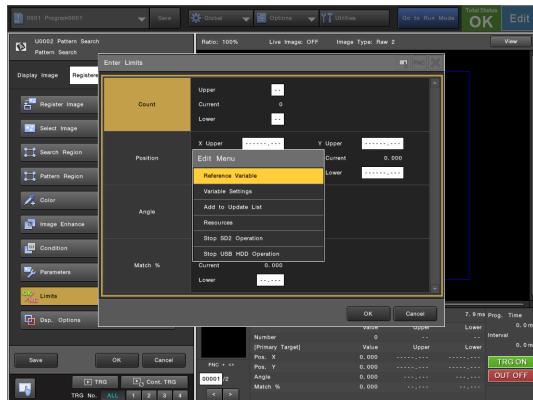
If a unit has parameters which support variable referencing, a variable can be assigned to control or change the parameters externally, or to tie multiple settings to one central point.

Reference Refer to "List of Setting Parameters" in the XG-X2000 Series Communications Control Manual for more details about the parameters that can be assigned and the supported variables.

- 1 Select the value input field of the setting parameter to assign a variable.**
- 2 Press the No.1 (FUNCTION) button on the handheld controller.**

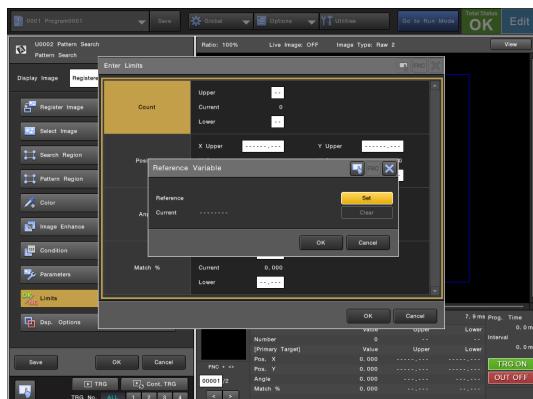
The [Edit Menu] is displayed.

Example: Using a variable for the [Upper] of an Pattern Search



- 3 Select [Reference Variable].**

The [Reference Variable] menu appears.



Reference The [Reference Variable] menu can be also be displayed by pressing the No. 7 button or No. 1 + No. 0 buttons.

- 4 Select [Set].**
- 5 Choose the type of variable to assign and then select [OK].**
- 6 Select the variable to assign.**

Notes on assigning variables to setting parameters

Each parameter has a set input range, if the value of the variable is invalid, an error will occur in the processing of that unit.

Reference For the lists of parameters, input ranges, and other details, refer to "List of Parameters" in the XG-X2000 Series Communications Control Manual.

Cancelling the variable assignment

Select [Clear] in the [Reference Variable] menu.

Reference If the assignment is canceled, the definition of the variable is not deleted.

Assigning an image variable

An image variable can be assigned to the current image of a unit and used as a reference for image processing or image display.

Assigning image variables

To reference an image variable, assign it to the [Captured Image] field in the [Select Image] menu of the unit.

Point

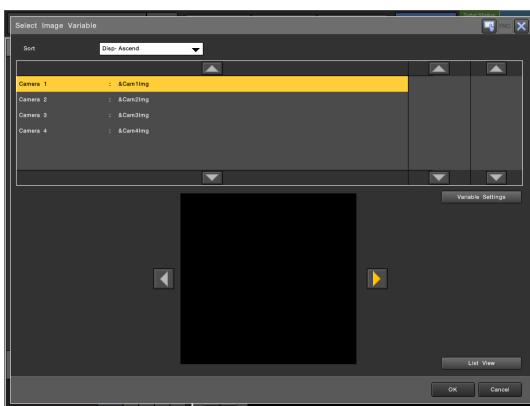
- The image variable can only be used to store image data from the capture, image operation and calibration units. To set an image variable to store a captured image from the capture unit, refer to the capture unit section (Page 2-25). To set an image variable as a result image from the image operation unit, refer to the image operation unit section (Page 2-373).
- A blank image variable assignment will result in a setting error.
- Units which support the assignment of image variables are limited to the vision tools, On-Screen Graphics image operation, and position adjustment units.

1 Open the [Select Image] menu for the unit.

[&Cam1Img] (the system image variable used for captured images from Camera1) is assigned to the current image by default.

2 To change the image variable, choose the image variable which contains the desired image.

The image display, and the camera No., image type, and number of pixels for [Source Image Information] are updated based on the information of the image variable.



Point

- If [Variable Settings] is selected, the [Image Variable] display will appear, and the image variables can be edited.
- The list display and the image display can be switched via the [List View] / [Image View].

Notes on changing the image variable assignment

Changing the image variable may reset some settings of the unit and result in errors. After changing the image variable, confirm that there are no errors.

Point

If no capture units in the flowchart are used to assign an image to an image variable, processing is performed using a black image.

Specifying the Model of the Connected Camera (Camera Selection)

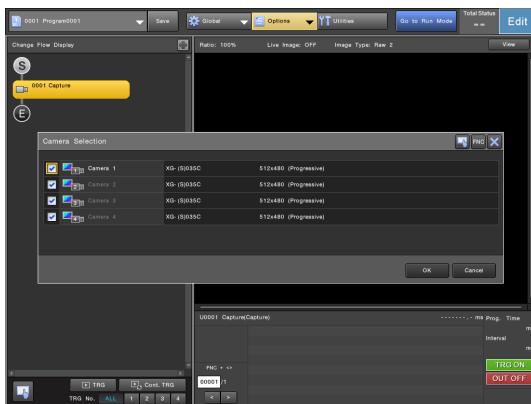
Specify the model of the camera connected to the controller.



- Connect the camera before turning on the controller.
- When you change the model or resolution, all setting values that are dependent on the camera model of each capture unit will be initialized to their default values.
- When the model or resolution is changed, all image variables, archived data, the output buffer, and target classification results are cleared.
- For more details on unsupported camera combinations, refer to the XG-X2000 Series Setup Manual.

1 From the [Options] menu, select [Camera Settings] - [Camera Selection].

The [Camera Selection] screen appears.

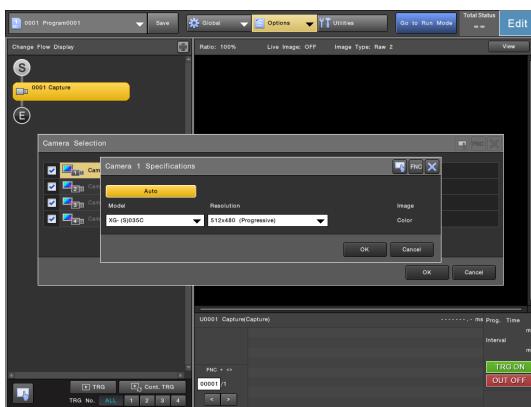


2 Put a check mark for the camera which is to be used, and select the camera number of the camera to be set.

The settings screen for the selected camera appears.



The cameras that are unchecked will be considered as not connected to the controller.



3 Choose the model of the connected camera in the [Model] field.

The selection shown under "Image" and the resolutions available to choose from will be set according to the selected model.

4 Change the camera settings and select [OK].

Changing the Settings for Capturing Asynchronously to the Flow (Image Capture Buffer Settings)

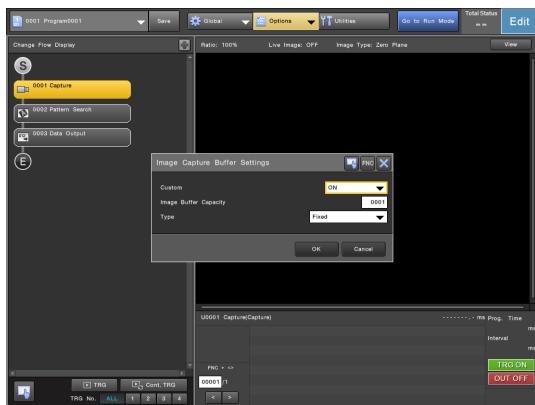
Set the image capture buffer according to the application speed and processing requirements.

Reference

- The image capture buffer settings are common for all capture units in the flowchart.
- For details about the image capture buffer, see the XG-X2000 Series Communications Control Manual.

1 From the [Options] menu, select [Camera Settings] - [Image Capture Buffer Settings].

The [Image Capture Buffer Settings] menu appears.



2 Set options for the image capture buffer operation.

Custom

- ON** (default): Use the image capture buffer and allocate image memory for storing multiple images.
- OFF**: Do not use the image capture buffer.

Point

- If there is insufficient image memory errors will occur.
- The image capture buffer cannot be used in combination with HDR capture (Page 2-29).

Image Buffer Capacity

Specify the number of images to be stored in the buffer between 1 to 1024 (Default: 1). The number of images that can be stored depends on the type and number of cameras used and the amount of free image memory.

Type

Choose how the buffer handles images when full.

- Fixed** (Default): When the buffer is full with unprocessed images additional captured images are ignored.
- Overwriting**: When the buffer is full with unprocessed images additional captured images overwrite existing images starting at the oldest unprocessed image.

3 Select [OK].

Point

- The image capture buffer memory is reserved for each camera.
- The capture unit assigns the oldest unprocessed image in the image capture buffer acquired with that unit's settings to the camera image variable.
- When the setting is changed, all image variables, archived data, the output buffer, and target classification results are cleared.
- When continuous capture is set with a line scan camera, the buffer operation mode requires overwriting buffer and capacity of 3 or more is required.

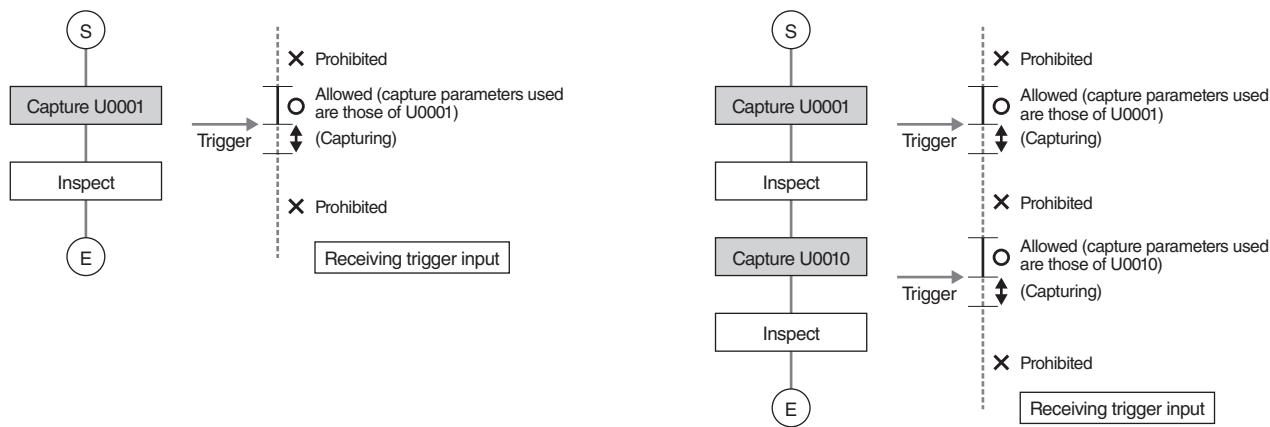
Examples of How the Image Capture Buffer is Used

This section describes typical capture settings and behavior.

Using only one camera or multiple cameras that all use the same capture priority condition

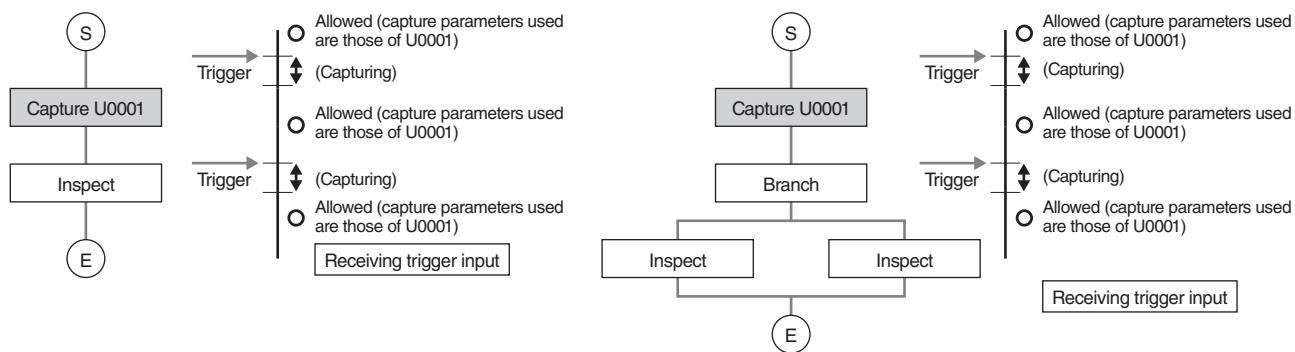
1. Image Capture Buffer: Disabled

If the image capture buffer is disabled, trigger input is only permitted while the flow is stopped at the capture unit and trigger input is prohibited at any other time.



2. Image Capture Buffer: Enabled (when only one capture unit is placed on the flowchart)

Capture processing is always performed with the capture parameters of one capture unit.

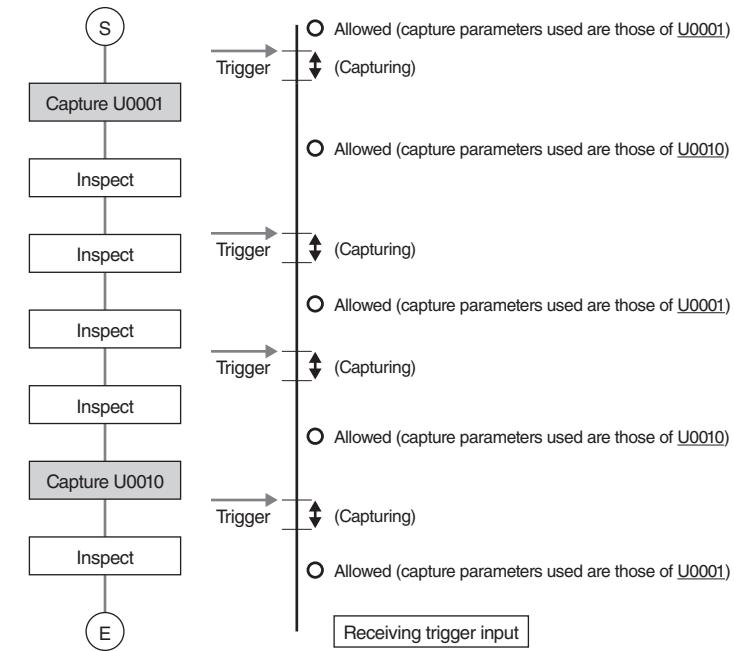


3. Image Capture Buffer: Enabled (when multiple capture units are placed on the flowchart)

Although capture processing must change capture parameters in the order the capture units are placed on the flowchart, capture unit behavior changes depending on the flowchart positioning.

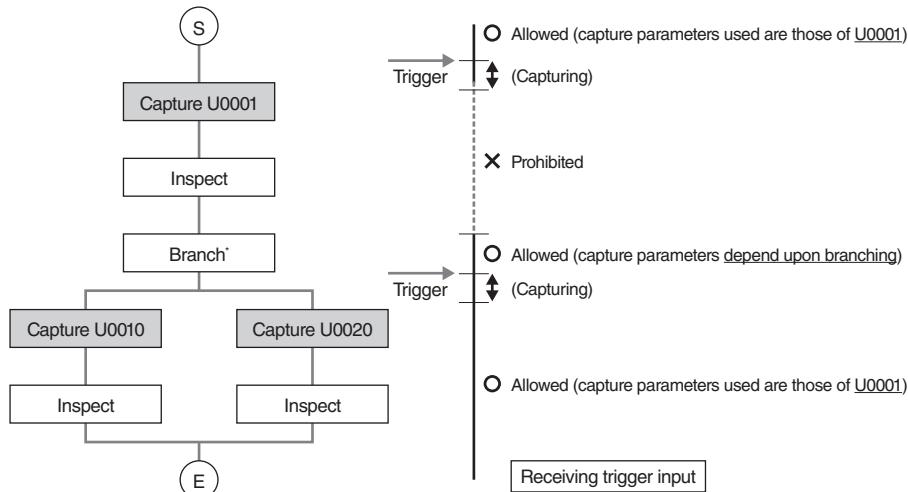
- **3-1** When the capture unit passing order is fixed:

The capture unit passing order is fixed on flowcharts like the one below. In cases such as this, image capture buffer processing applies the capture parameters reached next for each trigger received and can receive capture regardless of the execution position on the flowchart.



- **3-2** When the capture unit passing order changes per flow execution:

The capture unit passing order changes depending on the flow execution status on flowcharts like the one below. In cases such as this, image capture buffer processing automatically stops capture reception until the capture unit that will be passed through next is determined.



* If the branching condition is one of the following, capture trigger reception will not be stopped and will proceed immediately to the next capture unit.

- If the branching condition is the passing status of the capture unit (U0001 in this case) that is implemented before the branch unit, or if it is a fixed value.
- If controlled branching is enabled.

Using multiple cameras for which a capture priority condition is assigned to each camera individually

Configure this setting when multiple cameras are connected and capture must be performed asynchronously.

When using multiple cameras for which a capture priority condition is assigned to each camera individually, capture unit processing will finish at the time capture is completed for some cameras that meet any of the completion conditions. In this case, only images from some cameras are obtained so a branch unit whose branching condition is the passing status of the capture unit is placed immediately after the capture unit and the processing for the camera images are placed separately in the individual branch destinations as well.

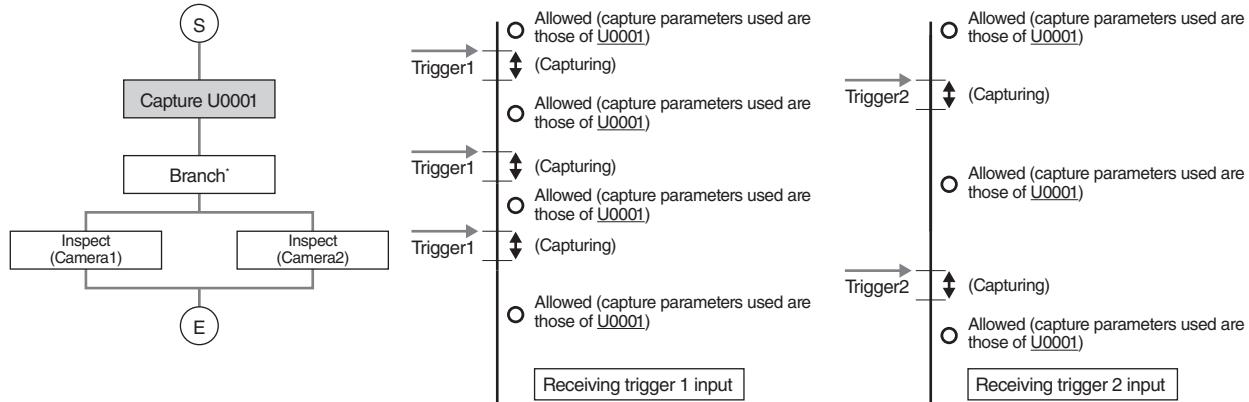
1. When only one capture unit is used

Capture processing can always be performed with the capture parameters set for one capture unit.

Example: When Capture Unit U0001 is set as follows, and the flowchart branches based on the passing status of Capture Unit U0001

Trigger	Capture Unit U0001*
Trigger 1	Camera 1, Light 1
Trigger 2	Camera 2, Light 2

* The Capture Priority for Capture Unit U0001 is set in such a way where a different condition number is assigned to each camera.



* By specifying the passing status of the U0001 capture unit as the branching condition, you can process the camera image captured with the U0001 at the correct destination unit.

2. When multiple capture units are used

When you use multiple cameras asynchronously, you can also place multiple capture units.

The flowchart is one where capture units are added to the branch destinations in the flowchart that is based on "1. When only one capture unit is used" (Page 4-15). By tinkering with the flowchart, you can capture multiple images with one camera and also receive trigger inputs for capturing for the other camera.

- **2-1** When the triggers, cameras, lighting, and flashes to be used are independent at each branch (when inspecting workpieces that move on two fully independent lines with multiple images captured by two cameras):

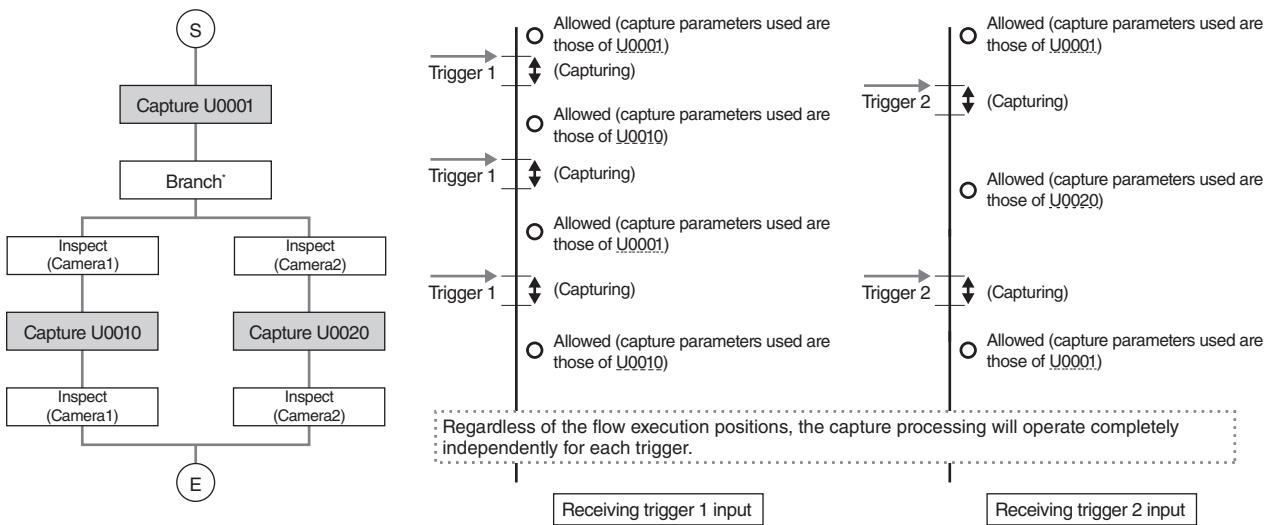
On a flowchart branched by the passing status of the first capture unit, if the trigger, camera, lighting, and flash at the branch destination are the same as the first Capture Priority, image capture will be processed fully independently for each trigger.

Point The passing status of the capture unit executed before the branch unit must be specified as the branch condition. If something else, such as a variable or unit result, is specified, the behavior will be the same as that in 2-2.

Example: When the settings for Capture Unit U0001 are as follows, and images can be captured with the same trigger, camera, lighting, and flash range at each branch

Trigger	Capture Unit U0001*	Capture Unit U0010	Capture Unit U0020
Trigger 1	Camera 1, Light 1	Camera 1, Light 1	-
Trigger 2	Camera 2, Light 2	-	Camera 2, Light 2

* The Capture Priority for Capture Unit U0001 is set in such a way where a different condition number is assigned to each camera .



* By specifying the passing status of the capture unit U0001 as the branching condition, the camera image obtained by U0001 can be processed by the unit in the correct branch destination.

Changing the Settings for Capturing Asynchronously to the Flow (Image Capture Buffer Settings)

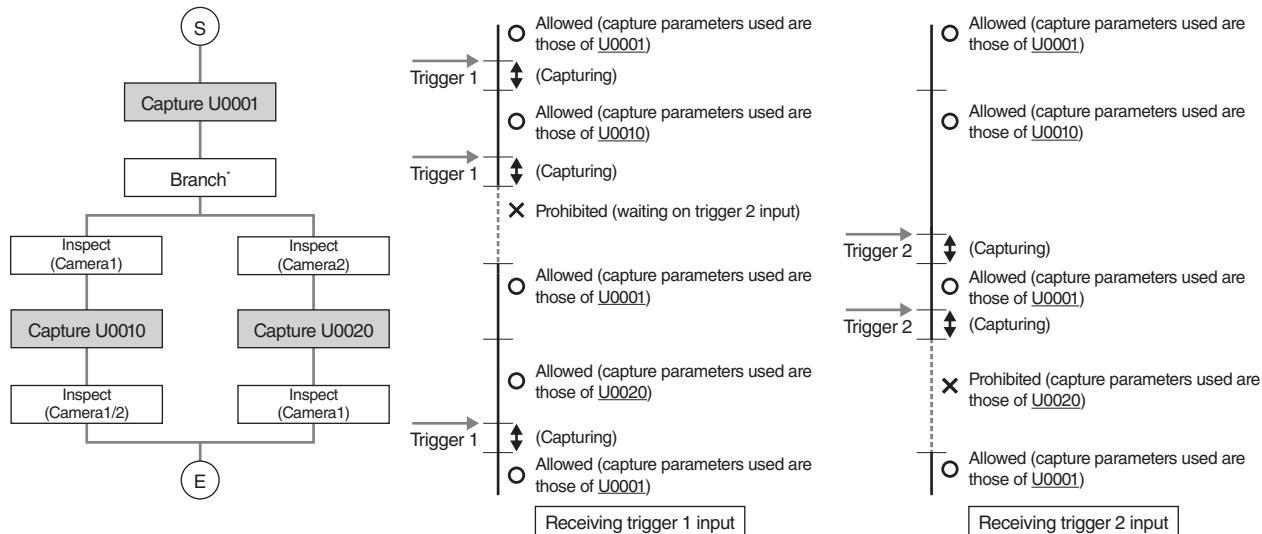
- 2-2** When the triggers, cameras, lighting, and flashes to be used are not independent at each branch (when the capture priority is set independently for two cameras and a capture unit is placed so that the Camera 2 image or the trigger, lighting, and flash used to capture the Camera 2 image are set so that they are used after the flowchart branches in association with the Camera 1 capture):

Capture processing is not fully independent for each trigger and is performed in accordance with settings for the capture unit reached after branching as per execution on the flowchart.

Example: When the settings for Capture Unit U0001 are as follows

Trigger	Capture Unit U0001*	Capture Unit U0010	Capture Unit U0020
Trigger 1	Camera 1, Light 1	Camera 1, Light 1	Camera 1, Light 1
Trigger 2	Camera 2, Light 2	Camera 2, Light 2	-

* The Capture Priority for Capture Unit U0001 is set in such a way where a different condition number is assigned to each camera.



* The passing status of the capture unit U0001 is specified as the branching condition.

If any other branching condition is specified, after the capture unit U0001 is implemented, as the capture unit which should next be implemented will not be able to be determined until the branching unit is accessed, the trigger inputs will be in an inhibited state.

Other image capture buffer precautions

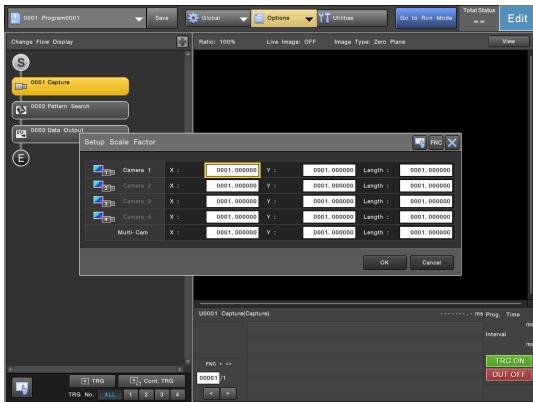
- By specifying the capture unit parameters (such as shutter speed) with variables and changing them with commands or a calculation unit placed in the flowchart, you can immediately apply the parameters to the capture operations. However, as the timing of trigger input and to change capture parameters cannot be precisely managed, you cannot associate capture parameters with images. If that behavior creates problems, disable the image capture buffer.
- In the XG-8000/7000 Series, even if you are able to place multiple capture units in the flowchart and enable the image capture buffer, if triggers are input multiple times in a short period of time, multiple images captured with the same capture unit parameters will be obtained and those images may be processed by a different capture unit. This is because the capture parameters will not change until the flow reaches the next capture unit. Note that while the XG-X Series functions correctly under these conditions, bear in mind the difference in behavior if you use the XG-8000/7000 Series and the XG-X Series for different purposes.
- The flowchart is analyzed and a capture processing operation method is set in advance in the XG-X Series. How the image capture buffer functions can be determined by looking at the image capture buffer operation level under [Current Resource Allocation] in Utilities. For more details, refer to "Checking the Controller Memory Usage (Current Resource Allocation)" (Page 5-49).

Setting the Scaling Correction Values for Each Camera (Scaling)

Specify the scale factors to be used for each camera.

- From the [Options] menu, select [Camera Settings]
- [Scaling].

The [Setup Scale Factor] menu appears.



- Specify the scale factor that can be used for measurement data from the vision tool units.

X

Input the scale factor to be applied in the X direction.

Y

Input the scale factor to be applied in the Y direction.

Length

Input the scale factor to be applied for length measurements.



For more details on the result data for which scaling can be used refer to "List of Result Data" in the XG-X2000 Series Communications Control Manual.

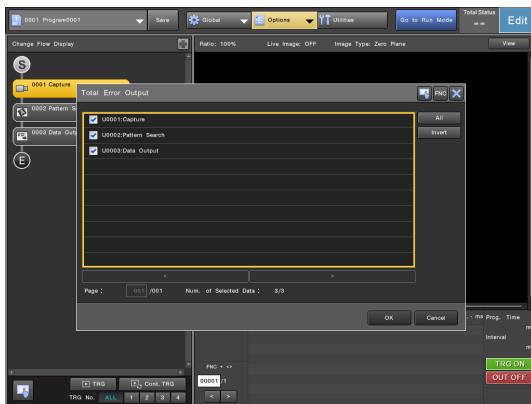
- Select [OK].

Specifying the Units which Are to Be Used As Unit Total Error Output (Error Output)

Choose the units to be associated with the total error output (%UnitError).

- From the [Options] menu, select [Error Output].

The [Total Error Output] menu appears.



- Select the unit or units to be used by checking the box of each unit.

The logical sum (OR function) of the errors of the selected units are used as the result for %UnitError.

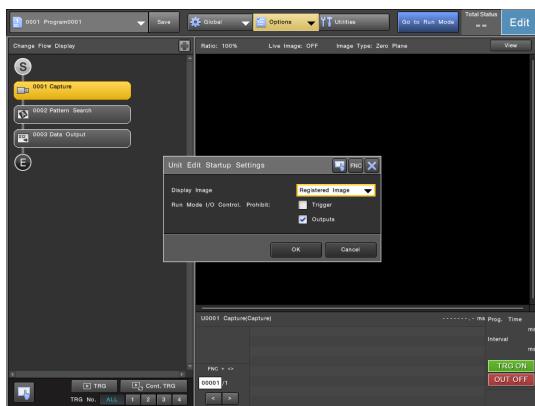
- Select [OK].

Changing Operations for When the Unit Is Being Set (Unit Edit Startup Settings)

Set the default background image for the Edit Unit menu or the trigger/output operations when setting up units in Run mode.

1 From the [Options] menu, select [Unit Edit Startup Settings].

The [Unit Edit Startup Settings] menu appears.



2 Change the settings as required.

Display Image

In the [Display Image] field, switch the image to be displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Run Mode I/O Control Prohibit:

- Disabling Trigger Inputs: Check [Trigger] to disable trigger inputs.
- Disabling Outputs: Check [Outputs] to disable outputs.



The setting to control the I/O operation is enabled when the flowchart is edited and disabled when the flowchart is closed.

3 Select [OK].

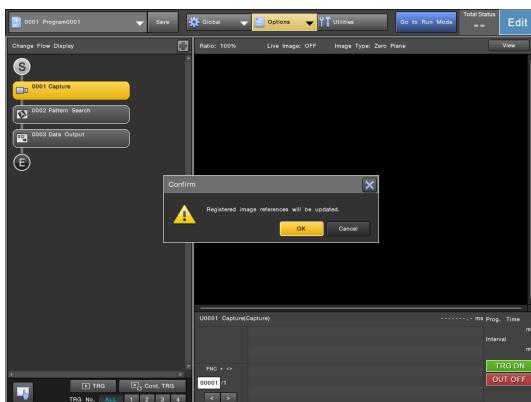
Registering All of the Registered Image Information which Is to Be Referenced from Registered Images

(Update Registered Image Information)

Registered image information used by multiple Pattern Search, ShapTrax3, ShapTrax2 and or PatternTrax units can be registered/updated simultaneously. If several units in a program use registered image information, this eliminates the need to change each individual set of settings.

- 1 From the [Options] menu, select [Reference Information Registration] - [Update Registered Image Information].

A confirmation screen appears.



- 2 Select [OK].

The registered image information is registered to all relevant units simultaneously.

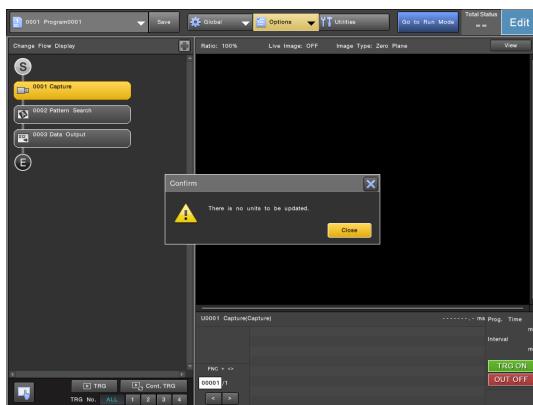
- 3 Select [Close].

Registering the Reference Position Information of the Position Adjustment Units in the Program All at Once (Update Reference Position Information)

Positioning information for position adjustment units in a program can be registered/updated simultaneously. If there are several position adjustment units in a program, this eliminates the need to change each individual set of settings.

- 1 From the [Options] menu, select [Reference Information Registration] - [Update Reference Position Information].

A confirmation screen appears.



- 2 Select [OK].

Positioning information is updated for all position adjustment units simultaneously.

- 3 Select [Close].

- Point**
- If there are no position adjustment units that allow the updating of the base position, a message "There are no units to be updated." appears and the settings are not updated.
 - Using [Update Reference Position Information] under these circumstances may result in an inaccurate position adjustment when:
 - the inspection region for a unit that affects position adjustment uses the current image.
 - the unit that is referenced by a position adjustment has not been registered with an appropriate registered image. Make sure to save the settings before turning off the controller.

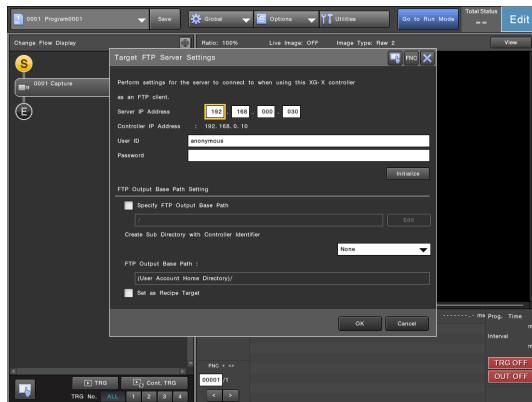
Setting the Server Information for FTP Output

(Target FTP Server Settings)

Set the destination FTP server information used to output the archived data (Page 5-4) in the controller and the data from the data output unit (Page 2-449), image output unit (Page 2-458) and VisionDatabase on the [Target FTP Server Settings] screen.

1 From the [Options] menu, select [Target FTP Server Settings].

The [Target FTP Server Settings] menu appears.



2 Change the settings as required.

Server IP Address

Specify the IP address of the FTP server to output the data to.

An address that conflicts with the controller's IP address cannot be specified.



- The controller outputs data to an FTP server by using the FTP command [APPE]. Data cannot be output if the FTP server in use does not support the [APPE] command.
- If there is a firewall on the FTP server or on the network route to the FTP server, connection may fail. You need to disable the firewall or find another way to connect to the FTP server. For details, check with your network administrator or computer manufacturer.

Controller IP Address

The IP address of the controller is displayed.

User ID

Enter the user name (up to 32 characters) to be used to log in to the FTP server.

Password

Input the password (up to 32 characters) for logging into the FTP server.

FTP Output Base Path Setting

- Specify FTP Output Base Path:** Ticking this box will allow you to specify the base path for the FTP output. Note that the base path specified here applies to all FTP outputs such as archive output, result output (data and image) and target classification output.



Point The folder for storing the data depends on the FTP server settings.

Create Sub Directory with Controller Identifier:

Select the sub folder name for identifying the controller from the following formats:

- None** (default): Does not create a sub folder.
- IP Address:** The IP address of the controller is used as the sub folder name.
- %ControllerId:** The content of the system variable %ControllerId is used as the sub folder name.
- Controller Name:** The controller name is used as the sub folder name. The controller name can be specified in [Controller Name] (Page 6-4) in the system settings.
- PROFINET Device Name:** The PROFINET device name is used as the sub folder name.



- Note that the sub folder specified here applies to all FTP outputs such as archive output, result output (data and image) and target classification output.
- If [Controller Name] is selected without setting the controller name, the operation will be the same as when [None] is selected (i.e. no sub folder will be created).

Set as Recipe Target

Refer to "Setting the FTP Output Base Path as a Recipe Target" (Page 8-202).

3 Select [OK].

To reset the information of the destination FTP server

Select [Initialize].

Locking / Unlocking Group-Lock (Lock/Unlock Group-Lock)

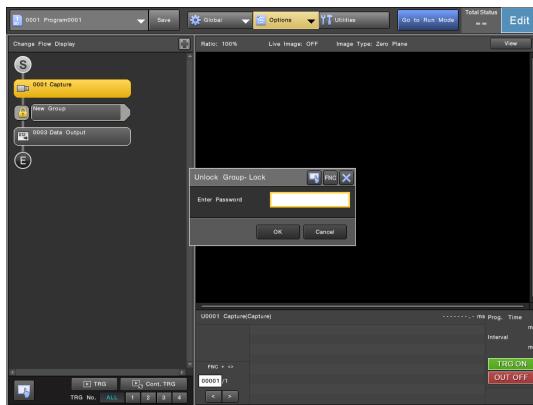
If a group has been locked via XG-X VisionEditor the group can be unlocked edited and locked again.

- Point** If the "Allow Group Lock Release on Controller" option has not been set via XG-X VisionEditor [Unlock Group-Lock] and [Lock Group-Lock] are not displayed.

Unlocking a group

- From the [Options] menu select [Unlock Group-Lock].

The [Unlock Group-Lock] menu appears.



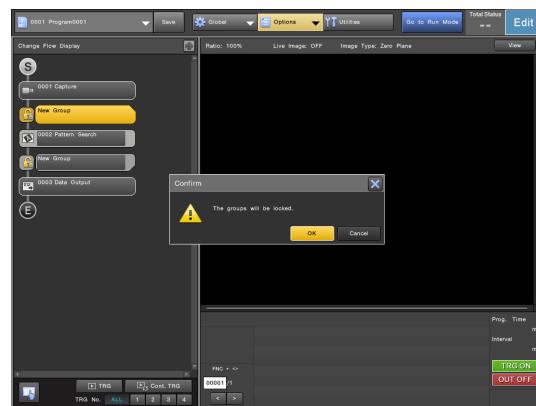
- Input the password and then select [OK].

If the password is correct, the group is unlocked.

Locking a group

- From the [Options] menu select [Lock Group-Lock].

A confirmation screen appears.



- Select [OK].

The group is locked.

Controller Display

Screen Settings

(Screen Editor)

Measurement-Related Settings
(Options Menu)

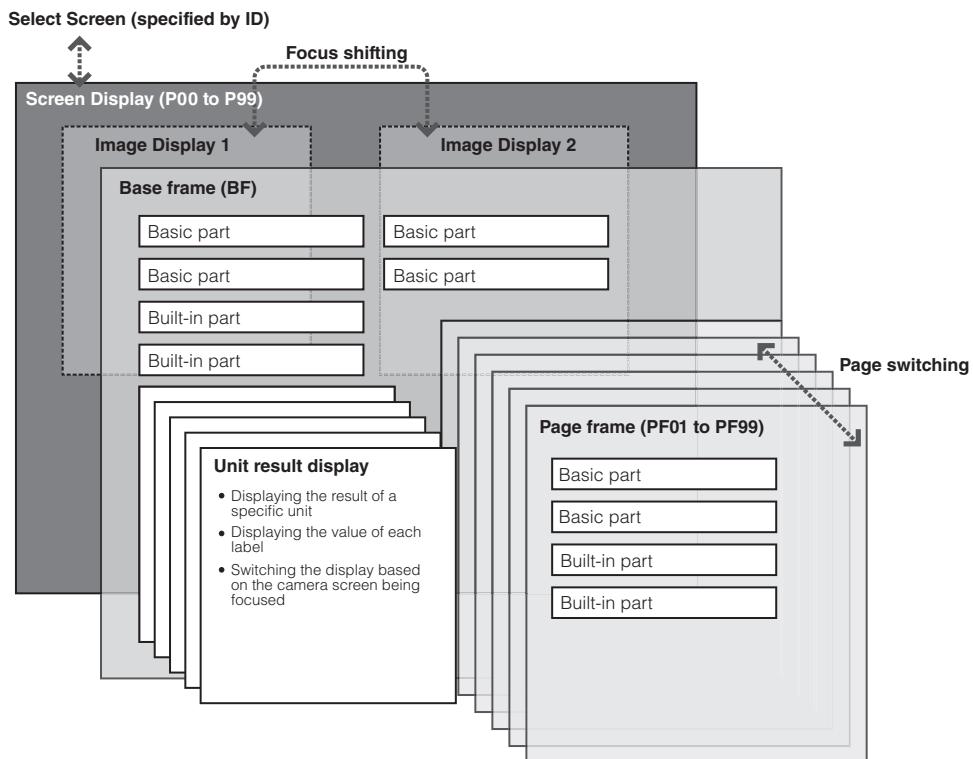
► **Controller Display Screen Settings**
(Screen Editor)

Overview of the Creation of Display Templates

It is possible to create a controller display screen by placing various parts on the screen (screen editing).

Organization of Display Screens Created in Screen Editor

The screen editor arranges and manages the display screens created for the controller in groups and hierarchies as outlined below.



Screen elements

Screen Display (P00 to P99)

Controller display screens.

Image Display (maximum 5 screens)

This is a part which displays the image captured by the camera.

Base Frame (BF, only 1)

This is a 1024 x 768 pixel (XGA) area part. All display parts can be placed on the base frame.

- **Basic Parts:** these parts display shapes and processing results in the controller.
- **Standard Parts:** these parts provide functions for special purposes.

Page Frame (PF01 to PF99)

This is a 1024 x 768 pixel (XGA) area part with page switching support. Like the base frame, it can be laid out with basic parts and most Standard parts.

Display mechanism

- The parts in the currently selected page frame appear visible on top of the base frame display.
- Parts which need to be visible at all times for the current display template should be placed directly in the base frame, whereas parts that need only be visible in certain situations should be placed in a page frame that is called into use when needed. This allows flexible display possibilities with a single display template.



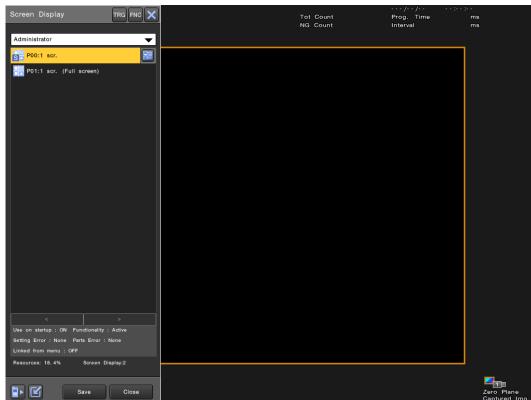
- Up to 500 parts can be placed in each frame.
- It is not possible to edit display templates when the memory usage reaches 100%.
- The memory usage can be checked in [Screen Display].

Creating Display Templates

This section explains how to create a display template that will serve as the display screen for the controller.

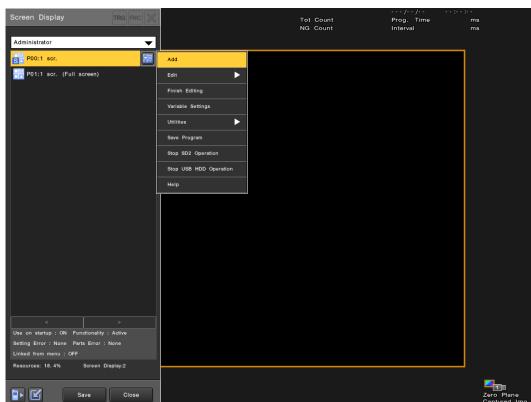
1 From the [Options] menu (Page 4-2) select [Screen Editor].

The [Screen Display] menu appears.



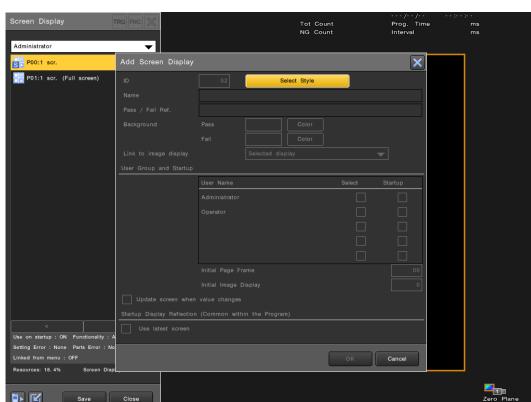
2 Press the No.1 (FUNCTION) button on the handheld controller.

The screen editing menu is displayed.



3 Select [Add].

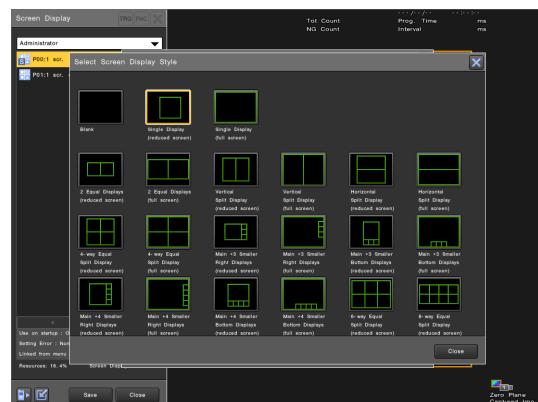
The [Add Screen Display] menu appears.



The [Add] option is disabled when the number of registered display templates has reached the maximum number (99).

4 Select [Select Style].

The [Select Screen Display Style] menu appears.



5 Select the desired display template.

In this step, select [Single Display (reduced screen)] as an example.



The most typically used parts can be quickly added by selecting any of the display templates, except the template labeled [Blank]. For more details, refer to "Screen Display Style" (Page 4-34).

6 Change the settings of the display template as necessary and then press [OK].

For more details on the settings, refer to "Common Settings for Display Style" (Page 4-34).

To change the settings of the existing display template:

Place the cursor on the display template to edit, press the No. 1 (FUNCTION) button on the handheld controller, and select [Edit] - [Properties] from the screen editing menu.

To delete a display template:

Place the cursor on the display template to delete, press the No. 1 (FUNCTION) button on the handheld controller, and select [Edit] - [Delete] from the screen editing menu.

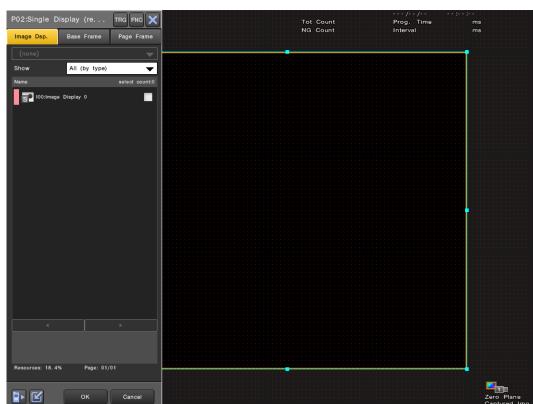


A display template which has been specified in a menu such as the [Update Variables] menu cannot be deleted.

Creating Display Templates

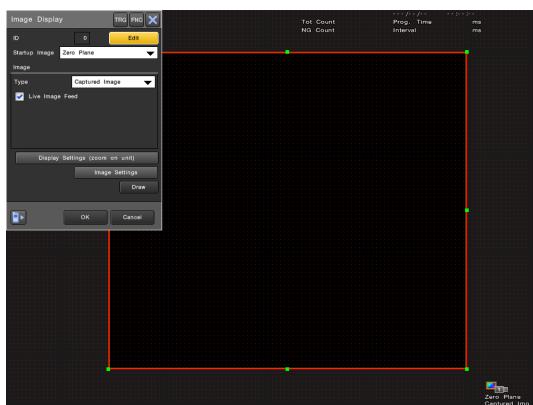
7 Select the display template added in step 6.

The display template setting menu appears.

**8 On the [Image Dsp.] tab, select a [Image Display] part.**

In this step, select [I00: Image Display 0] as an example.

The [Image Display] menu appears.

**9 Change the settings of the image display as necessary and then press [OK].**

For more details on the settings, refer to "Image Display" (Page 4-42).

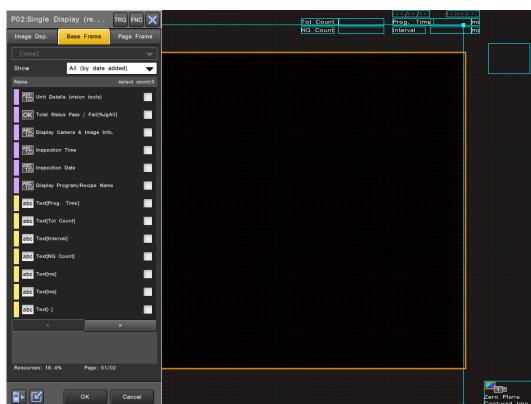
To add a image display:

Press the No. 1 (FUNCTION) button on the handheld controller and select [Add] from the screen editing menu.

Point The [Add] option is disabled when five camera screens have already been placed.

To delete a image display:

Place the cursor on the image display to delete, press the No. 1 (FUNCTION) button on the handheld controller, and select [Edit] - [Delete] from the screen editing menu.

10 Select [Base Frame] tab and change the settings as necessary.

The base frame is used to control all parts that appear at all times. In the base frame, both basic and built in parts can be edited.

Reference Use [Show] to select an option so that only parts which satisfy the selected condition are listed.

To add a part to the base frame:

Press the No. 1 (FUNCTION) button on the handheld controller and select [Add] - [(Part name to be added)] from the screen editing menu. The selected part is added at the center of the screen.

Use [Data (Text & Value)] in the parts list to add [Text] (Variable name) and [Value] (Variable value) of the selected result data or variable simultaneously.

Point

- If no base frame exists, no parts can be added. Press the No. 1 (FUNCTION) button on the handheld controller and select [Edit Base Frame] - [Add] from the screen editing menu to add a base frame.
- The [Add] option is disabled when the number of registered parts has reached the maximum.

To edit the part placed in the base frame:

Select a part to edit, and the menu for editing the part is displayed. For more details, refer to "Screen Parts" (Page 4-42).

Point

When two or more parts are selected, only their properties can be viewed, and no editing options other than [Draw] can be selected.

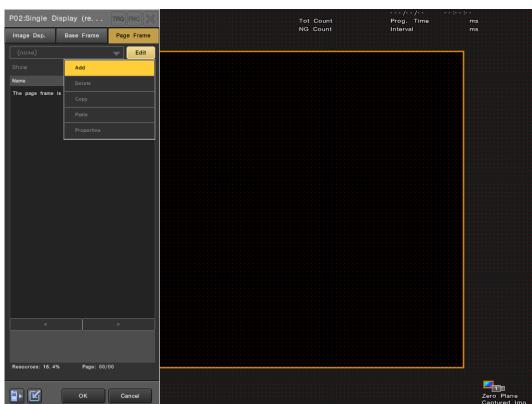
To delete the part placed in the base frame:

Place the cursor on the part to delete, press the No. 1 (FUNCTION) button on the handheld controller, and select [Edit] - [Delete] from the screen editing menu.

11 Select the [Page Frame] tab.

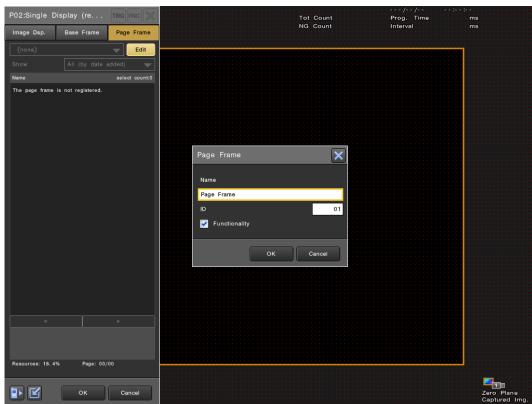
The page frame is used to control parts that appear when the user switches to a specific page. In the page frame, it is possible to edit basic parts and most of the standard parts.

12 Select [Edit] - [Add].



! Point The [Add] option is disabled when the number of registered page frames has reached the maximum number (99).

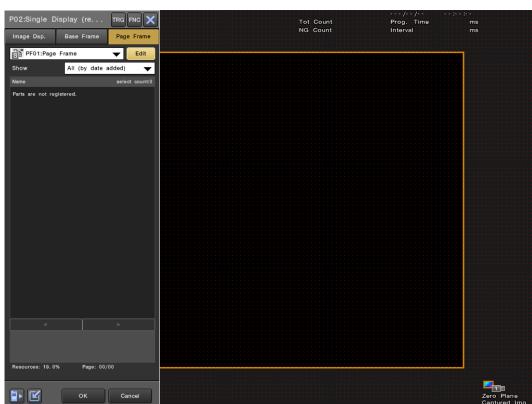
The [Page Frame] menu appears.



13 Change the settings of the page frame, and then Select [OK].

The page frame is added and the display template setting menu appears again.

14 Change the settings as necessary.



To add a page frame:

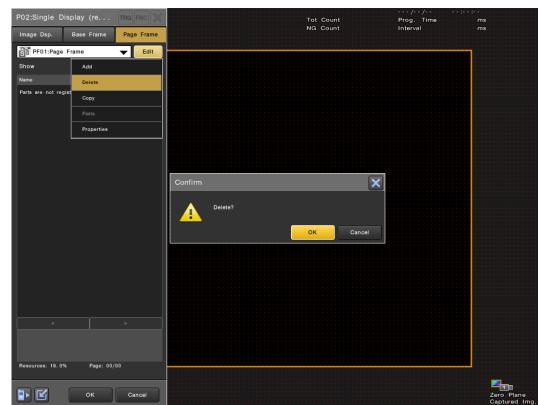
Select [Edit] - [Add] (Refer to the instruction in steps 12 and 13.)

To change the page frame used to edit parts:

Select a desired page frame from the list at the top of the screen.

To delete a page frame:

Select a page frame to delete from the list at the top of the screen and select [Edit] - [Delete].



Select [OK] on the confirmation screen.

To edit the parts in the page frame (add/edit/delete parts):

The operation is the same for the base frame.

! Point

- Some parts may not be added or deleted depending on the specified location. Refer to the description of each part for more details.
- To edit the part placed in the page frame, it is necessary to switch to the page frame containing the part.

15 When editing is complete, select [OK].

The display returns to the [Screen Display] menu.

16 Select [Save].

A confirmation screen appears.

17 Select [OK].

Changing the Position of a Placed Part

 To change the display contents of the parts, refer to the description of each part.

Editing the placement position of a part (Draw mode)

To change the placement position of a display part, select [Draw] in the editing dialog of the part, or place the cursor on the part and press the BACK button and ENTER button on the handheld controller (Draw mode).

In Draw mode, the currently selected part (current part) is shown in a red frame (a pink thick frame when more than one parts are selected), the other selected parts are shown in pink thin frames, and other parts are shown in blue frames.

- Up/down/right/left key: Move or resize the selected part.
- No. 0 (ENTER): Confirm the setting.
- No. 2 (ESCAPE): Exit from Draw mode.

Refer to "Key operations on the dialog in Draw/Multi Select menu" (Page 4-33) for more details on other operation.

Editing the placement positions of multiple parts simultaneously (Multi Select mode)

It is possible to directly select multiple parts which have been placed.

To enter Multi Select mode, enter Draw mode once, and then press the No. 1 (FUNCTION) button on the handheld controller and select [Edit] - [Start Multi Select (BACK + ENT)], or press the BACK and ENT buttons.

In Multi Select mode, the currently selected part (current part) is shown in a red frame (a pink thick frame when more than one parts are selected), the other selected parts are shown in pink thin frames, and other parts are shown in green frames.

- Up/down/right/left key: Select a part (Change the current part.).
- No. 0 (ENTER): Include the current part in the selected parts or exclude it from them.
- No. 2 (ESCAPE): Exit from Multi Select mode.
- Refer to "Key operations on the dialog in Draw/Multi Select menu" (Page 4-33) for more details on other operation.

Arranging parts

It is possible to select multiple parts and arrange them in various ways.

Select two or more display parts, press the No. 1 (FUNCTION) button on the handheld controller, select [Align & Order] - [Align] or [Distribute], and select a desired option.

Align

All of these options align the selected parts based on the part on which the cursor is currently placed (current part).

- **Left Align:** Align the parts with the left end of the current part.
- **Center Align:** Align the horizontal center of the parts with the horizontal center of the current part.
- **Right Align:** Align the parts with the right end of the current part.
- **Top Align:** Align the parts with the top of the current part.
- **Middle Align:** Align the vertical center of the parts with the vertical center of the current part.
- **Bottom Align:** Align the parts with the bottom of the current part.

Distribute

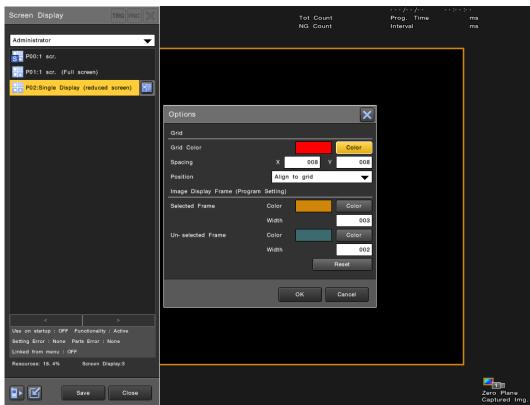
- **Horizontally:** Arrange the selected display parts with equal spacing between the rightmost and leftmost parts. The vertical position of each part does not change.

- **Vertically:** Arrange the selected display parts with equal spacing between the topmost and bottommost parts. The horizontal position of each part does not change.

 The image display parts cannot be aligned or arranged.

Changing the grid display settings

It is possible to change the display options of the grid displayed during screen editing in the [Options] menu. Press the No. 1 (FUNCTION) button on the handheld controller and select [Utility] - [Options] from the screen editing menu.



Grid

- Grid Color:** To change the color of the grid, select [Color].
- Spacing:** Specify the grid interval.
- Position:** Specify the parts layout method.
 - **Align to grid:** Parts are positioned so that the top left of the part is aligned with the grid.
 - **Free:** Parts can be positioned freely while ignoring the grid.



- When [Align to grid] is selected with [Scale On] specified, the centers of horizontal line parts (Page 4-53) and vertical line parts (Page 4-54) are aligned with the grid.
- As for the case of circle or cross mark parts, their center coordinates are aligned with the grid.

Image Display Frame (Program Setting)

Specify the display color and line thickness of the frame for the cases where the camera screen is in focus or not in focus.

Changing the overlap order of parts

Overlapped parts can be rearranged in a different order. Place the cursor on the part to change the overlap order, press the No. 1 (FUNCTION) button on the handheld controller, and select [Overlay] - [On top] or [Underneath].

- On top:** Move the selected part to the foremost position.
- Underneath:** Move the selected part to the rearmost position.



When several parts are selected, these parts are moved as a group with the same overlap order to the foremost/rearmost position.

Other Screen Editing Operations

Sorting/filtering relevant parts

When searching for a part, it is possible to filter the parts based on type, or sort the parts by the order they are added.

On the display template setting dialog, select the appropriate option from [Show] on either the [Base Frame] or [Page Frame] tab.

- All (by date added):** Display all parts after sorting them in the order of they are added.
- All (by type):** Display all parts after sorting them by their types.
- Basic parts:** Display basic parts only.
- Standard parts:** Displays standard parts only.
- Selected:** Display parts which are selected for multiple selection only.
- Values only:** Display [Value display] parts only.
- Text only:** Display [Text] parts only.
- Active Text:** Display [Active Text] parts only.
- Horizontal Line:** Display [Horizontal Line] parts only.
- Vertical Line:** Display [Vertical Line] parts only.
- Point:** Display [Point] parts only.
- Rectangle:** Display [Rectangle] parts only.
- Circle:** Display [Circle] parts only.
- Polygon:** Display [Polygon] parts only.
- Table:** Display [Table] parts only.
- Values and Text:** Display [Value] and [Text] parts only.
- Error or Empty:** Display parts which contain [Error] or [Empty] items.



The [Show] list does not show the categories to which no part belongs.

Selecting multiple parts for simultaneous operation

It is possible to select multiple display parts to copy, delete, align, or arrange them simultaneously.

To select multiple parts, check desired display parts listed on the display template setting dialog.

Reference Multi Select mode (Page 4-30) can also be used to select parts directly by viewing the placed parts.

Deleting selected parts simultaneously

Press the No. 1 (FUNCTION) button on the handheld controller and select [Edit] - [Cancel Multi Select] from the screen editing menu.

Cancelling the previous operation

When a mistake is made, it is possible to undo by one step. Press the No. 1 (FUNCTION) button on the handheld controller and select [Edit] - [Undo] from the screen editing menu.

Point When there is no operation to be undone, a message "Undo (BACK+FNC)" is displayed and [Undo] cannot be selected.

Copying, cutting, and pasting parts

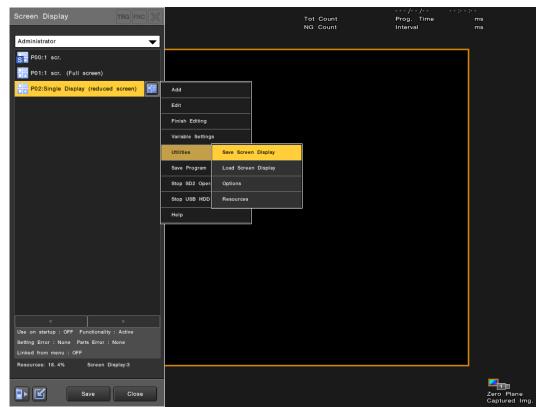
Place the cursor on the part, press the No. 1 (FUNCTION) button on the handheld controller, and select [Edit] - [(Desired operation)] from the screen editing menu.

Reference An item can be pasted to a different display template if the editing object specified at the destination supports the cut or copied part.

Saving or loading display templates

It is possible to save the settings of a specific display template in a display template file (***.srn) and load it into the controller.

Place the cursor on the display template list, press the No. 1 (FUNCTION) button on the handheld controller, and select [Utility] - [(Desired operation)] from the screen editing menu.



- **Save Screen Display:** On the displayed dialog, select the display template to save and its file name and Select [Execute] to save the display template file.
- **Load Screen Display:** On the displayed dialog, specify the display template file, select the destination display template and Select [Execute] to load the display template.

- Point**
- If the loaded display template does not conform to the settings of the current program, an error may occur, resulting in improper display. It is recommended to check for errors after loading the template.
 - The display template file contains the active text table (Page 2-444), the screen frame setting (program-specific) which is an option for screen editing, and the initial display application setting (program-specific). When a display template is loaded, these settings will be overwritten.

Key Operations Related to Screen Editing

Key operations on the [Screen Display] menu

No. 6 button (MENU)	Display help.
No. 7 Back button + No. 6 button (MENU)	Change the transparency of the menu.
No. 7 Back button + No. 4 button (SCREEN)	Switch between grid layout and free layout
No. 7 Back button + Right/left key	Move the dialog to right/left.

Displaying the key operation list

It is possible to display the help window and see the list of key operations.

Press the No. 1 (FUNCTION) button on the handheld controller and select [Help (MENU)] from the screen editing menu.

 The list can also be displayed by pressing the No. 6 (MENU) button.

Key operations on the display template setting menu

No. 6 button (MENU)	Display help.
No. 7 Back button + No. 6 button (MENU)	Change the transparency of the menu.
No. 7 Back button + No. 0 button	Switch to Draw mode.
No. 7 Back button + Right/left key	Move the menu to right/left.
No. 7 Back button + No. 4 button (SCREEN)	Switch between grid layout and free layout
No. 7 Back button + No. 1 button (FUNCTION)	Undo

Key operations on the dialog in Draw/Multi Select menu

No. 6 button (MENU)	Display help.
No. 7 Back button + No. 6 button (MENU)	Change the transparency of the menu.
No. 7 Back button + No. 0 button	Switch between Draw mode and Multi Select mode
No. 7 Back button + 8-way key	Change the current part (in Draw mode) Move the current part (in Multi Select mode)
No. 7 Back button + No. 4 button (SCREEN)	Switch between grid layout and free layout
No. 7 Back button + No. 1 button (FUNCTION)	Undo

 Switching between grid layout and free layout using key operation does not affect the [Position] on the [Options] menu (Page 4-31). The layout returns to the one specified by [Position] when the [Options] menu is displayed.

Screen Display Style

Overview of Screen Display Style

Screen display styles are preset screen templates that display information for the controller.

When creating a new screen display, a display style must be chosen in the ScreenEditor. Display styles allow you to create screen displays quickly by allowing users to choose a style and make changes to it.

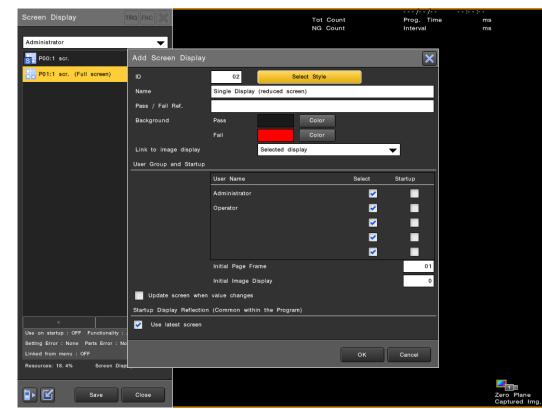
The following 21 display styles are available.

- Blank (Page 4-36)
- Single Display (reduced screen) (Page 4-36)
- Single Display (full screen) (Page 4-37)
- 2-way Equal Displays (reduced screen) (Page 4-37)
- 2-way Equal Displays (full screen) (Page 4-37)
- Vertical Split Display (reduced screen) (Page 4-37)
- Vertical Split Display (full screen) (Page 4-37)
- Horizontal Split Display (reduced screen) (Page 4-38)
- Horizontal Split Display (full screen) (Page 4-38)
- 4-way Equal Split Display (reduced screen) (Page 4-38)
- 4-way Equal Split Display (full screen) (Page 4-38)
- Main +3 Smaller Right Displays (reduced screen) (Page 4-39)
- Main +3 Smaller Right Displays (full screen) (Page 4-39)
- Main +3 Smaller Bottom Displays (reduced screen) (Page 4-39)
- Main +3 Smaller Bottom Displays (full screen) (Page 4-39)
- Main +4 Smaller Right Displays (reduced screen) (Page 4-40)
- Main +4 Smaller Right Displays (full screen) (Page 4-40)
- Main +4 Smaller Bottom Displays (reduced screen) (Page 4-40)
- Main +4 Smaller Bottom Displays (full screen) (Page 4-40)
- 6-way Equal Split Display (reduced screen) (Page 4-41)
- 8-way Equal Split Display (reduced screen) (Page 4-41)

Common Settings for Display Style

The controller can switch between 100 screen displays per program. The Screen Editor offers 21 types (Page 4-34) of display templates. Each type is set in the same way, the only difference being the display template parts (Page 4-42) initially included with the template.

The following is an explanation of the common setting procedures used on the Add Screen Display menu (Page 4-27).



Reference

For details on the screen display parts initially installed on the display template, see the explanation for each individual part.

ID

Specify the screen display ID from 0 to 99.

Point

- The ID must be unique within the same inspection program.
- The ID of a screen display that is selected as a screen display in the menu cannot be changed.

Name

Enter the name of the display template.

This name appears on controller screen.

Pass / Fail Ref.

When changing the background color based on the results, specify the reference value (variable, setting parameter, or results data) for determining OK/NG.

Background

Specify the background colors to use when the result is normal (OK, no value specified) and when failed (NG).

- **Pass:** Select the color of the background when the inspection is OK.
- **Fail:** Select the color of the background when the inspection is NG.

Link to image display

The variable, setting parameter, or results data specified for the [Pass / Fail Ref.] can be linked to the result of the image displayed in the image display (Page 4-42).

If the image display is set to display an archived image, the background color will match the result of the archived image. Otherwise, the background color will match the latest result for the displayed image.

- **None:** Background color always matches the latest result, independent of the image display.
- **Selected display:** Links the background color to the result of the displayed image from the camera image selected on the controller.
- **Image display ID:** Permanently links the background color to the result of the displayed image on the specified image display.

 Point

- If the link is set to an image display that has been set to an archived image with no results logging data, the background color will always be the color set for [Pass].
- A setting error will occur if the image display specified for the display template does not exist.

User Group and Startup

This option designates the display template as the default display and makes it selectable for each user account (Page 5-41).

- **Select:** Makes this display template selectable when the user is logged into the controller for the specified user account. Remove the check mark to prevent the user from selecting this display template.
- **Startup:** Makes the selected display template the default display when the program is loaded with the specified user account.

 Point

- Only one screen display can be set as the Startup screen for each account.
- If there are no screen displays which are set as changeable under [Select], then the screen display with the lowest ID number is used as the Startup screen.
- The Startup screen state for each account can be checked from the Startup icon  that is linked to the [User account specification] on the Screen Display List, and the selection status can be checked from the color of the icon (blue if selectable, gray if not selectable).

Initial Page Frame

This specifies the first page number to (i.e., page frame part (Page 4-46)), immediately after switching to this display template.

Initial Image Display

This specifies which image display (Page 4-42), when located on the display template, should have focus immediately after switching to this display template.

Update screen when value changes

Check this box to update the camera image and screen display contents when a variable value was changed from the Update Variables menu or by external input.

 Point

If [Update screen when value changes] is enabled, the area for the applicable unit is displayed on the screen even if the unit specified as the display target for the camera screen is not executed.

Use latest screen

Check this option to overwrite the initial display status when the settings are saved on the controller.



- The following items are overwritten in the display status:
 - Initial display template
 - Initial display page
 - Focused image display in the initial display
 - Unit initially displayed on each image display
 - Processed image type initially displayed on each image display
 - Zoom ratio initially displayed on each image display
- The [Use latest screen] setting is saved as part of the program file.

Display Template List

Changing the settings of a screen display

Place the cursor on the screen display to edit, then press the controller No. 1 (FUNCTION) button and select [Edit] - [Properties] from the Screen Editor menu.

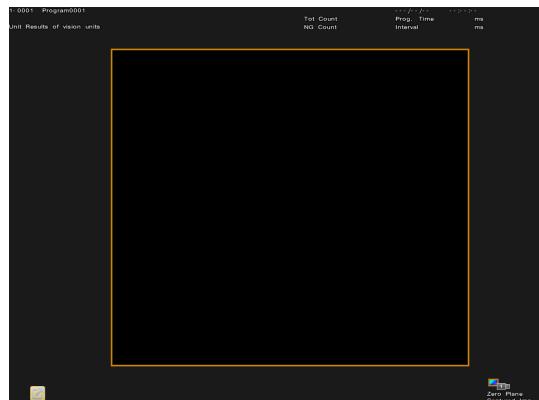
Blank

This template contains a base frame only.



Single Display (reduced screen)

This template displays one image and information related to that image. The template consists of a single image display, and a base frame with parts for displaying related information.



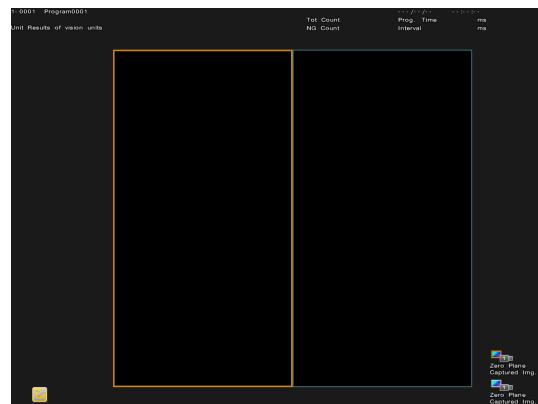
Single Display (full screen)

This template displays one image and information related to that image using the entire screen. The template consists of a single image display, and a base frame with parts for displaying related information.



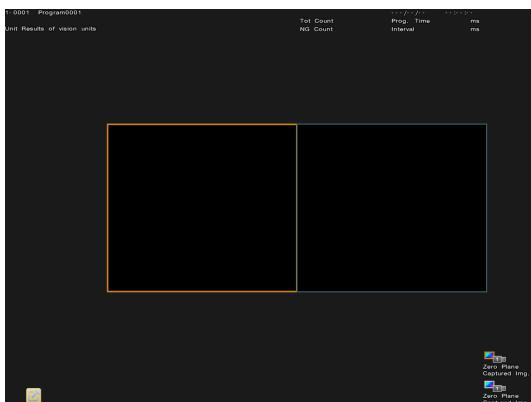
Vertical Split Display (reduced screen)

This template displays two images half of the display size in the X direction, side by side, and information related to those images. The template consists of two image displays, and a base frame with parts for displaying related information.



2 Equal Displays (reduced screen)

This template displays two images of the same size, side by side, and information related to those images. The template consists of two image displays, and a base frame with parts for displaying related information.



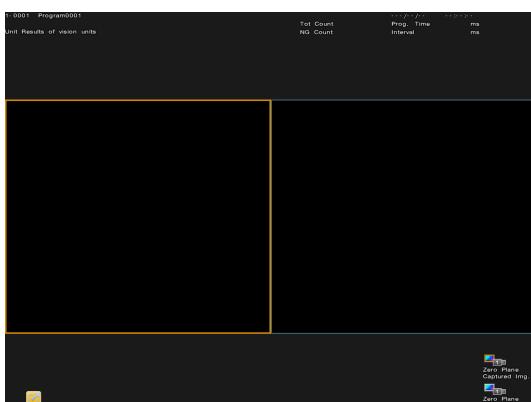
Vertical Split Display (full screen)

This template displays two images half of the display size in the X direction, side by side, and information related to those images using the entire screen. The template consists of two image displays, and a base frame with parts for displaying related information.



2 Equal Displays (full screen)

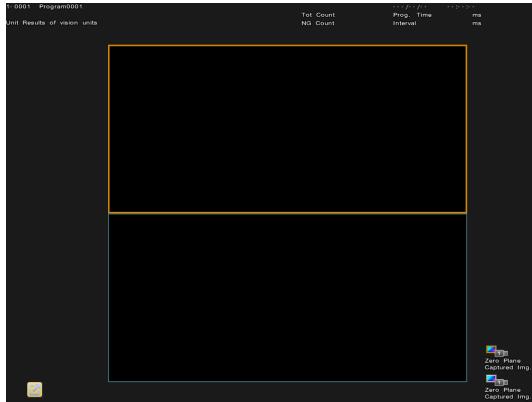
This template displays two images of the same size, side by side, and information related to those images using the entire screen. The template consists of two image displays, and a base frame with parts for displaying related information.



Horizontal Split Display (reduced screen)

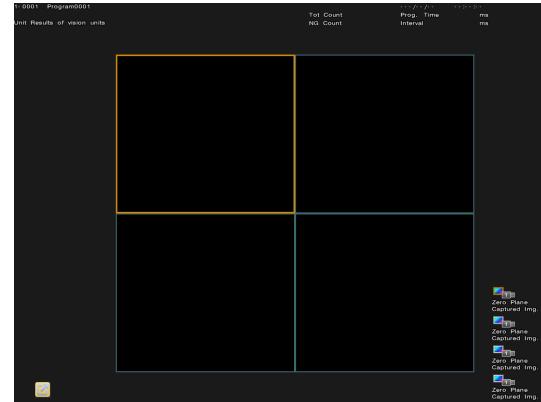
This template displays two images half of the display size in the Y direction, top and bottom, and information related to those images.

The template consists of two image displays, and a base frame with parts for displaying related information.



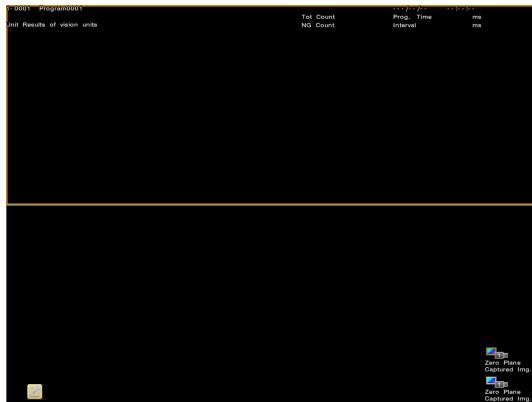
4-way Equal Split Display (reduced screen)

This template displays four tiled images of the same size and information related to those images. The template consists of four image displays, and a base frame with parts for displaying related information.



Horizontal Split Display (full screen)

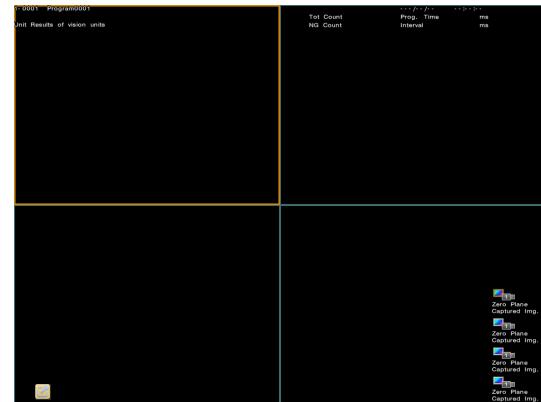
This template displays two images half of the display size in the Y direction, top and bottom, and information related to those images using the entire screen. The template consists of two image displays, and a base frame with parts for displaying related information.



4-way Equal Split Display (full screen)

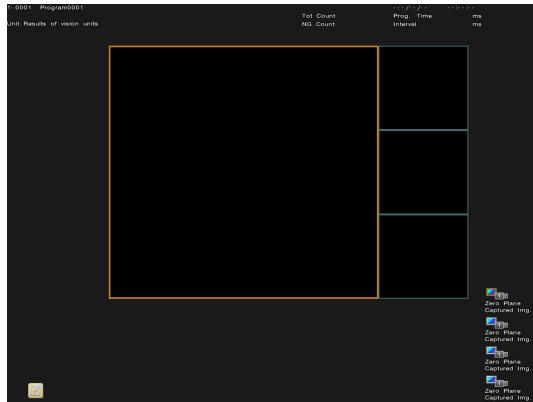
This template displays four tiled images of the same size and information related to those images using the entire screen.

The template consists of four image displays, and a base frame with parts for displaying related information.



Main +3 Smaller Right Displays (reduced screen)

This template displays one large image and three smaller images vertically and to the right, and information related to those images. The template consists of four image displays, and a base frame with parts for displaying related information.



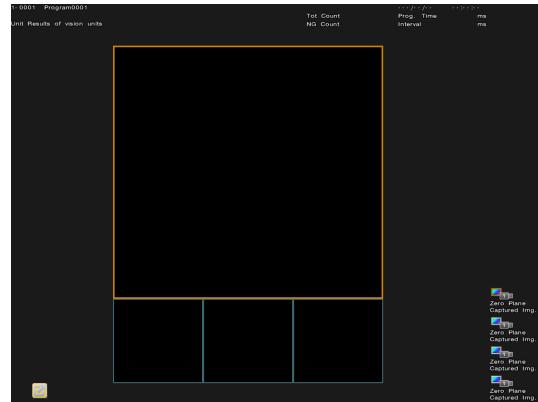
Main +3 Smaller Right Displays (full screen)

This template displays one large image and three smaller images vertically and to the right, and information related to those images using the entire screen. The template consists of four image displays, and a base frame with parts for displaying related information.



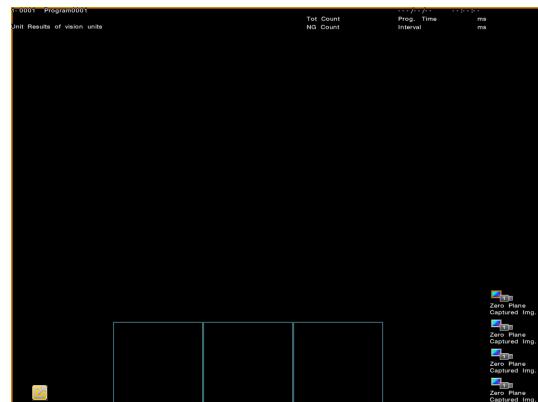
Main +3 Smaller Bottom Displays (reduced screen)

This template displays one large image and three smaller images horizontally below, and information related to the images. The template consists of four image displays, and a base frame with parts for displaying related information.



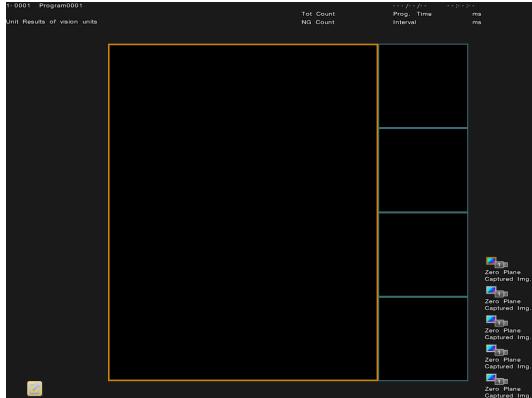
Main +3 Smaller Bottom Displays (full screen)

This template displays one large image and three smaller images horizontally below, and information related to those images using the entire screen. The template consists of four image displays, and a base frame with parts for displaying related information.



Main +4 Smaller Right Displays (reduced screen)

This template displays one large image and four smaller images vertically and to the right, and information related to those images. The template consists of five image displays, and a base frame with parts for displaying related information.



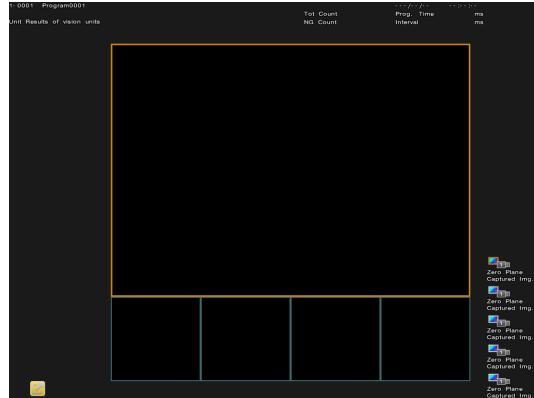
Main +4 Smaller Right Displays (full screen)

This template displays one large image and four smaller images vertically and to the right, and information related to those images using the entire screen. The template consists of five image displays, and a base frame with parts for displaying related information.



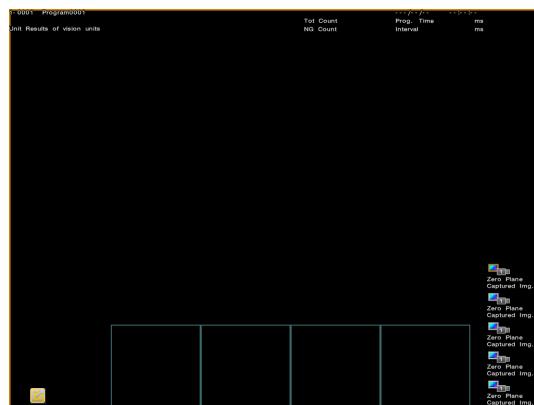
Main +4 Smaller Bottom Displays (reduced screen)

This template displays one large image and four smaller images horizontally below, and information related to those images. The template consists of five image displays, and a base frame with parts for displaying related information.



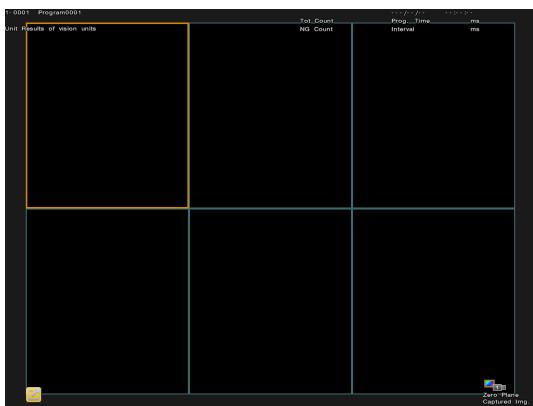
Main +4 Smaller Bottom Displays (full screen)

This template displays one large image and four smaller images horizontally below, and information related to those images using the entire screen. The template consists of five image displays, and a base frame with parts for displaying related information.



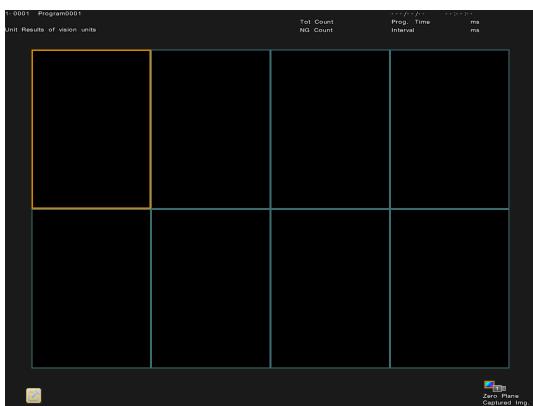
6-way Equal Split Display (reduced screen)

This template displays a latticed array of 6 images of the same size, and information related to those images. The template consists of six image displays, and a base frame with parts for displaying related information.



8-way Equal Split Display (reduced screen)

This template displays a latticed array of 8 images of the same size, and information related to those images. The template consists of eight image displays, and a base frame with parts for displaying related information.



Screen Parts

Overview of Display Template Parts

Screen display parts are modularized elements that are used to display various information on the controller. Users can place basic parts such as values, text, and lines on a base frame (Page 4-45) or page frame (Page 4-46), or built-in parts such as inspection information and results.

The following 25 screen display parts are available.

Parts that can be placed directly on the display template

- Image Display (Page 4-42)
- Base Frame (Page 4-45)
- Page Frame (Page 4-46)

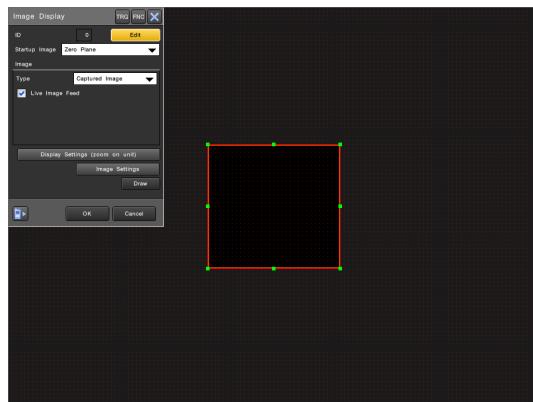
Parts that can be placed on a base frame or page frame

- Basic Parts
 - Value (Page 4-46)
 - Text (Page 4-48)
 - Active text (Page 4-49)
 - Rectangle (Page 4-52)
 - Horizontal Line (Page 4-53)
 - Vertical Line (Page 4-54)
 - Point (Page 4-55)
 - Circle (Page 4-56)
 - Polygon (Page 4-57)
 - Table (Page 4-58)
- Standard parts
 - Display Program/Recipe Name (Page 4-59)
 - Inspection Date (Page 4-60)
 - Inspection Time (Page 4-61)
 - Display Camera & Image Information (Page 4-62)
 - Display Area & Magnification (Page 4-63)
 - Total Status Pass / Fail (Page 4-64)
 - Logo Image (BMP) (Page 4-65)
 - Unit Details (vision tools) (Page 4-65)
 - Unit Details (non-vision tools) (Page 4-67)
 - Variable List (Page 4-68)
 - Unit Pass / Fail Graphic (Page 4-69)
 - Unit Result Summary List (Page 4-70)

- Point**
- New [Polygon] parts cannot be added. It is also not possible to edit the nodes of existing polygon parts.
 - [Unit Details (vision tools)], [Unit Details (non-vision tools)], [Variable List], and [Unit Result Summary List] parts cannot be placed in a page frame.

Image Display

This part adds an area to the display template that displays the image captured by the camera. Up to 8 image display parts can be placed on a single screen display.



ID

Displays the screen number (0 to 9). To change the number, select [Edit].



Point The image display ID must be unique within the same display screen display.

Startup Image

Select the image type to display initially for the image display.

Image

Select the type of image to display for the unit in the image display.

- **Captured Image:** Displays the current image (image variable) of the selected unit.

- **Registered Image:** Displays the registered image of the selected unit.

- **Image Archive:** Displays an archived image of the selected unit. If you selected [Archive Image], specify which image in the archive to display.

- **Image Archive:** Specify the image archive (Page 5-4) to reference (0 to 7).

- **Image No.:** Specify the archive count to reference (0 to 1023).

- **Preceding Image No.:** If you have set the archive method to [Include preceding image] (Page 5-4), specify the preceding image number to reference (1 to 512).

Point

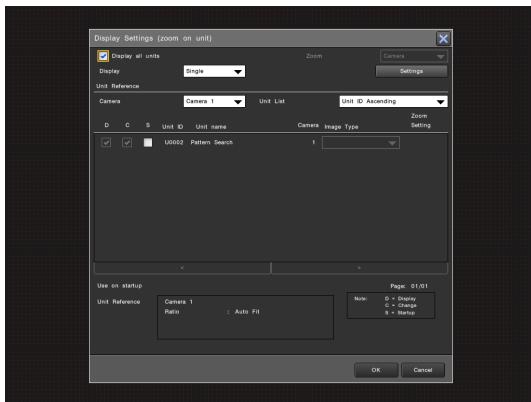
- If these settings do not match the image archive settings (Page 5-4), an error will occur.
- The image displayed will reflect the condition when flow execution reaches the end unit. If the flowchart overwrites image data after the controller executes the selected unit, discrepancies will occur between the displayed image and the processing result of the executed unit.
- During retesting, an image display which shows an archive image appears black.
- When the image memory on the [Resources] menu is close to 100%, it may not be possible to set an archive image.

Live Image Feed

Check this option to display an image from a camera when the Screen Update setting under Trigger Setting in the Capture unit is set to [Live Image]. If this option is unchecked and the Screen Update is set to [Live Image], the screen will only update with a trigger input.

Point

- Continuously updated images are displayed when these conditions are met:
- the image update option for the most recently executed (or currently executing) capture unit is set to [Live Image].
 - the current image variable for the currently selected unit on the screen is the same as the destination image variable for the most recently executed (or currently executing) capture unit.
 - the controller is in trigger wait condition regardless of whether background capture is enabled/disabled.

Display Settings (zoom on unit)

- Display all units:** Check this option to display all units which can be displayed in the image display.

Reference

Units that can be displayed are inspection units, graphics units, position adjustment units, image operation units, C-Plugin units, and calibration units.

- Area:** Specify how to display the region on the image display.

- Single:** Displays only the region for the unit selected on the controller.
- Selected:** Simultaneously displays the regions for the applicable display units that reference the same registered image (if [Type] on the [Select Image] tab is set to [Registered Image]), or image variable (if [Type] is set to [Captured Image]) for the unit selected on the controller.

Point

- If [Single] is selected for [Display], checkmarks are automatically added to [C] for the units that have [D] selected.
- If a unit that uses a processed image region (Page 2-473) is not the topmost window when [Display] is set to [Selected], the image display will show the raw image regardless of the image type specified for that unit.

- Zoom:** Select whether to specify the zoom setting for each camera or each unit.

- Camera:** Specify the zoom setting for each camera.

- Unit:** Specify the zoom setting for each unit.

Point

This setting is fixed to [Camera] if the [Display all units] option is selected.

- Settings:** The zoom operation varies depending on the [Location] setting. See "Setting the details for zoom operation" (Page 4-44) for more details.

This is not displayed when [Zoom] is set to [Unit]. Set the [Zoom Setting] for each unit under [Select Unit].

- Coordinate:** Select the method to display coordinates when a unit is specified as the target of position correction.

Before position adjust (default): Displays the coordinate value before correcting the position of the inspection region.

After position adjust: Displays the coordinate value after correcting the inspection region to the reference position.

- Location**

OFF (default): Disables zoom tracking. The image is displayed at the specified zoom ratio.

Detected Point: Zooms to the specified zoom ratio centered at the result obtained by the position measurement unit.

Inspection Region: Zooms to the specified zoom ratio centered at the position of the measurement region for the unit.

Reference

The XY coordinates listed below are the tracking targets when [Detected Point] is selected. For measurements that detect multiple positions, the tracking target is set on the primary target or a label specified by an index.

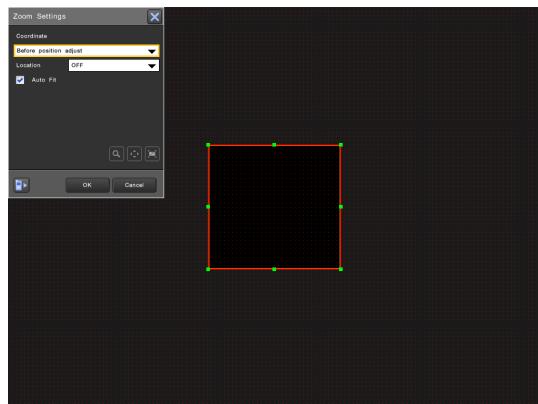
Applicable units	Tracking targets	
Pattern Search	Primary target	
ShapeTrax3, ShapeTrax2, PatternTrax	Primary target	
Edge Position	Primary target	
Edge Angle	Center position	
Defect	Grouping OFF	Position
	Grouping ON	Center of gravity
Blob	Center of gravity	
Grayscale Blob	Center of gravity	
Profile Position	Circle/Line OFF	Position
	Circle ON	Circle center
	Line ON	Line center
Profile Defect, Multi-Profile Defect	Defect position	
On-Screen Graphics	Supports only [Point] at the top of the graphic settings.	

Note, if [Detected Point] is set for a unit not listed above, the measurement region position will be displayed as the primary target.

Screen Parts

Setting the details for zoom operation

Operation varies depending on the [Location] setting.

**• If turned [OFF]**

- **Auto Fit:** When checked, this option automatically adjusts the zoom ratio so that the image fits the image display size on the Screen Editor. (All other manual settings become disabled.)
- **Ratio:** Specifies the zoom ratio to use.
- **Offset:** Set the amount of offset when displaying the image in the image display.

• If set to [Detected Point]

- **Ratio:** Specifies the zoom ratio to use.
- **Offset:** Set the amount of zoom center offset relative to the detected point.
- **All scroll to:** Specifies the label to track when there are multiple detected targets (default: Primary Target).

• If set to [Inspection Region]

- **Ratio:** Specifies the zoom ratio to use. If set to [Auto], this option automatically adjusts the long end of the inspection region (if the region is not a rectangle, the rectangle surrounding the region) so that it fits within 90% of the image display.
- **Offset:** Set the amount of zoom center offset.

- **Unit Reference:** Specify the image display settings for each unit.

- **Camera** (only when [Zoom] is set to [Camera]): Displays only the units for the selected camera No.

- **Unit List:** Select the unit ID display order.

- Unit ID Ascending:** Sort in ascending order of unit IDs.

- Unit ID Descending:** Sort in descending order of unit IDs.

- Camera No. Ascending** (only when [Zoom] is set to [Unit]): Sort in ascending order of camera No.

- Camera No. Descending** (only when [Zoom] is set to [Unit]): Sort in descending order of camera No.

- **D:** Place a check in this option to display the unit information in the image display for the set unit.

- **C:** Place a check in this option to make the unit information selectable on the image display from the console.

- **S:** Place a check in this option to display the unit when the inspection program is loaded.

- **Unit ID:** Displays the unit ID.

- **Unit Name:** Displays the unit name.

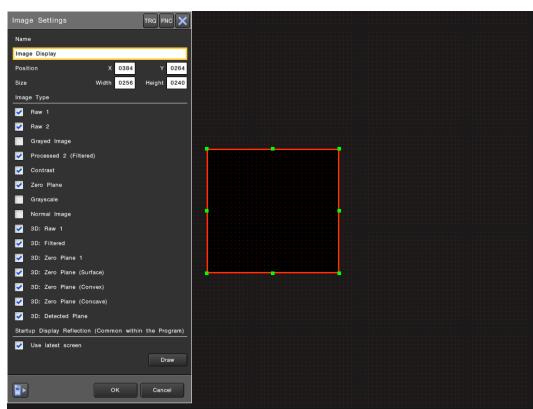
- **Camera:** Displays the camera number referenced by the unit.

- **Image Type:** Select whether to display Raw Image1 or Raw Image2 when both raw images are selected when an Image Processing unit (Page 2-373) or C Plug-In unit is executed. Select either [Source 1] (default) or [Source 2].

Point

- [D] and [C] are enabled and cannot be disabled if the [Display all units] option is enabled. [Image Type] is also fixed at [Source 1]. (To select [Source 2], remove the check.)
- You can specify up to 64 units to display.
- To display the resultant image from an operation, set the image type to either [Processed 1 (Gray)], [Processed 2 (Filtered)], or [Contrast].
- Zoom settings cannot be made when none of the valid units have a check mark.
- If the [Zoom] option is set to [Camera], the same settings will be applied to all units that reference the same camera number, except for the selectability and startup settings.
- If the [Display all units] option is not checked, the maximum number of units that can be selected for display is 64.

Image Settings



- Name:** Enter the name of the image display. This name appears in the Select Screen Display menu.
- Position:** Specify the position for displaying the image with the top left coordinate (X: 0 to 974, Y: 0 to 718).
- Size:** Specify the image size (width: 50 to 1024, height: 50 to 768).
- Image Type:** For each display type, specify whether the display type should be selectable. Check the box to make that type selectable.
- Use latest screen:** Check this option to overwrite the initial display status when the settings are saved on the controller.

- Point**
- The following items in the display settings will be overwritten:
 - Initial display template
 - Initial display page
 - Focused image display in the initial display
 - Unit initially displayed on each image display
 - Processed image type initially displayed on each image display
 - Zoom ratio initially displayed on each image display
 - The [Use latest screen] setting is saved as part of the program file.

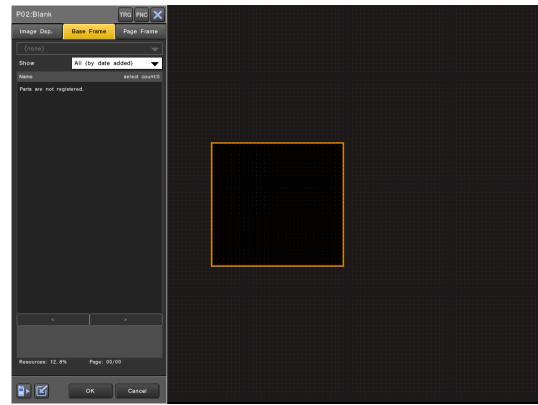
Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Base Frame

This part adds a base frame to the display template. The Screen Browser shows and organizes parts such as values, various graphic shapes, and judgment results grouped under a base frame.

- A display template can have only one base frame.
- Unlike the page frame (Page 4-46), parts placed on the base frame appear on the screen at all times regardless of the page selected.



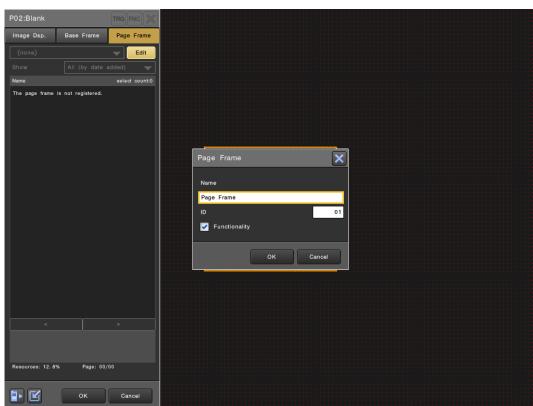
There are no setting items for the Screen Editor on the controller.

Screen Parts

Page Frame

This part adds a page frame to the display template. The Screen Browser shows and organizes parts such as values, various graphic shapes, and judgment results grouped under a page frame.

- A screen display can have up to 99 page frames.
- Parts laid out on a page frame support page switching. By using page frames with the base frame (Page 4-45), designers can control the display parts that should appear at all times and those that should appear only when the user switches to that page.



By selecting [Edit Page Frame] - [Properties], you can change the following page frame settings.

Name

Enter the name of the page frame.

This name appears in the Select Screen Display menu.

ID

Specify the display page ID for the page frame (1 to 99).

Point The page ID must be unique within the same screen display.

Functionality

Remove the check to exclude this page from page switching on the console.

Reference is displayed when the page frame is set as the startup image. is displayed when the page frame is selectable and is displayed when it is not selectable. is displayed when there is an error in the page frame settings.

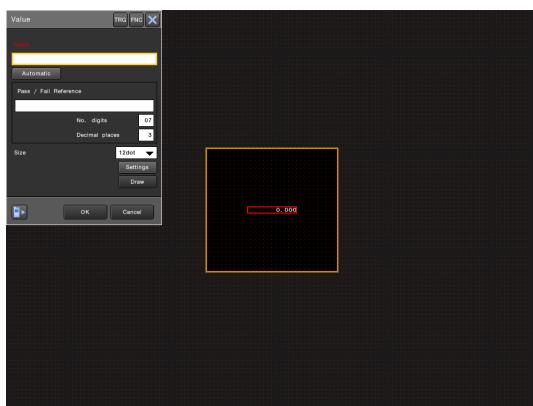
Basic Parts

These parts can be placed directly on the frame of the display template.

- The maximum number of parts, including standard parts (Page 4-59) that can be placed on a single frame is 500.
- The maximum number of parts that can be placed on a single screen display is 4000, excluding the frame.
- The maximum number of parts that can be placed in a single inspection program is 60000, excluding the frame.

Value

This part is used to display measurements and variables as numeric values.

**Value**

Specify the item to display as a value (variable, setting parameter, or result data).

Automatic

If the [Value] field is set to a setting parameter or results data, the judge value and number of digits will be set automatically according to the value.

Point All other values will be displayed as a 7-digit integer and to 3 decimal places.

Pass / Fail Reference

If you specified to change the value displayed based on the results, specify the threshold value (variable, setting parameter, or results data) for changing the display. If the first decimal place rounds to 0, the result is OK. Otherwise the value is NG.

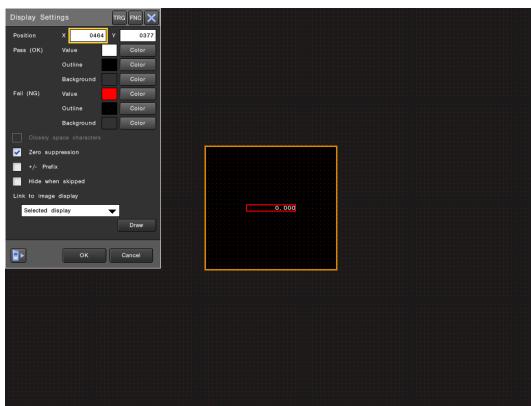
No. digits, Decimal places

Specify the number of digits to display as 1 to 10 digits for the integer portion and 0 to 6 digits for the decimal portion.

Size

Select the display size for the value from 12, 16, 24, 32, or 48 dots (default: 12 dots).

Settings



- Position:** Specify the top left coordinate of the position to display the value (X: 0 to 1023, Y: 0 to 767).
- Pass (OK):** Select the color of the value and the outline for it when the judgment is OK or if no judge value is specified.
 - Value:** To change the value color, select [Color]. You can also select [None] to hide the value.
 - Outline:** To change the value outline color, select [Color].
 - Background:** Select [Color] to specify the background color of the value.
- Fail (NG):** Select the color of the value and the outline for the value when the judgment is NG.
 - Value:** To change the value color, select [Color]. You can also select [None] to hide the value.
 - Outline:** To change the value outline color, select [Color].
 - Background:** Select [Color] to specify the background color of the value.
- Closely space characters:** Select this check box to remove spacing for specified characters. You can only select this check box if the background color is enabled in both [Pass (OK)] and [Fail (NG)]. This is useful when you want to match the display and screen layout to that of the XG-8000/7000 series.
- Zero Suppression:** Remove the check to display the value with leading zeros. For example, when the number of integer digits is set to 5 and the value is 500, "00500" will be displayed when zero suppression is disabled, and "500" will be displayed when zero suppression is enabled.
- +/- Prefix:** Place a check in this option to show the "+" symbol before a positive value.
- Hide when skipped:** Place a check in this option to display the value only when the controller executes the unit for the setting parameter or results data specified in [Value] (Page 4-46) and [Pass / Fail Reference] (Page 4-46).

• **Link to image display:** The setting parameter or results data specified for the [Value] (Page 4-46) and [Pass / Fail Reference] (Page 4-46) can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the displayed value will be the results data for the archived image. (For any other shown image, the latest value will be displayed.)

- **None:** Displays the latest results, independent of the image display.
- **Selected display:** Displays the result associated with the displayed image on the image display that is selected on the controller.
- **Image display ID:** Always displays the result associated with the displayed image on the specified image display.

! Point

- The [Outline] option is only enabled if [Background] is set to [None].
- If a link is set to a image display that is set to display an archived image which does not have any results data, no value will be displayed.
- A setting error will occur if the specified image display does not exist on the display template.

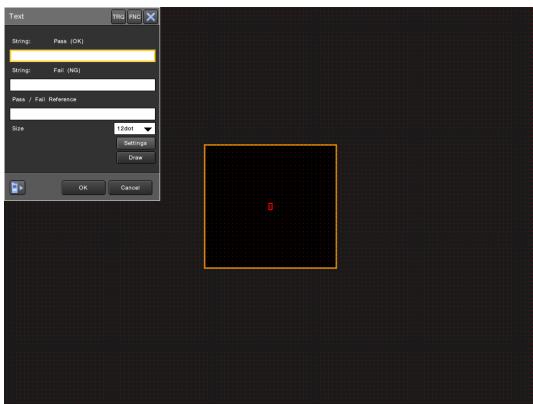
Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Screen Parts

Text

This part is used to display a text string.



String

- Pass (OK):** Specify the text to display when the judgment is OK or if no pass/fail reference is specified.
- Fail (NG):** Specify the text to display when the judgment is NG.

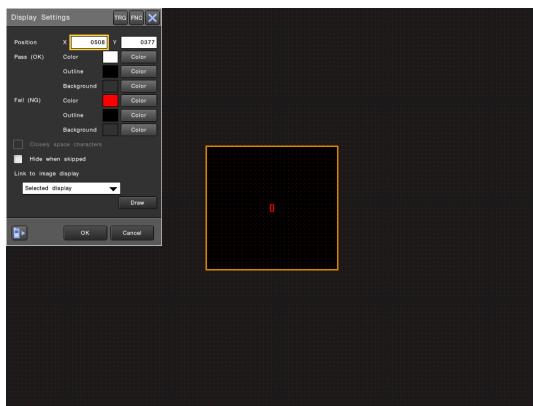
Pass / Fail Reference

Change the text displayed based on a value like a variable, setting parameter, or results data. If the first decimal place rounds to 0, the result is OK. Otherwise the value is NG.

Size

Select the display size for the text from 12, 16, 24, 32, or 48 dots (default: 12 dots).

Settings



- Position:** Specify the top left coordinate of the position to display the text (X: 0 to 1023, Y: 0 to 767).
- Pass (OK):** Select the color of the text and the outline for the text when the judgment is OK or if no judge value is specified.
 - Color:** To change the text color, select [Color]. You can also select [None] to hide the text.
 - Outline:** To change the text outline color, select [Color].
 - Background:** Select [Color] to specify the background color of the value.
- Fail (NG):** Select the color of the text and the outline for the text when the judgment is NG.
 - Color:** To change the text color, select [Color]. You can also select [None] to hide the text.
 - Outline:** To change the text outline color, select [Color].
 - Background:** Select [Color] to specify the background color of the value.
- Closely space characters:** Select this check box to remove spacing for specified characters. You can only select this check box if the background color is enabled in both [Pass (OK)] and [Fail (NG)]. This is useful when you want to match the display and screen layout to that of the XG-8000/7000 series.
- Hide when skipped:** Place a check in this option to display the value only when the controller executes the unit for the setting parameter or results data specified in [Pass / Fail Reference] (Page 4-48).

- Link to image display:** The setting parameter or results data specified for the [Pass / Fail Reference] (Page 4-48) can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the displayed text will be linked to the results data for the archived image. (For any other shown image, the display is linked to the latest result.)
 - **None:** Background color always matches the latest result, independent of the image display.
 - **Selected display:** Displays the result associated with the displayed image on the image display that is selected on the controller.
 - **Image display ID:** Permanently links the background color to the result of the displayed image on the specified image display.

Point

- The [Outline Color] option is only enabled if [Background Color] is set to [None].
- If the link is set to a image display that has been set to an archived image with no results logging data, the text will always be the text set for [Pass (OK)].
- A setting error will occur if the specified image display does not exist on the display template.

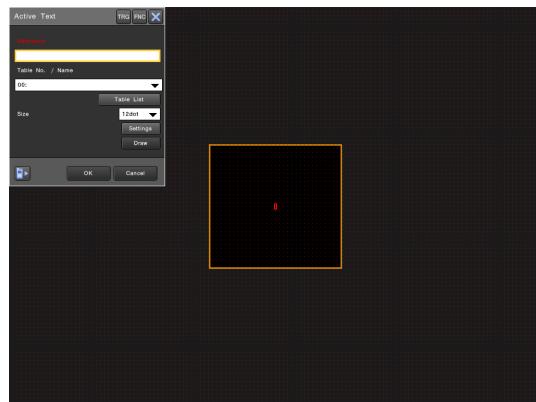
Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Active Text

In addition to information such as measurement value and judgment results, this part is used to display user-defined text (active text) linked to measurement results.

Up to 512 combinations of values and text can be managed in up to 64 tables. This function is useful when switching between multiple display messages depending on the measurement result.



Reference

Specify the item to display as a value (variable, setting parameter, or result data).

Table No./name

Select a table to be used from the predefined tables.

Table Setting

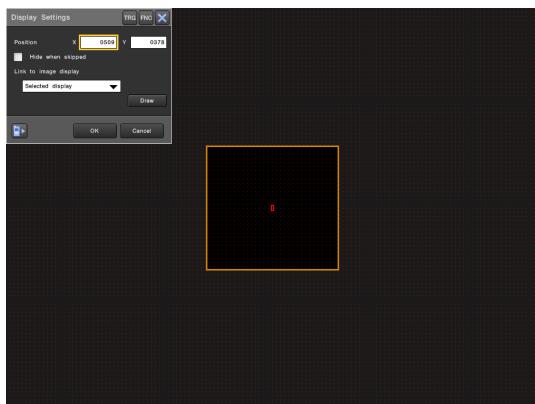
Show the [Table List] menu for editing a table which stores the different strings of text and associated displaying conditions. See "Creating the active text table" (Page 4-50) for more details.

Size

Select the display size for the value from 12, 16, 24, 32, or 48 dots (default: 12 dots).

Screen Parts

Settings



- Position:** Specify the top left coordinate of the position to display the value (X: 0 to 1023, Y: 0 to 767).
- Hide when skipped:** Place a check in this option to display the text only when the controller executes the unit for the setting parameter or results data specified in [Reference] (Page 4-49).
- Link to image display:** The setting parameter or results data specified for the [Reference] (Page 4-49) can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the displayed text will be linked to the results data for the archived image. (For any other shown image, the display is linked to the latest result.)
 - **None:** Background color always matches the latest result, independent of the image display.
 - **Selected display:** Displays the result associated with the displayed image on the image display that is selected on the controller.
 - **Image display ID:** Permanently links the background color to the result of the displayed image on the specified image display.

- Point**
- If a link is set to a image display that is set to display an archived image which does not have any results data, no value will be displayed.
 - A setting error will occur if the specified image display does not exist on the display template.

Draw

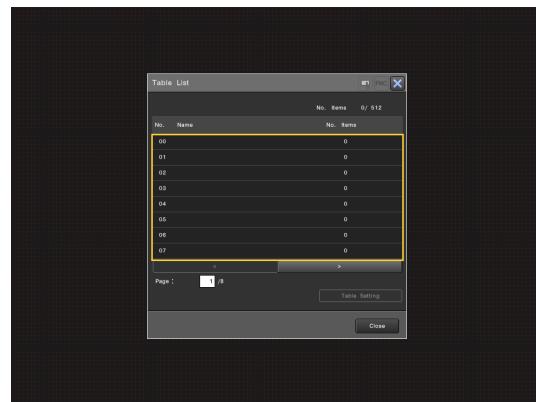
Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Creating the active text table

In the [Table List] menu, you can edit tables which store the different strings of text and associated displaying conditions.

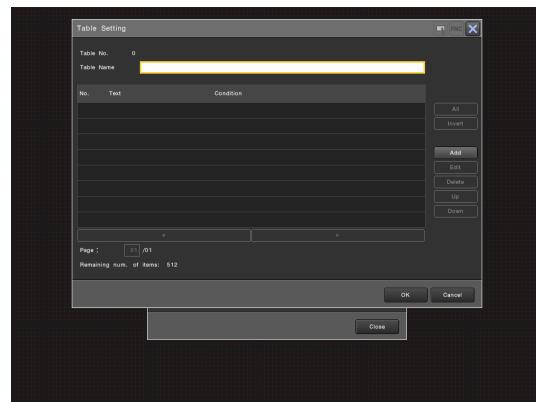
1 On the Active Text menu, select [Table List].

The [Table List] menu appears.



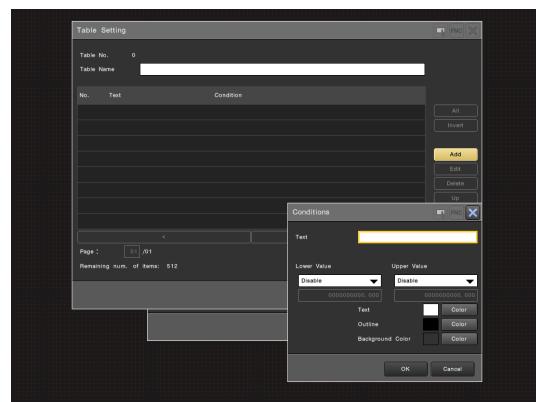
2 Select the line of the table No. to edit and then select [Table Setting].

The [Table setting] menu of the selected table appears.



3 Select [Add].

The [Condition] menu appears.



4 Edit the conditions for text display.

Text

Enter the text (up to 64 1-byte characters or 32 2-byte characters) that you want to display when the conditions are met.

Lower Value

Choose [Enable] and then set the lower limit for the measured value, at or above which the text will be displayed.

Upper Value

Choose [Enable] and then set the upper limit for the measured value, at or below which the text will be displayed.



Point When the reference value is within the upper and lower limit of a certain Item No., the text specified for that Item No. will be displayed. For example, if Item No. 1 has an upper limit of 10 and a lower limit of 1, a reference value of 5 will display the text for that condition. If Item No. 2 has an upper limit of 20 and a lower limit of 11, it will only display the text for Item No. 2 if a reference value between 11 and 20 is found.

Text

Select the color of the text.

Outline

Select the color of the outline for the text.

Background Color

Select the background color of the string.

5 Select [OK].

A new display condition will be added to the bottom of the list on the Table Setting screen.

6 Edit the table details as required.

- **Table Name:** Enter a table name (up to 64 1-byte characters or 32 2-byte characters).
- **All:** Select all conditions.
- **Invert:** Invert the current checkmark selections.
- **Delete:** Delete the selected text display condition.
- **Up:** Move the selected condition up one line.
- **Down:** Move the selected condition down one line.

7 When editing is complete, select [OK].

The changes made to the [Table Setting] are reflected and the display returns to the [Table List] menu

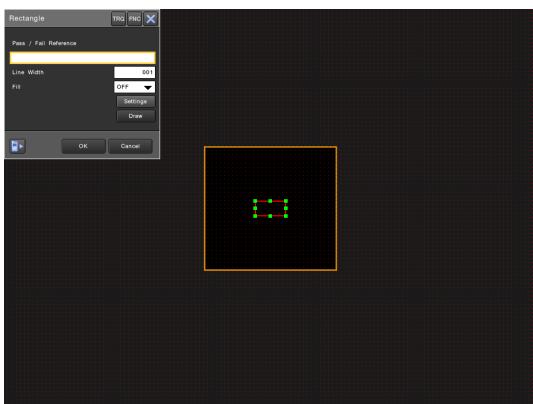
8 To edit other tables, repeat steps 2 to 7.

9 When the editing of all tables is complete, select [Close].

Screen Parts

Rectangle

This part is used to display a rectangle.



Pass / Fail Reference

Change the rectangle displayed based on a value like a variable, setting parameter, or results data. If the first decimal place rounds to 0, the result is OK. Otherwise the value is NG.

Line Width

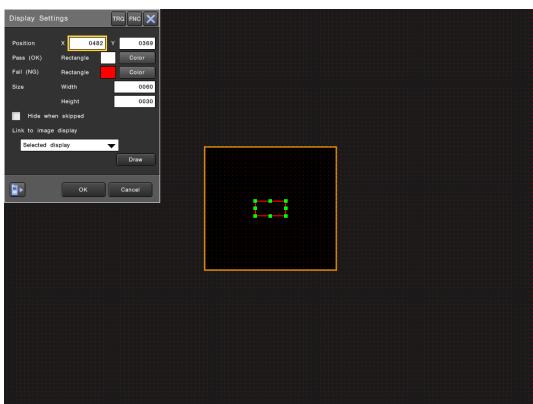
Specify the width of the rectangle lines from 1 to 999 (default: 1).

Fill

Select whether to fill the rectangle.

- **ON:** The rectangle is filled.
- **OFF** (default): Only the outline of the rectangle is displayed.

Settings



- **Position:** Specify the top left coordinate of the position to display the rectangle (X: 0 to 1023, Y: 0 to 767).
- **Pass (OK):** Select the color of the rectangle when the judgment is OK or if no judge value is specified. You can also select [None] to hide the rectangle.
- **Fail (NG):** Select the color of the rectangle when the judgment is NG. You can also select [None] to hide the rectangle.
- **Size:** Specify the width and height of the rectangle from 1 to 9999 (defaults: 60 (width), 30 (height)).
- **Hide when skipped:** Place a check in this option to display the rectangle only when the controller executes the unit for the setting parameter or results data specified in [Pass / Fail Ref.] (Page 4-52).

• **Link to image display:** The setting parameter or results data specified for the [Pass / Fail Ref.] (Page 4-52) can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the displayed color will be linked to the results data for the archived image. (For any other shown image, the display is linked to the latest result.)

- **None:** Background color always matches the latest result, independent of the image display.

- **Selected display:** Displays the result associated with the displayed image on the image display that is selected on the controller.

- **Image display ID:** Permanently links the background color to the result of the displayed image on the specified image display.



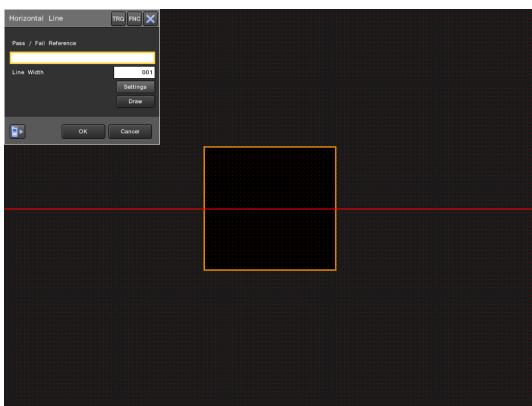
- If the link is set to a image display that has been set to an archived image with no results logging data, the line will always be drawn in the color set for [Pass (OK)].
- A setting error will occur if the specified image display does not exist on the display template.

Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Horizontal Line

This part is used to display a horizontal line.



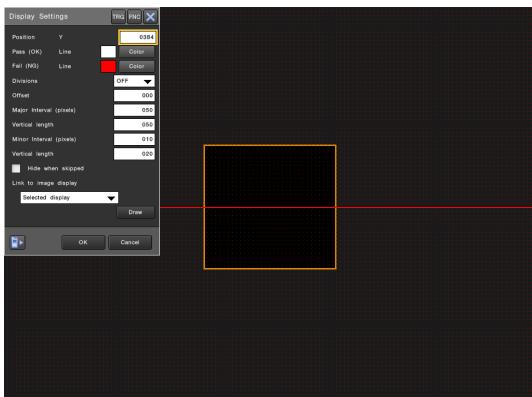
Pass / Fail Reference

Change the horizontal line displayed based on a value like a variable, setting parameter, or results data. If the first decimal place rounds to 0, the result is OK. Otherwise the value is NG.

Line Width

Specify the width of the horizontal line from 1 to 999 (default: 1).

Settings



- Position Y:** Specify the horizontal line Y coordinate from 0 to 767.
- Pass (OK):** Select the color of the horizontal line when the judgment is OK or if no judge value is specified. You can also select [None] to hide the horizontal line.
- Fail (NG):** Select the color of the horizontal line when the judgment is NG. You can also select [None] to hide the horizontal line.
- Divisions:** Select whether to show a scale on the line when a horizontal line is drawn.
 - **ON:** Show the scale. Adjust the settings for [Offset], [Major Interval (pixels)], [Vertical Length], [Minor Interval(pixels)] and [Vertical Length] to display the required scale.
 - **OFF** (default): Do not show the scale.
- Offset:** Specify the offset distance from the left side of the screen from 0 to 999 (default: 0).

- Major Interval (pixels):** Specify the major interval (pixels) on Scale (1) from 0 to 999 (default value: 50).
- Vertical Length:** Specify the length of the marks on the scale from 0 to 999 (default value: 50).
- Minor Interval (pixels):** Specify the minor interval (pixels) on the Division from 0 to 999 (default value: 10).
- Vertical length:** Specify the length of the marks on the Division from 0 to 999 (default value: 20).
- Hide when skipped:** Place a check in this option to display the horizontal line only when the controller executes the unit for the setting parameter or results data specified in [Pass / Fail Reference] (Page 4-53).
- Link to image display:** The setting parameter or results data specified for the [Pass / Fail Reference] (Page 4-53) can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the displayed color will be linked to the results data for the archived image. (For any other shown image, the display is linked to the latest result.)
 - **None:** Background color always matches the latest result, independent of the image display.
 - **Selected display:** Displays the result associated with the displayed image on the image display that is selected on the controller.
 - **Image display ID:** Permanently links the background color to the result of the displayed image on the specified image display.



- No division will be shown even if the [Division] option is set to [ON] if both [Major Interval], [Vertical Length], [Minor Interval] and [Vertical Length] are set to 0.
- If the link is set to a image display that has been set to an archived image with no results logging data, the line will always be drawn in the color set for [Pass (OK)].
- A setting error will occur if the specified image display does not exist on the display template.

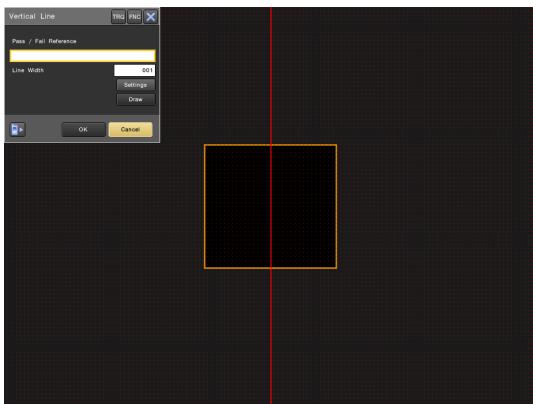
Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Screen Parts

Vertical Line

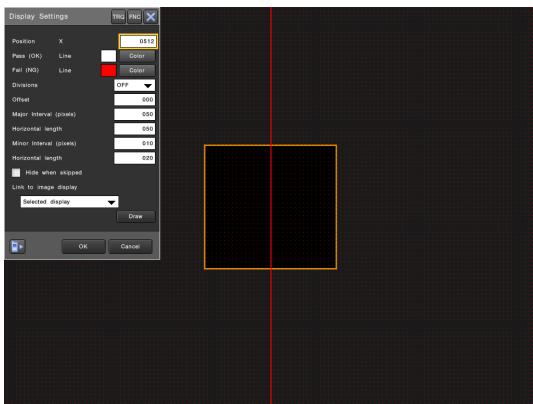
This part is used to display a vertical line.

**Pass / Fail Reference**

Change the vertical line displayed based on a value like a variable, setting parameter, or results data. If the first decimal place rounds to 0, the result is OK. Otherwise the value is NG.

Line Width

Specify the width of the vertical line from 1 to 999 (default: 1).

Settings

- Position X:** Specify the horizontal line Y coordinate from 0 to 1023.
- Pass (OK):** Select the color of the vertical line when the judgment is OK or if no judge value is specified. You can also select [None] to hide the vertical line.
- Fail (NG):** Select the color of the vertical line when the judgment is NG. You can also select [None] to hide the vertical line.
- Division:** Select whether to show a scale on the line when a vertical line is drawn.
 - ON:** Show the scale. Adjust the settings for [Offset], [Major Interval (pixels)], [Horizontal Length], [Minor Interval (pixels)] and [Horizontal Length] to display the required scale.
 - OFF** (default): Do not show the scale.
- Offset:** Specify the offset distance from the top of the screen from 0 to 999 (default: 0).

- Major Interval (pixels):** Specify the major interval (pixels) on the Devision from 0 to 999 (default value: 50).
- Horizontal Length:** Specify the length of the marks on the Division from 0 to 999 (default value: 50).
- Minor Interval (pixels):** Specify the minor interval (pixels) on the Division from 0 to 999 (default value: 10).
- Horizontal Length:** Specify the length of the marks on the Division from 0 to 999 (default value: 20).
- Hide when skipped:** Place a check in this option to display the vertical line only when the controller executes the unit for the setting parameter or results data specified in [Pass / Fail Reference] (Page 4-54).
- Link to image display:** The setting parameter or results data specified for the [Pass / Fail Reference] (Page 4-54) can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the displayed color will be linked to the results data for the archived image. (For any other shown image, the display is linked to the latest result.)
 - None:** Background color always matches the latest result, independent of the image display.
 - Selected display:** Displays the result associated with the displayed image on the image display that is selected on the controller.
 - Image display ID:** Permanently links the background color to the result of the displayed image on the specified image display.

Point

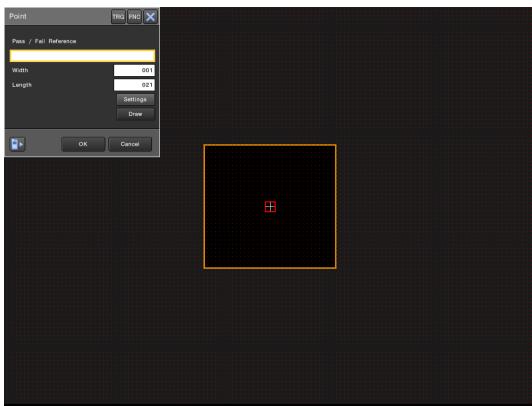
- No Divison will be shown even if the [Division] option is set to [ON] if both [Major Interval (pixels)], [Horizontal Length], [Minor Interval (pixels)] and [Horizontal Length] are set to 0.
- If the link is set to a image display that has been set to an archived image with no results logging data, the line will always be drawn in the color set for [Pass (OK)].
- A setting error will occur if the specified image display does not exist on the display template.

Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Point

This part is used to display a point.



Pass / Fail Reference

Change the point displayed based on a value like a variable, setting parameter, or results data. If the first decimal place rounds to 0, the result is OK. Otherwise the value is NG.

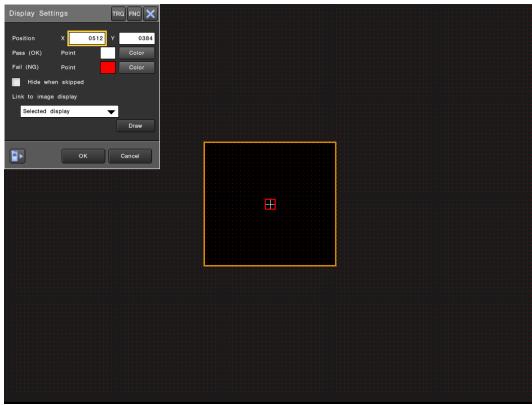
Width

Specify the width of the lines that compose the point from 1 to 999 (default: 1).

Length

Specify the length of the lines that compose the point from 1 to 999 (default: 21).

Settings



- Position:** Specify the center coordinate of the position to display the point (X: 0 to 1023, Y: 0 to 767).
- Pass (OK):** Select the color of the point when the judgment is OK or if no judge value is specified. You can also select [None] to hide the point.
- Fail (NG):** Select the color of the point when the judgment is NG. You can also select [None] to hide the point.
- Hide when skipped:** Place a check in this option to display the point only when the controller executes the unit for the setting parameter or results data specified in [Pass / Fail Reference] (Page 4-54).

• **Link to image display:** The setting parameter or results data specified for the [Pass / Fail Reference] (Page 4-55) can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the displayed color will be linked to the results data for the archived image. (For any other shown image, the display is linked to the latest result.)

- **None:** Background color always matches the latest result, independent of the image display.

- **Selected display:** Displays the result associated with the displayed image on the image display that is selected on the controller.

- **Image display ID:** Permanently links the background color to the result of the displayed image on the specified image display.



Point

- If the link is set to a image display that has been set to an archived image with no results logging data, the line will always be drawn in the color set for [Pass (OK)].
- A setting error will occur if the specified image display does not exist on the display template.

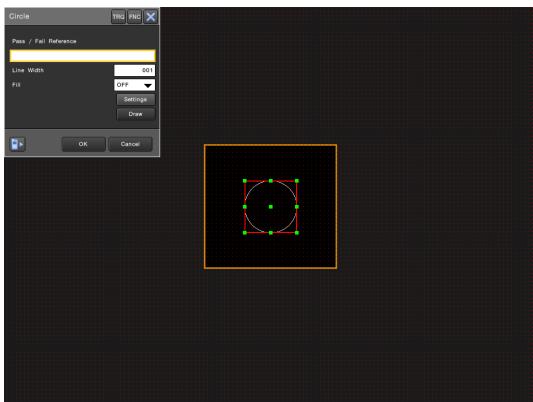
Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Screen Parts

Circle

This part is used to display a circle.



Pass / Fail Reference

Change the circle displayed based on a value like a variable, setting parameter, or results data. If the first decimal place rounds to 0, the result is OK. Otherwise the value is NG.

Line Width

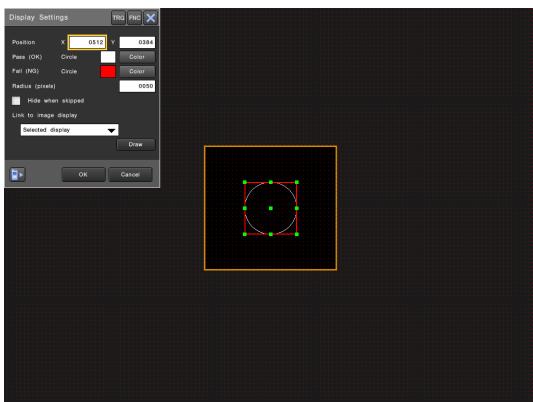
Specify the width of the circle line from 1 to 999 (default: 1).

Fill

Select whether to fill the circle.

- **ON:** The circle is filled.
- **OFF** (default): Only the outline of the circle is displayed.

Settings



- **Position:** Specify the center coordinate of the position to display the circle (X: 0 to 1023, Y: 0 to 767).
- **Pass (OK):** Select the color of the circle when the judgment is OK or if no judge value is specified. You can also select [None] to hide the circle.
- **Fail (NG):** Select the color of the circle when the judgment is NG. You can also select [None] to hide the circle.
- **Radius (Pixels):** Specify the radius of the circle from 0 to 9999 (default value: 50).

- **Hide when skipped:** Place a check in this option to display the circle only when the controller executes the unit for the setting parameter or results data specified in [Pass / Fail Reference] (Page 4-56).

- **Link to image display:** The setting parameter or results data specified for the [Pass / Fail Reference] (Page 4-56) can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the displayed color will be linked to the results data for the archived image. (For any other shown image, the display is linked to the latest result.)

- **None:** Background color always matches the latest result, independent of the image display.

- **Selected display:** Displays the result associated with the displayed image on the image display that is selected on the controller.

- **Image display ID:** Permanently links the background color to the result of the displayed image on the specified image display.



Point

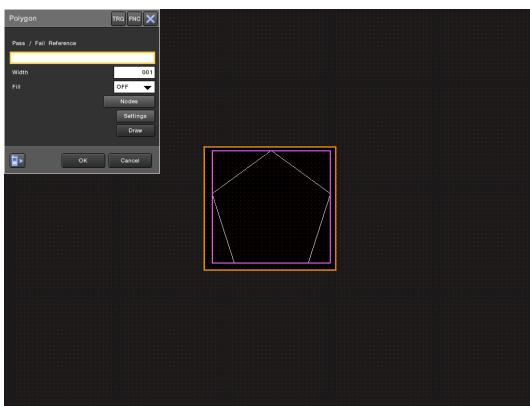
- If the link is set to a image display that has been set to an archived image with no results logging data, the line will always be drawn in the color set for [Pass (OK)].
- A setting error will occur if the specified image display does not exist on the display template.

Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Polygon

This part is used to display a polygon.



Point Polygons can only be added with XG-X VisionEditor.

Pass / Fail Reference

Change the polygon displayed based on a value like a variable, setting parameter, or results data. If the first decimal place rounds to 0, the result is OK. Otherwise the value is NG.

Line Width

Specify the width of the polygon lines from 1 to 999 (default: 1).

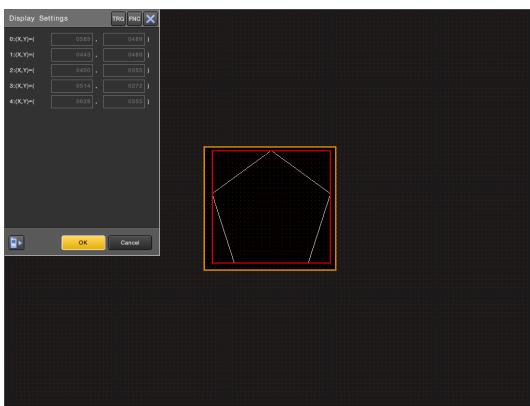
Fill

Select whether to fill the polygon.

- ON:** The polygon is filled.
- OFF** (default): Only the outline of the polygon is displayed.

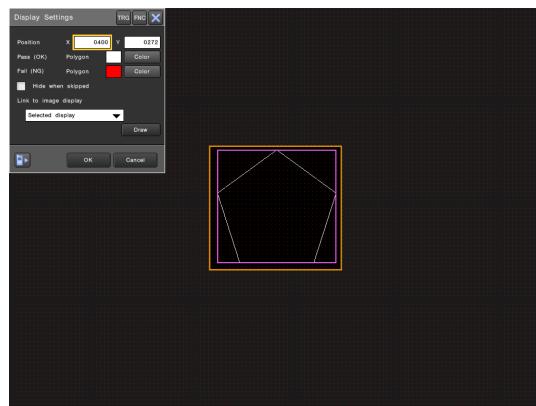
Nodes

Display the coordinates of each node in the polygon.



Point Nodes cannot be edited with the controller.

Settings



- Position:** Specify the top left coordinate of the position to display the polygon (X: 0 to 1023, Y: 0 to 767).
- Pass (OK):** Select the color of the polygon when the judgment is OK or if no judge value is specified. You can also select [None] to hide the polygon.
- Fail (NG):** Select the color of the polygon when the judgment is NG. You can also select [None] to hide the polygon.
- Hide when skipped:** Place a check in this option to display the polygon only when the controller executes the unit for the setting parameter or results data specified in [Pass / Fail Reference] (Page 4-57).
- Link to image display:** The setting parameter or results data specified for the [Pass / Fail Reference] (Page 4-57) can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the displayed color will be linked to the results data for the archived image. (For any other shown image, the display is linked to the latest result.)
 - None:** Background color always matches the latest result, independent of the image display.
 - Selected display:** Displays the result associated with the displayed image on the image display that is selected on the controller.
 - Image display ID:** Permanently links the background color to the result of the displayed image on the specified image display.

- If the link is set to a image display that has been set to an archived image with no results logging data, the line will always be drawn in the color set for [Pass (OK)].
- A setting error will occur if the specified image display does not exist on the display template.

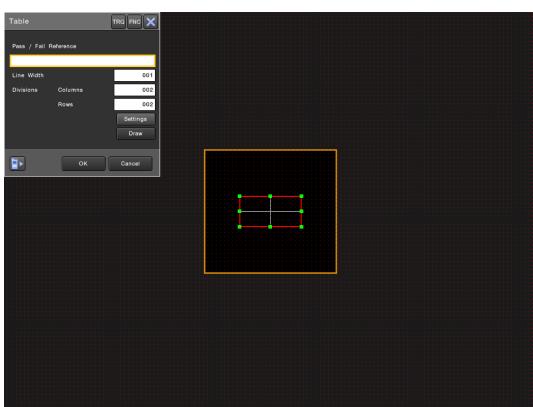
Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Screen Parts

Table

This part is used to display tables.

**Pass / Fail Reference**

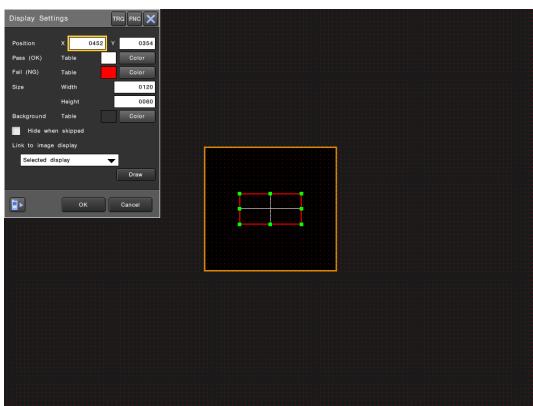
Change the table of lines displayed based on a value like a variable, setting parameter, or results data. If the first decimal place rounds to 0, the result is OK. Otherwise the value is NG.

Line Width

Specify the width of the table lines from 1 to 999 (default: 1).

Divisions

Specify the number of cells in the table by row and column from 1 to 100 (default: 2 for both width and height).

Settings

- Position:** Specify the top left coordinate of the position to display the table (X: 0 to 1023, Y: 0 to 767).
- Pass (OK):** Select the color of the table when the judgment is OK or if no judge value is specified. You can also select [None] to hide the table.
- Fail (NG):** Select the color of the table when the judgment is NG. You can also select [None] to hide the table.
- Size:** Specify the overall width and height of the table from 1 to 9999 (defaults: 120 (width), 60 (height)).
- Background:** Selects the background color of the entire table.

- Hide when skipped:** Place a check in this option to display the table only when the controller executes the unit for the setting parameter or results data specified in [Pass / Fail Reference] (Page 4-58).

- Link to image display:** The setting parameter or results data specified for the [Pass / Fail Reference] (Page 4-58) can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the displayed color will be linked to the results data for the archived image. (For any other shown image, the display is linked to the latest result.)

- **None:** Background color always matches the latest result, independent of the image display.

- **Selected display:** Displays the result associated with the displayed image on the image display that is selected on the controller.

- **Image display ID:** Permanently links the background color to the result of the displayed image on the specified image display.



- If the link is set to a image display that has been set to an archived image with no results logging data, the line will always be drawn in the color set for [Pass (OK)].
- A setting error will occur if the specified image display does not exist on the display template.

Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

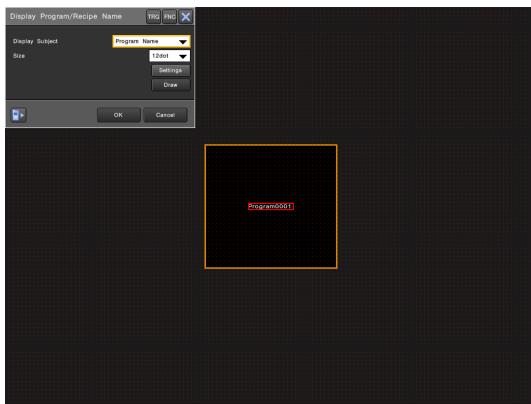
Standard Parts

These parts can be placed directly on the frame of the display template. (Some parts can only be placed on the base frame.)

- The maximum number of parts, including basic parts (Page 4-46) that can be placed on a single frame is 500.
- The maximum number of parts that can be placed on a single screen display is 4000, excluding the frame.
- The maximum number of parts that can be placed in a single inspection program is 60000, excluding the frame.

Display Program/Recipe Name

This part is used to display the program name or recipe name.



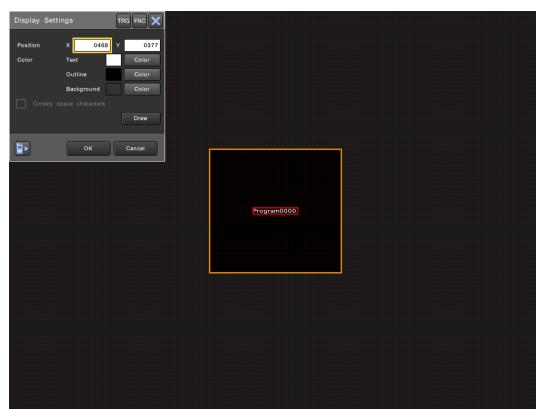
Display Subject

Select whether to display the program name (Default) or recipe name.

Size

Select the display size for the program name or recipe name from 12, 16, 24, 32, or 48 dots (default: 12 dots).

Settings



- Position:** Specify the top left coordinate of the position to display the program name or recipe name (X: 0 to 1023, Y: 0 to 767).
- Color:** Select the color to display the program name or recipe name and outline.
 - Text:** To change the program name or recipe name color, select [Color]. You can also select [None] to hide the program name or recipe name.
 - Outline:** To change the program name or recipe name outline color, select [Color].
 - Background:** Select [Color] to specify the background color of the program name or recipe name.
- Closely space characters:** Select this check box to remove spacing for specified characters. You can only select this check box if the background color is enabled in [Color]. This is useful when you want to match the display and screen layout to that of the XG-8000/7000 series.

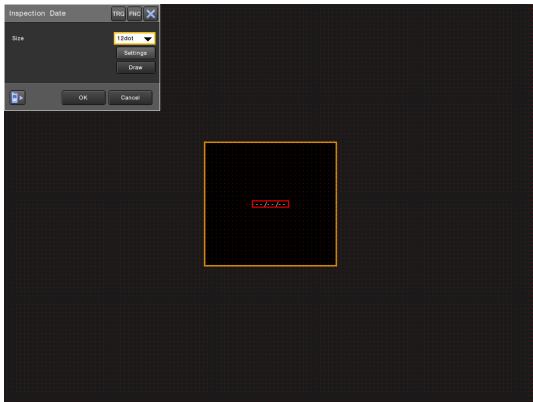
Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Screen Parts

Inspection Date

This part is used to display the date when the flowchart-based inspection started.

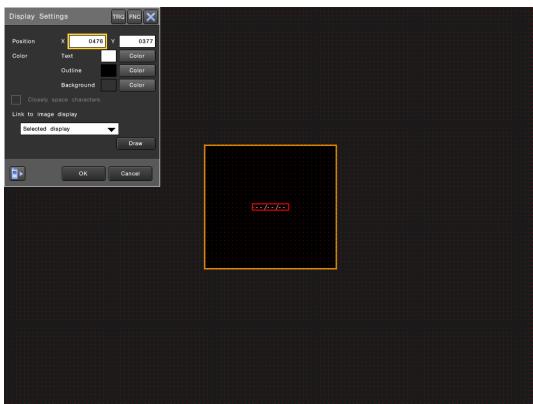


- Point** This is the timing at which the first capture unit in the flowchart starts capturing.

Size

Select the display size for the inspection date from 12, 16, 24, 32, or 48 dots (default: 12 dots).

Settings



- Position:** Specify the top left coordinate of the position to display the inspection date (X: 0 to 1023, Y: 0 to 767).
- Color:** Select the color to display the date and outline.
 - Text:** To change the inspection date color, select [Color]. You can also select [None] to hide the inspection date.
 - Outline:** To change the inspection date outline color, select [Color].
 - Background:** Select [Color] to specify the background color of the date.
- Closely space characters:** Select this check box to remove spacing for specified characters. You can only select this check box if the background color is enabled in [Color]. This is useful when you want to match the display and screen layout to that of the XG-8000/7000 series.

- Link to image display:** The date can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the displayed value will be the inspection starting date for the archived image. (For any other displayed image, the value shown will be the most recent inspection starting date.)

- **None:** Displays the most recent inspection starting date, independent of the image display.
- **Selected display:** Displays the inspection starting date associated with the displayed image on the image display that is selected on the controller.
- **Image display ID:** Always displays the inspection start date associated with the displayed image on the specified image display.

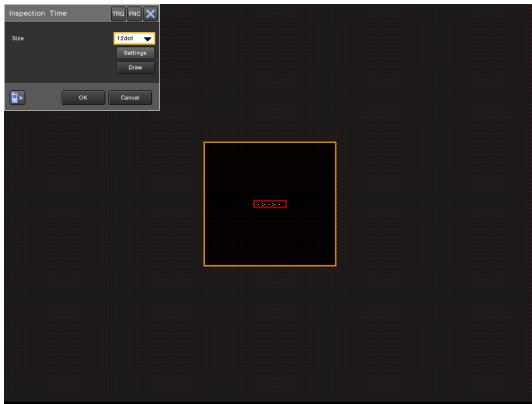
- Point**
 - [Outline] is only effective when [Background] is set to [None].
 - If the link is set to an image display that has been set to an image archive with no results logging data, the date will appear as "---.---".
 - A setting error will occur if the specified image display does not exist on the display template.

Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Inspection Time

This part is used to display the time when the flowchart-based inspection started.

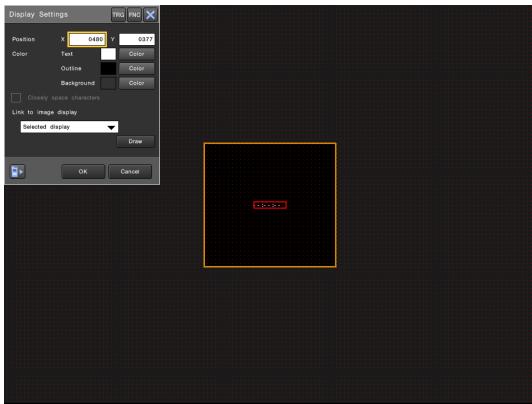


This is the timing at which the first capture unit in the flowchart starts capturing.

Size

Select the display size for the inspection time from 12, 16, 24, 32, or 48 dots (default: 12 dots).

Settings



- Position:** Specify the top left coordinate of the position to display the inspection time (X: 0 to 1023, Y: 0 to 767).
- Color:** Select the color to display the time and outline.
 - Text:** To change the inspection time color, select [Color]. You can also select [None] to hide the inspection time.
 - Outline:** To change the inspection time outline color, select [Color].
 - Background:** Select [Color] to specify the background color of the time.
- Closely space characters:** Select this check box to remove spacing for specified characters. You can only select this check box if the background color is enabled in [Color]. This is useful when you want to match the display and screen layout to that of the XG-8000/7000 series.

- Link to image display:** The time can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the displayed value will be the inspection starting time for the archived image. (For any other displayed image, the value shown will be the most recent inspection starting time.)

- **None:** Displays the most recent inspection start time, independent of the image display.
- **Selected display:** Displays the inspection start time associated with the displayed image on the image display that is selected on the controller.
- **Image display ID:** Always displays the inspection start time associated with the displayed image on the specified image display.



- [Outline] is only effective when [Background] is set to [None].
- If the link is set to an image display that has been set to an image archive with no results logging data, the date will appear as "----".
- A setting error will occur if the specified image display does not exist on the display template.

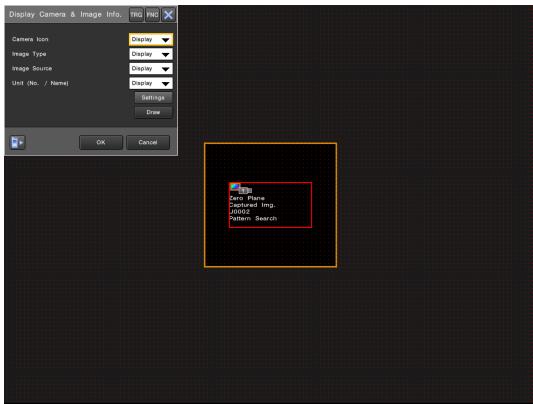
Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Screen Parts

Display Camera & Image Info.

This part is used to display information about the screen, such as the camera icon, image type, display image, and associated units.



It is not possible to set all settings on the [Display Camera & Image Info.] menu to [OFF].

Camera Icon

Select whether to display the camera icon.

- Display** (default): Displays the camera icon.
- OFF**: Hides the camera icon.

Image Type

Select whether to display the image type.

- Display** (default): Displays the image type.
- OFF**: Hides the image type.

Image Source

Select whether to display the display image.

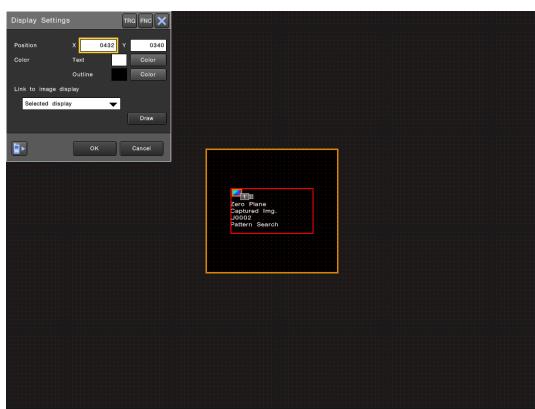
- Display** (default): Displays the display image.
- OFF**: Hides the display image.

Unit (No. / Name)

Select whether to display the unit ID and name.

- Display** (default): Displays the unit ID and name.
- OFF**: Hides the unit ID and name.

Settings



- Position**: Specify the top left coordinate of the position to display the image information (X: 0 to 1023, Y: 0 to 767).
- Color**: Select the color to display the image information and outline.
 - Text**: To change the image information color, select [Color]. You can also select [None] to hide the image information.
 - Outline**: To change the image information outline color, select [Color].
- Link to image display**: The contents of the image information to display can be linked with the image displayed in the image display (Page 4-42).
 - Selected display**: Displays the image information for the image display that is selected on the controller.
 - Image display ID**: Always displays the image information for the specified image display.



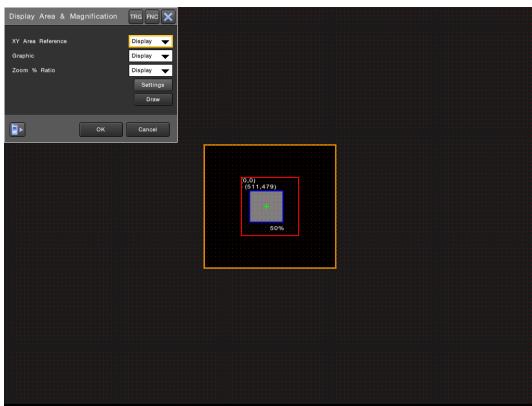
A setting error will occur if the specified image display does not exist on the display template.

Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Display Area & Magnification

This part is used to display zoom information.



- Point** It is not possible to set all settings on the [Display Area & Magnification] menu to [OFF].

XY Area Reference

Select whether to display the coordinates.

- **Display** (default): Displays the coordinates.
- **OFF**: Hides the coordinates.

Overview Image

Select whether to display the capture range of the camera and an overview image of the current display area.

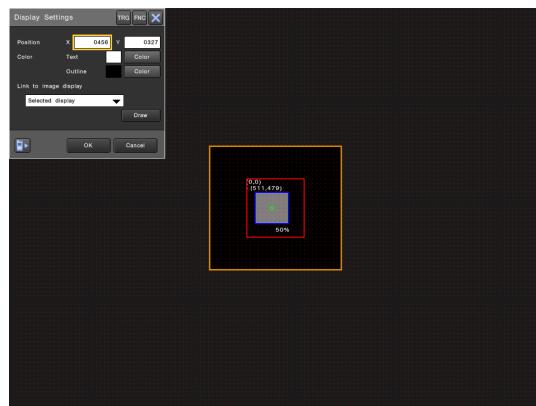
- **Display** (default): Displays the graphic.
- **OFF**: Hides the overview image.

Zoom % Ratio

Select whether to display the zoom ratio.

- **Display** (default): Displays the zoom ratio.
- **OFF**: Hides the zoom ratio.

Settings



- **Position**: Specify the top left coordinate of the position to display the zoom information (X: 0 to 1023, Y: 0 to 767).
- **Color**: Select the color to display the zoom information and outline.
 - **Text**: To change the zoom information color, select [Color]. You can also select [None] to hide the zoom information.
 - **Outline**: To change the zoom information outline color, select [Color].
- **Link to image display**: The contents of the zoom information to display can be linked with the image displayed in the image display (Page 4-42).
 - **Selected display**: Displays the zoom information for the image display that is selected on the controller.
 - **Image display ID**: Always displays the zoom information for the specified image display.

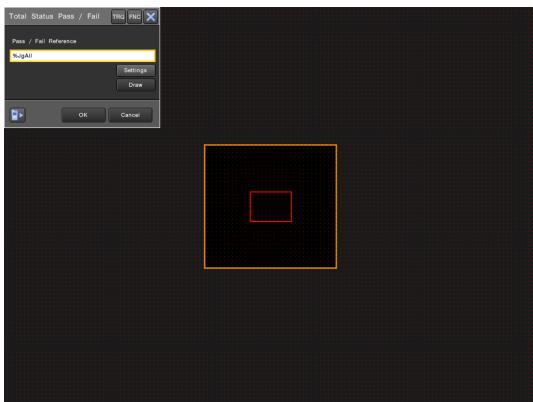
- Point** A setting error will occur if the specified image display does not exist on the display template.

Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Total Status Pass/Fail

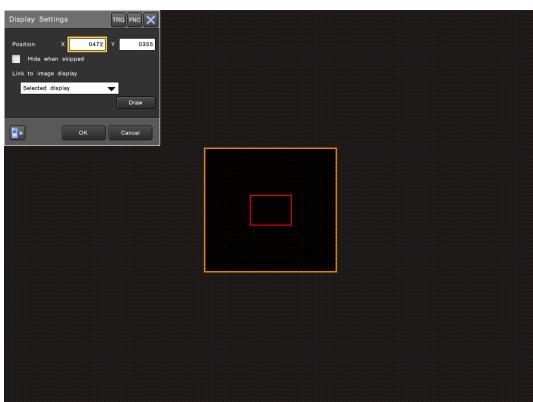
This part is used to display the OK or NG status.



Pass / Fail Reference

Change the OK/NG display based on a value like a variable, setting parameter, or results data (default: %JgAll). If the first decimal place rounds to 0, the result is OK. Otherwise the value is NG.

Settings



- Position:** Specify the top left coordinate of the position to display the total status (X: 0 to 1023, Y: 0 to 767).
- Hide when skipped:** Place a check in this option to display the total status only when the controller executes the unit for the setting parameter or results data specified in [Pass / Fail Reference] (Page 4-64).
- Link to image display:** The [Total Status Pass / Fail] can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the Pass / Fail status display will be linked to the results data for the archived image. (For any other shown image, the display is linked to the latest result.)
 - **None:** Background color always matches the latest result, independent of the image display.
 - **Selected display:** Displays the result of the displayed image on the image display that is selected on the controller.
 - **Image display ID:** Permanently links the background color to the result of the displayed image on the specified image display.



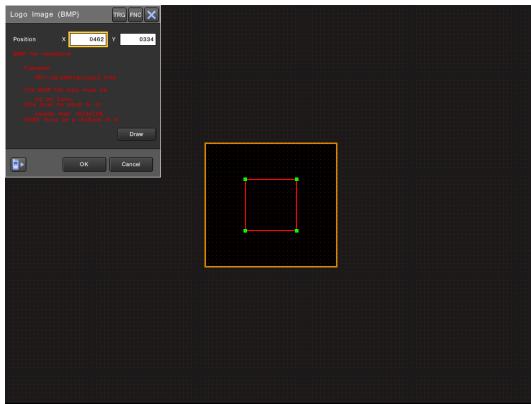
- If the link is set to an image display that has been set to an image archive with no results logging data, no result data will be displayed.
- A setting error will occur if the specified image display does not exist on the display template.

Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Logo Image (BMP)

This part is used to display any user-specified bitmap image file. This allows users to display a custom logo image on the controller screen.



Logo file specifications

To display a custom logo image, save the image as a file that meets these specifications:

- Image file type:** 24-bit color bitmap
- Image Size:** The image must have a width resolution that is in a multiple of 8. For 1024 x 768 display resolution, the maximum logo size is 1024 x 768.
- Image filename:** Logo2.bmp
- Location of image file:** SD1:/xg/setting/

Point To allow the background to be visible through the logo image, set the background color to R: 254, G: 1, B: 152.

Position

Specify the top left coordinate of the position to display the logo (X: 0 to 1023, Y: 0 to 767).

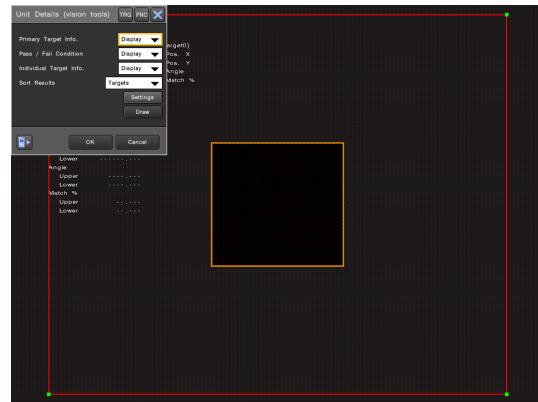
Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Unit Details (vision tools)

This part is used to display the unit results of Vision Tools units.

- In addition to displaying the inspection results (measured values and tolerances) for Vision Tools units selected at the controller, this part can also display the unit ID, unit name, unit type, and execution time.
- Some units may support page switching to allow them to display individual results.



The Unit Details (vision tools) part cannot be placed on a page frame. It can only be placed on a base frame.

Primary Target Info.

Select whether to display the result of the primary target.

- Display** (default): Displays the result of the primary target.
- OFF**: Hides the result of the primary target.

Pass / Fail Condition

Select whether to display the limits.

- Display** (default): Displays the limits.
- OFF**: Hides the limits.

Individual Target Info.

Select whether to display the individual results.

- Display** (default): Displays the individual results.
- OFF**: Hides the individual results.

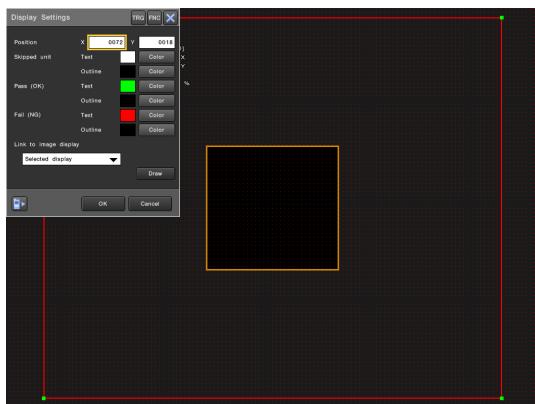
Sort Results

Select the method for sorting the display of unit results of Vision Tools units.

- Items**: Sorts by result items.
- Target** (default): Sorts by labels.

Screen Parts

Settings



Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

- **Position:** Specify the top left coordinate of the position to display the unit results (X: 0 to 1023, Y: 0 to 767).
- **Skipped unit:** Select the color to display the Vision Tools unit result and outline under normal conditions (when the unit is not executed, or the judgment result has not been finalized yet).
 - **Text:** To change the unit result (Vision Tools unit) color, select [Color]. You can also select [None] to hide the unit result.
 - **Outline:** To change the unit result (Vision Tools unit) outline color, select [Color].
- **Pass (OK):** Select the color of the unit result (Vision Tools unit) and outline when judgment is OK.
 - **Text:** To change the unit result (Vision Tools unit) color, select [Color]. You can also select [None] to hide the unit result.
 - **Outline:** To change the unit result (Vision Tools unit) outline color, select [Color].
- **Fail (NG):** Select the color of the unit result (Vision Tools unit) and outline when judgment is NG.
 - **Text:** To change the unit result (Vision Tools unit) color, select [Color]. You can also select [None] to hide the unit result.
 - **Outline:** To change the unit result (Vision Tools unit) outline color, select [Color].
- **Link to image display:** The measurement results can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the displayed value will be the results data for the archived image. (For any other displayed image, the latest value will be shown.)
 - **Selected display:** Displays the inspection result associated with the displayed image on the image display that is selected on the controller.
 - **Image display ID:** Always displays the inspection result associated with the displayed image on the specified image display.

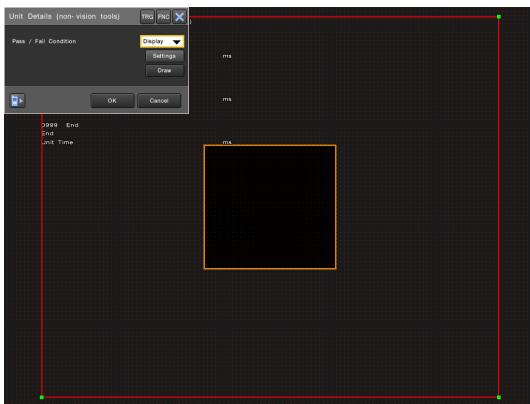
Point

- If a link is set to an image display that is set to display an image archive which does not have any results data, no result data will be displayed.
- A setting error will occur if the specified image display does not exist on the display template.

Unit Details (non-vision tools)

This part is used to display a list of the unit results of non-Vision Tools units.

- It can display various information about non-Vision Tools units from the start unit to the last end unit in the flowchart, such as unit ID, unit name, unit type, execution time, and various individual results. The list is displayed in ascending order of the unit ID.
- This part may support page switching when there are many units.



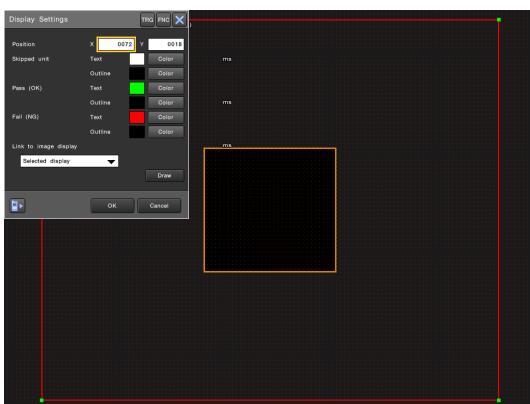
Point The Unit Details (non-vision tools) part cannot be placed on a page frame. It can only be placed on a base frame.

Pass / Fail Condition

Select whether to display the tolerance.

- Display** (default): Displays the tolerance.
- OFF**: Hides the tolerance.

Settings



- Position**: Specify the top left coordinate of the position to display the results from non-Vision Tools units (X: 0 to 1023, Y: 0 to 767).
- Skipped unit**: Select the color to display the unit result (non-Vision Tools units) and outline under normal conditions (when the unit is not executed, or the judgment result has not been finalized yet).
 - Text**: To change the result (non-Vision Tools units) color, select [Color]. You can also select [None] to hide the result.
 - Outline**: To change the result (non-Vision Tools units) outline color, select [Color].

- Pass (OK)**: Select the color of the unit results (non-Vision Tools units) and outline when the judgment is OK.

- **Text**: To change the result (non-Vision Tools units) color, select [Color]. You can also select [None] to hide the result.

- **Outline**: To change the result (non-Vision Tools units) outline color, select [Color].

- Fail (NG)**: Select the color of the unit results (non-Vision Tools units) and outline when the judgment is NG.

- **Text**: To change the result (non-Vision Tools units) color, select [Color]. You can also select [None] to hide the result.

- **Outline**: To change the result (non-Vision Tools units) outline color, select [Color].

- Link to image display**: The measurement results (non-Vision Tools units) can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the displayed value will be the results data for the archived image. (For any other displayed image, the latest value will be shown.)

- **None**: Displays the latest results (non-Vision Tools units), independent of the image display.

- **Selected display**: Displays the unit results (non-Vision Tools units) of units associated with the displayed image on the image display that is selected on the controller.

- **Image display ID**: Always displays the result (non-Vision Tools units) associated with the displayed image on the specified image display.



- If a link is set to an image display that is set to display an archived image which does not have any results data, no value will be displayed.
- A setting error will occur if the specified image display does not exist on the display template.

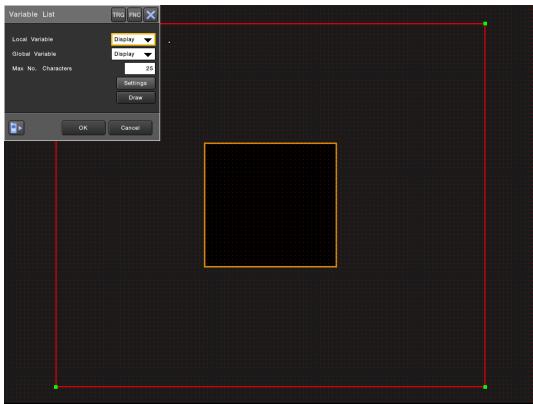
Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Variable List

This part is used to display a list of the values of local and global variables.

- The list displays all local variables, which includes the defined arrays, structures and global variables in that order.
- This part may support page switching when there are many variables.



Point

- The Variable List part cannot be placed on a page frame. It can only be placed on a base frame.
- It is not possible to set all settings on the [Variable List] menu to [OFF].

Local variables

Select whether to display a list of the local variables.

- Display** (default): Displays a list of the local variables.
- OFF**: Does not display the list of local variables.

Global variables

Select whether to display a list of the global variables.

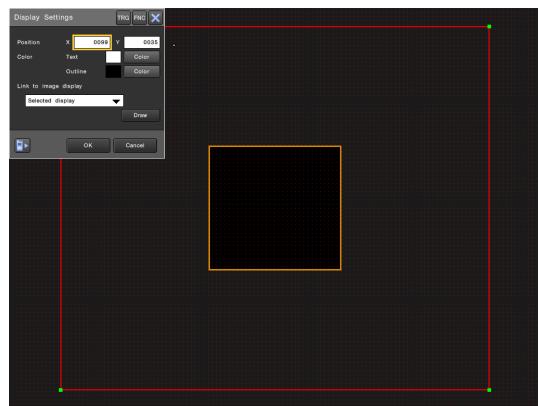
- Display** (default): Displays a list of the local variables.
- OFF**: Does not display the list of global variables.

Max No. Characters

Specify the number of characters to include when displaying variable names from 2 to 41 (default: 25).

Variable names longer than the specified number of characters will be truncated.

Settings



- Position**: Specify the top left coordinate of the position to display the variable list (X: 0 to 1023, Y: 0 to 767).
- Color**: Select the color of the list of variables and outline.
 - Text**: To change the variable list color, select [Color]. You can also select [None] to hide the variable list.
 - Outline**: To change the variable list outline color, select [Color].
- Link to image display**: The variable list can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the displayed value will be the list of variables for the archived image. (For any other displayed image, the values shown will be of the latest variables.)

- None**: Displays the latest variable list, independent of the image display.

- Selected display**: Displays the variable list associated with the displayed image on the image display that is selected on the controller.

- Image display ID**: Always displays the variable list associated with the displayed image on the specified image display.

Point

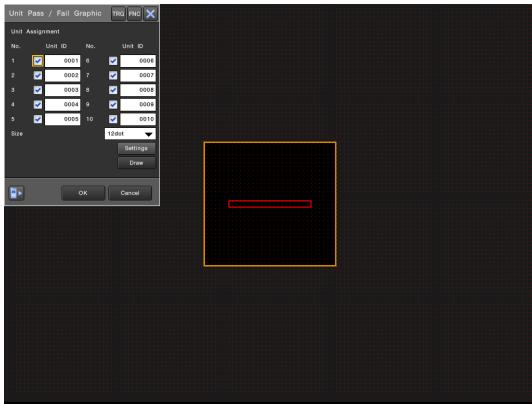
- If a link is set to an image display that is set to display an image archive which does not have any results data, no value will be displayed.
- A setting error will occur if the specified image display does not exist on the display template.

Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Unit Pass/Fail Graphic

This part is used to display a list of icons that indicate up to 10 unit judgment results.



Unit Assignment

Specify up to 10 units to display.

- In the Unit ID field, specify the ID number of the units for which you wish to display the judgment result.
- Removing the check hides the display of that unit.

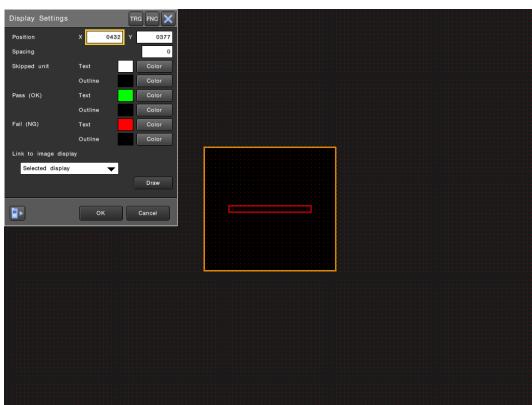


- If the specified unit ID does not perform a tolerance judgment, the indicator will always show OK.
- Indicators will not appear until the judgment result has been made, such as immediately after the system is started.

Size

Select the display size for the unit pass/fail graphic from 12, 16, 24, 32, or 48 dots (default: 12 dots).

Settings



- Position:** Specify the top left coordinate of the position to display the unit pass/fail graphic (X: 0 to 1023, Y: 0 to 767).
- Spacing:** Specify the spacing between indicator icons used to display the unit judgment results from 0 - 7 1-byte spaces (default: 0).

- Skipped unit:** Select the color to display the unit pass/fail graphic and outline under when the unit is skipped (when the unit is not executed, or the judgment result has not been finalized yet).

- **Text:** To change the unit pass/fail graphic color, select [Color]. You can also select [None] to hide the unit pass/fail graphic.
- **Outline:** To change the unit pass/fail graphic outline color, select [Color].

- Pass (OK):** Select the color of the unit pass/fail graphic and outline when the judgment is OK.

- **Text:** To change the unit pass/fail graphic color, select [Color]. You can also select [None] to hide the unit pass/fail graphic.

- **Outline:** To change the unit pass/fail graphic outline color, select [Color].

- Fail (NG):** Select the color of the unit pass/fail graphic and outline when the judgment is NG.

- **Text:** To change the unit pass/fail graphic color, select [Color]. You can also select [None] to hide the unit pass/fail graphic.

- **Outline:** To change the unit pass/fail graphic outline color, select [Color].

- Link to image display:** The unit pass/fail graphic can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the unit judgment results will show the results data for the archived image. (For any other displayed image, the values shown will be of the latest results.)

- **None:** Displays the latest results, independent of the image display.

- **Selected display:** Displays the result associated with the displayed image on the image display that is selected on the controller.

- **Image display ID:** Always displays the result associated with the displayed image on the specified image display.



- If the archived image used in the image display is not set to log results data, nothing will be displayed.
- A setting error will occur if the specified image display does not exist on the display template.

Draw

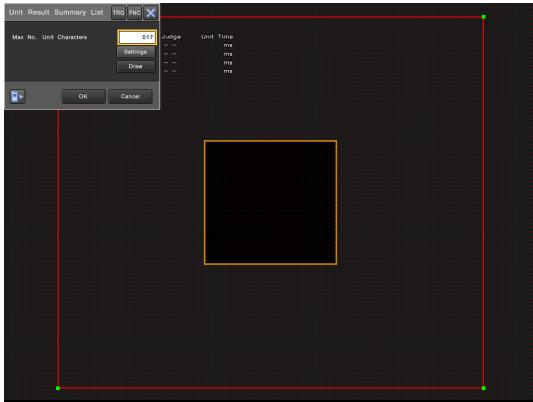
Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Screen Parts

Unit Result Summary List

This part is used to display a list of the results of all units in the flowchart.

- It can display various information about all units from the start unit to the last end unit in the flowchart, such as unit ID, unit name, judgment result, and execution time. The list is displayed in ascending order of the unit ID.
- This part may also support page switching when there are many units.



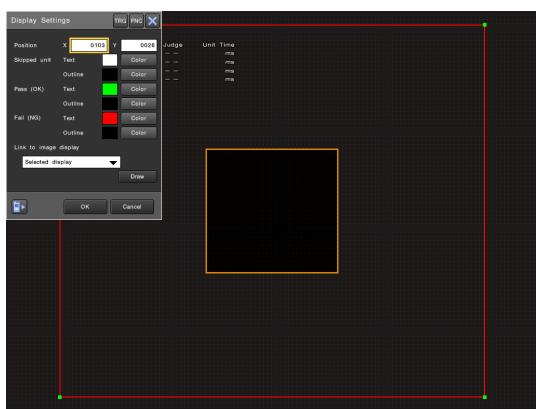
Point The Unit Result Summary List part cannot be placed on a page frame. It can only be placed on a base frame.

Max. No. Unit Characters

Specify the number of characters to include when displaying unit names from 10 to 100 (default: 17). Unit names longer than the specified number of characters will be truncated.

Point If you specify more than 78 characters, some of the items may run off the display area and not be visible.

Settings



- Position:** Specify the top left coordinate of the position to display the common unit results list (X: 0 to 1023, Y: 0 to 767).
- Skipped unit:** Select the color to display the inspection unit result and outline under normal conditions (when the unit is not executed, or the judgment result has not been finalized yet).
 - Text:** To change the common unit results list color, select [Color]. You can also select [None] to hide the common unit results list.
 - Outline:** To change the common unit results list outline color, select [Color].
- Pass (OK):** Select the color of the common unit results list and outline when the judgment is OK.
 - Text:** To change the common unit results list color, select [Color]. You can also select [None] to hide the common unit results list.
 - Outline:** To change the common unit results list outline color, select [Color].
- Fail (NG):** Select the color of the common unit results list and outline when the judgment is NG.
 - Text:** To change the common unit results list color, select [Color]. You can also select [None] to hide the common unit results list.
 - Outline:** To change the common unit results list outline color, select [Color].

- **Link to image display:** The unit list can be linked with the image shown in the image display (Page 4-42). If the image display is set to show an archived image, the list of unit results will show the results data for the archived image. (For any other shown image, the value displayed will be the latest value.)
 - **None:** Displays the latest list of all unit results, independent of the image display.
 - **Selected display:** Displays the list of all unit results associated with the displayed image on the image display that is selected on the controller.
 - **Image display ID:** Always displays the unit list associated with the displayed image on the specified image display.

 Point

- If a link is set to a image display that is set to display an archived image which does not have any results data, no value will be displayed.
- A setting error will occur if the specified image display does not exist on the display template.

Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Chapter 5

Utility

Utility

Documentation for the installation and configuration methods of the controller, software, and CAD data can be downloaded from the following URL.

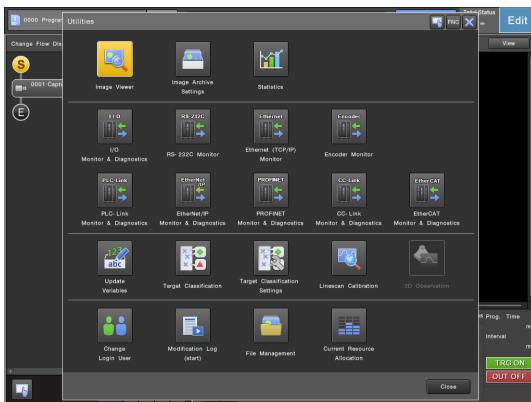
www.keyence.com/xgx_support

Utility Overview

Select [Utilities] at the top of the screen to use the various utility functions available. The utility menu can also be opened by selecting [Utilities] from the [Function] menu.

Functions Available in Setup Mode

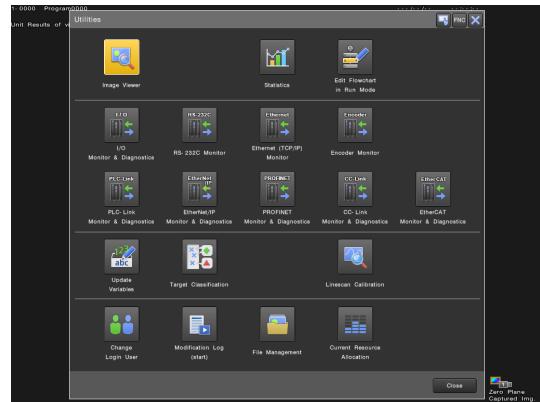
Utility



- Checking the Image Archive/Using Measurement Results for Retesting (Image Viewer) (Page 5-3)
- Setting the Conditions for Archiving Images Used for Inspection and Result Data (Image Archive Settings) (Page 5-4)
- Analyzing the Operation Results (Statistics) (Page 5-15)
- Verifying the Connection Status of Input and Output Terminals (I/O Monitor & Diagnostics) (Page 5-23)
- Verifying the Status of RS-232C Communication (RS-232C Monitor) (Page 5-23)
- Checking the Ethernet Communication Status (Ethernet (TCP/IP) Monitor) (Page 5-24)
- Monitoring the Encoder Input Status (Encoder Monitor) (Page 5-24)
- Checking the PLC-Link Communication Status (PLC-Link Monitor & Diagnostics) (Page 5-25))
- Checking the EtherNet/IP Communication Status (EtherNet/IP Monitor & Diagnostics) (Page 5-26)
- Checking the PROFINET Communication Status (PROFINET Monitor & Diagnostics) (Page 5-27)
- Checking the CC-Link Communication Status (CC-Link Monitor & Diagnostics) (Page 5-28)
- Checking the EtherCAT Communication Status (EtherCAT Monitor & Diagnostics) (Page 5-29)
- Changing a Variable Value (Update Variables) (Page 5-31)
- Storing and Viewing Detected Target Types (Target Classification) (Page 5-34)

- "Viewing a Graph of the Line Scan Camera Capture Conditions (Linescan Calibration)" (Page 8-184)
- Logging Handheld Controller Operations (Modification Log (Start/Stop)) (Page 5-42)
- Managing the Files in the SD Cards and the USB HDD (File Management) (Page 5-43)
- Checking the Controller Memory Usage (Current Resource Allocation) (Page 5-49)

Functions Available in Run Mode



In addition to some of the utilities available in Setup mode, you can use the following functions in Run mode:

- Editing the Flowchart in Run Mode (Edit Flowchart in Run Mode) (Page 5-22)
- Changing the Login User (Change Login User) (Page 5-41)

Checking the Image Archive/Using Measurement Results for Retesting (Image Viewer)

By setting archiving conditions beforehand, images captured in Run mode can be recorded in the controller's image memory for review at a later time. By also archiving the results at the same time as the images, the images and measurement values during capture may also be checked at the same time (Replay). This is useful when you want to check an NG (failed) image without stopping the controller or when a judgment of an inspection cannot be reproduced in a retest because the same conditions, such as external control and variables, as the inspection cannot be replicated.

In Setup mode, it is also possible to check and modify the image processing flowchart using stored archived images on the controller or images saved on the SD card/FTP/USB HDD in lieu of current images from the camera (Retest).



- The display and functionality of the Image Viewer may be limited due to settings in the XG-X VisionEditor. For more details, refer to "Controller Global Settings" in the XG-X VisionEditor Reference Manual.
- The [Image Viewer] screen cannot be displayed while the XG-X VisionEditor or any other program is accessing the archive data.
- Images can only be archived in Run mode. Images cannot be recorded in other modes.
- The archive data is recorded in the controller's memory and will be cleared in the following circumstances. If the archive data is required for later use, save the data to an SD card (Page 5-14).
 - When the controller is turned off
 - When the controller is RESET
 - When changing programs
 - When the current program is overwritten via an external application
 - When clearing is executed via a command or from the menu
 - When the [White Balance] screen is opened (Page 6-10)
 - When editing the image archive settings
 - When adding, editing, or deleting image variables in the [Variable Settings] screen
 - When the camera type setting is changed
 - When the [Area Settings] screen is displayed in a capture unit
 - When the image capture buffer setting is changed



- Using the image archive does not affect the processing time.
- Images can be recorded from multiple cameras at the same time.

Number of images that can be archived

The number of images that can be archived varies depending on the setting content, the controller and the combination of connected cameras. For more details on the maximum number of images that can be archived into the system image memory, see "Controller Specifications" (Page 9-26).

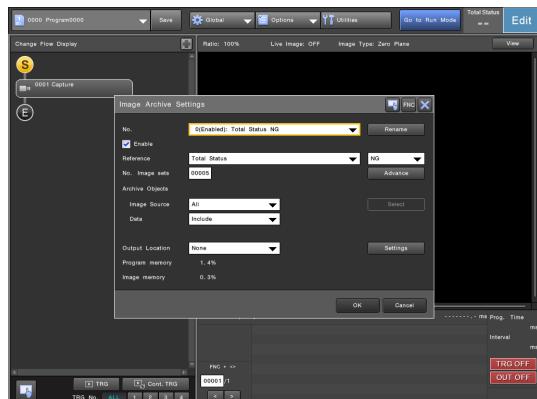
Setting the Conditions for Archiving Images Used for Inspection and Result Data (Image Archive Settings)

Set the conditions for archiving the images used in the inspection executed on the controller and the result data to the controller's image memory and program memory as archive data. Up to eight criteria settings can be set. Each criteria setting produces a separate image archive in the controller. Even if the same criteria is specified in multiple image archive settings, the data is handled separately.

- Point** Enabling an image archive setting No. consumes image memory and program memory.

1 Select [Image Archive Settings] on the [Utilities] screen (Page 5-2).

The [Image Archive Settings] screen appears.



On the [Image Archive Settings] screen, you can check the current list of image archive conditions and the controller memory usage with regards to the current program No.

- Point** If the program and image memory usages in the [Program memory] field and [Image memory] field are close to 100%, it may not be possible to add an archive condition.

2 Choose the image archive condition No. to set criteria for.

3 Change the settings as required.

Enable

Check this box to enable the archive setting. When you check this box, the controller will allocate memory according to the selected archive criteria settings.

Reference

Specify the target to evaluate for determining whether to perform archiving or not. Specify also the result (All/OK / NG) to be used as criteria for archiving.

- Point**
 - The results of [Total Status] and [Camera Judgment] depend on the contents of [Judgment Settings] (Page 4-3).
 - In addition to the [Total Status] and [Camera Judgment] options, the reference includes all units that have a Unit Result judgment value (UJG) available.

No. Image sets

Specify the number of archives (up to a total of 30000) for all the condition Nos. combined).

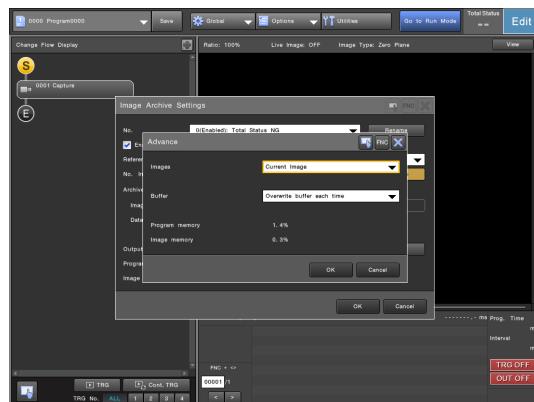
- If [Images] is set to [Current Image]: One measurement worth of data are archived at a time.
- If [Images] is set to [Include preceding images]: Multiple measurements (in a series) worth of data are archived at a time.



Point

If the archive criteria is set to store a lot of images including preceding images and a lot of items, this will consume a large amount of memory. Make sure there is sufficient free memory available.

Advance



• Images: Specify the units of images to be archived.

- Current Image:** Archives only the measurement count where the evaluation target matches the criteria.
- Include preceding images:** Archives the measurement count where the evaluation target matches the criteria and a number of preceding images as specified in [No. Image sets (Inc.latest)] (max. 512) as one unit. This is useful when the images before the NG state need to be reviewed as well.
- Buffer:** Choose how the image buffer works when the capacity is reached.
 - Overwrite buffer each time:** Continues archiving by overwriting data starting from the oldest.
 - Process until buffer full:** Stops archiving when the buffer is full. Archiving resumes when the controller is reset or the data in the archive criteria are cleared.



Point

The following diagram explains how the [Images] setting affects storage range when the archive criteria is met.



Archive Objects

- **Image source:** Selects the image variable to be archived.
 - **All:** All image variables that are used in the program are archived (all except black images are archived).
 - **Select:** Select which image variables to archive (up to 256 image variables can be selected).
- **Data:** Specify whether or not to include archive result data in the archive (Default: Do not include).

Point

- If the result data is not archived, the data cannot be used for result check on the controller, archive replay in XG-X VisionEditor, or screen tracking display using camera image display parts in a display template.
- Even when [All] is selected, images for image variables that are not used by the measurement unit are not output. If the output of black images for image variables that are not used is required, select [Select] and check the boxes of the individual image variables to output images for.
- If [Select] is used under [Image Source] and all the image variables are deselected, this will force the setting for [Data] to be changed to [Do not Include].

Output Location

Choose the output location where images and archive result data are automatically output to when the archive criteria is met.

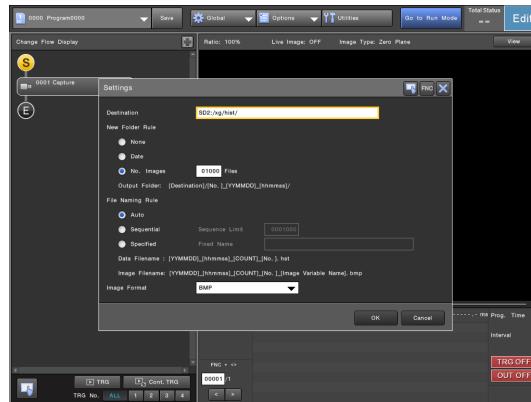
- **None:** Does not output the archive data.
- **SD Card:** Outputs data to the SD card of the controller.
- **PC Program:** Outputs data to the XG-X VisionTerminal or ActiveX control.
- **FTP:** Outputs data to the FTP server.
- **USB HDD:** Outputs data to the external USB HDD.

Point

- If [Archive Objects] is set to [Select] and the image variable with a check mark is not actually used, the data is output as a black image.
- Outputting archived images differs from using the image output unit (Page 2-458) as all images are stored in the image memory before they are output. This prevents the loss of images, even for a continuous image output, as long as there is enough memory to hold the images required.
- For the data output to the FTP server, the FTP command [APPE] is used. If your FTP server does not support the [APPE] command, data cannot be output to the FTP server.
- If there is a firewall on the FTP server or on the network route to the FTP server, connection may fail. You need to disable the firewall or find another way to connect to the FTP server. For details, check with your network administrator or computer manufacturer.

Settings

This menu is used to set the destination for the archive data.



- **Destination:** Specifies the save destination for archived data.

Point

- If [PC Program] is selected as the Output Location, the archive data will be saved in the specified folder below the destination base path folder, or in a newly created folder.
- If [FTP] is selected as the Output Location, the archive data will be saved in the specified folder under the FTP server home directory or in a newly created folder. Note that, depending on the FTP server specification, the server may require a full path including the home directory. For details on such settings, consult with your FTP server administrator.

- **New Folder Rule:** Specifies the rule for creating new folders for saving archive data.

- **None:** The archive data are saved in the specified destination folder without division.
- **Date:** Every time output starts, a new folder named "[No.]_[YYMMDD]" is created in the folder specified as the destination folder and the actual output data files are saved in this folder. When the date changes, a new folder is created and this becomes the new destination for the output data files.
- **No. Images:** The archive data is saved in a folder created below the specified destination folder. Folders are named as "[No.]_[YYMMDD]_[HHMMSS]". (Folders can store up to 50,000 images.) When the number of images in the folder reaches the specified limit, a new folder is created and this becomes the new destination folder for archive data.

Point

- If you select [None] and continue to save a large number of files to the same folder, saving may be time-consuming.
- When [No. Images] is selected, the output folder will also be created at the first trigger input after:
 - Power on
 - Reset operation
 - Prog. No. is switched
 - The output folder is not available at the destination.

- **File Naming Rule:** Specifies the rules for naming files when saved.
 - **Auto:** Files are named automatically with the date and time when the data was archived, "[YYMMDD]_[hhmmss]_[Count]_[No.]_[ImageVariable Name].jpg/bmp" for image files and "[YYMMDD]_[hhmmss]_[Count]_[No.].hst" for results files.
 - **Sequential:** The files are named as [Sequence No._Fixed name_Image variable name.jpg/bmp] (image file) and [Sequence No._Fixed name.hst] (results file). Specify the maximum number of images in the [Sequence Limit] field (max.1000000), and a fixed name to use in the [Fixed Name] field. Each field may contain no more than 32 characters.
 - **Specified:** Names the file as "Fixed name.bmp/jpg" (image file) and "Fixed name.hst" (result file). A desired file name (64 single-byte characters) can be entered into the [Fixed Name] field.

 Point

- When [Auto] is selected and data is archived multiple times within one second, the output file will be overwritten.
- If [Sequential] is selected and [Sequence Limit] is set smaller than the value set for [No. Images] in [New Folder Rule], the folder will not be divided regardless of the folder division setting.
- If [Specified] is selected, only one image will be output even if multiple image variables are selected in [Archive Objects] because the output file name is always the same. Even if the file is output multiple times, only the final output images/result data will remain because they all have the same file name.

 Reference

When [Sequential] or [Specified] is selected, the fixed name for the file naming rule can be overwritten externally with a command. For details, refer to the description of the OW command in the XG-X2000 Series Communications Control Manual.

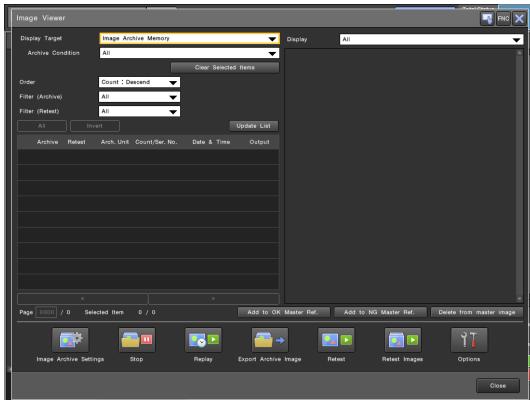
- **Image Format:** This specifies the file format for saving the image data.
 - **BMP:** Outputs the image in Windows bitmap format (24-bit color: color camera, 8-bit grayscale: monochrome camera).
 - **BMP (1/2 Resolution):** Compress the pixel counts in the respective directions vertical and horizontal by 1/2, then output the image in Windows bitmap format (24-bit color: color camera, 8-bit grayscale: monochrome camera).
 - **BMP (1/4 Resolution):** Compress the pixel counts in the respective directions vertical and horizontal by 1/4, then output the image in Windows bitmap format (24-bit color: color camera, 8-bit grayscale: monochrome camera).
 - **BMP (1/8 Resolution):** Compress the pixel counts in the respective directions vertical and horizontal by 1/8, then output the image in Windows bitmap format (24-bit color: color camera, 8-bit grayscale: monochrome camera).
 - **JPG:** Outputs the image as a JPEG file.

4 Select [OK].

Viewing Archived Images

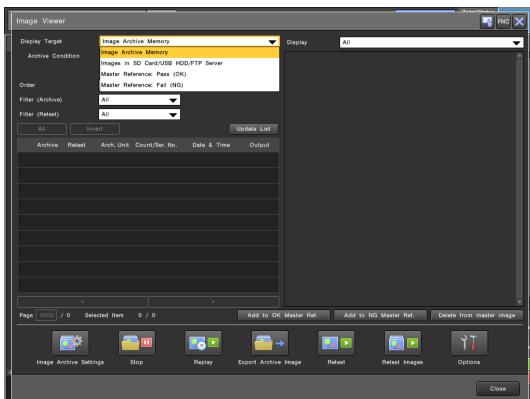
1 Select [Image Viewer] on the [Utilities] screen (Page 5-2).

The [Image Viewer] screen appears.



2 In [Display Target], select the save destination of the images to be viewed.

A summary list of the images archived in the selected save destination are displayed along with the Archive Unit set and Status.



3 Select the image you wish to display.

If [Image Archive Memory] is Selected As the Display Target

In [Archive Condition], select the criteria for the images to be viewed. A summary list of the images recorded based on the selected criteria are displayed along with the Archive Unit set and Status.

If [Images in SD Card/USB HDD/FTP Server] is Selected As the Display Target

Select the location of the images you wish to display in [Device] and [Location].

If [Master Reference: Pass (OK)] or [Master Reference: Fail (NG)] is Selected As the Display Target

The content of the folder specified on the [Options] (Page 5-13) screen is displayed.

Archived Image Information

When you select an image you wish to check in the archived image list on the left side of the screen, its thumbnail will appear on the right side of the screen.

- **Archive:** Displays the measurement result as OK or NG.
- **Retest:** Displays the retest result (Page 5-9) as OK or NG.
- **Arch. Unit:** Displays the units of images (Page 5-4) at the time when the archive is saved.
- **Count/Ser. No.:** Displays the measurement count or the sequential number of the output file.
- **Date & Time:** Displays the measurement date/time.
- **Output:** Displays if the data have already been output to the SD card or USB HDD.



- If [Images in SD Card/USB HDD/FTP Server] is selected as the display target, [Archive], [Arch. Unit] and [Output] are not displayed. [Date & Time] is only displayed for images that were output by setting the [File Naming Rule] to [Auto].
- If [Master Reference: Pass (OK)] or [Master Reference: Fail (NG)] is selected as the display target, [Archive], [Arch. Unit] and [Output] are not displayed.
- The retest result is displayed after the execution of a retest or batch test.

4 Use [Order] to change the display order of the image files.

5 To narrow down the images to be displayed based on the measurement or retest results, select the criteria in [Filter (Archive)] and [Filter (Retest)].

- **Filter (Archive):** Narrows down the images to be displayed based on the measurement result (OK/NG). This function is only available when [Image Archive Memory] is selected as the display target.
- **Filter (Retest):** Narrows down the images to be displayed based on the retest result (OK/NG) (Page 5-9).

6 Use [Display] to choose the image variable to show.

- **All** (Default): Displays all the images from each measurement.
- **<Image Variable Name>**: Displays only images for the user-specified image variable.

7 After reviewing the images, select [Close].

Deleting the Archive Data

Select [Clear Selected Items].

Delete the current archive data from the image memory.



- Only the archive data of the currently selected archive condition are deleted.
- If the archiving state is set to hold, the data held are released.

Pausing the Archive

Pausing the archive is useful when data is being archived at high speeds so the data do not get overwritten when reviewing.

Pausing the Archive

Select [Stop] at the bottom of the [Image Viewer] screen.

While archiving is paused, the button changes to [Start].

Resuming the Archive

Select [Start].



- The archiving will remain paused even if the [Image Viewer] screen is closed. The paused condition will remain in effect until either power is turned off and on again, or until it is canceled via an external command.

Replaying Image Archive Results (Replay)

The measurement values and other results at the time of the image capture can be replayed using the archived images and result archive data. This is useful for reviewing the conditions when an NG occurred.



- If the archive condition is not configured to archive result data, only images are replayed.
- When program data is changed in the Edit Unit menu (Page 2-14) on the controller, the archived result data recorded before the change may not conform to the changed inspection result, preventing proper replay of the archived result.

1 Check to specify one or more measurement counts to be replayed in the archived image list on the [Image Viewer] screen (Page 5-4).

2 Select [Replay].

The measurement result for the selected inspection is displayed.

3 If multiple measurement counts are selected, select a thumbnail image in the image bar to switch the measurement count.

The measurement result for the selected inspection is displayed.



- The measurement count can also be switched by moving the 8-way key left or right while holding down the No.1 button or No.7 button on the handheld controller with the image bar closed.

4 When the replay check is finished, select [Image Viewer (End Replay)] in the image bar or [Exit Replay] in the [Function] menu.



- Results displayed during replay cannot be output to an external device.
- If program data is changed in the Edit Unit menu, the archived result data recorded before the change may not replay properly.
- The image bar can be opened/closed using the MENU button.
- A replay can also be ended by pressing the No.2 (ESCAPE) button on the handheld controller with the image bar closed.

Re-checking the Image Processing Using Archived Images (Retest)

Specify the images recorded in the image memory or image files output to the SD card, USB HDD or FTP and execute image processing. This mode is useful to check for the conditions when an NG occurred at a later time.

Point

- Image processing via trigger input cannot be executed during a retest. If you executed a retest in Run mode, the controller mode will switch to Setup mode and the retest will then be executed.
- The setting changes made during a retest are directly applied to the active program.
- [Change Programs] and [Rename Program], [Copy/Delete Setting], [Save/Load Programs], [Image Viewer], [Change Login User], and [Change to Run Mode] cannot be used during a retest.
- The availability of some commands may be different from that in Run mode. For more details, refer to the XG-X2000 Series Communications Control Manual.
- The encoder value is not reflected to [:EC (Encoder Measured Value) during retest, even if a line scan camera is being used in [Continuous Capture] mode.

1 Select [Utilities] - [Image Viewer].

2 Check the images to retest in the list of archived images on the [Image Viewer] screen (Page 5-4).

3 Select [Retest].

A retest is performed using the current program.



If you executed a retest in Run mode, the controller mode will switch to Setup mode and the retest will then be executed.

4 To retest another image, select the thumbnail of the image to retest from the image bar.

To retest the same image again, press the No. 3 (TRIGGER) button on the handheld controller to execute retesting for the currently selected image.

5 End the retest.

You can end the retest in one of the following ways:

- On the image bar, select [End Retest] or [Image Viewer].
- On the Function menu, select [End Retest].
- On the Utilities menu, select [Image Viewer].

Point

- The images shown on the Image Strip are the images specified by the image variable referenced by the unit which is selected at the time when the image bar was displayed. To display the images specified by a different image variable, close the image bar, change the unit, and then display the image bar again.
- The image bar can be opened/closed using the MENU button.
- When performing retesting, the format of the image file name must be one of the following.
 - YYMMDD_hhmmss_Count_No._Image variable name.bmp/jpg
 - Sequential No._Fixed name_Image variable name.bmp/jpg
 - Sequential No._Image variable name.bmp/jpg
- If the file name is changed, it may not be possible to perform retesting on the image.
- Files that contain double-byte characters cannot be used for retesting.

Editing the Program Content in Retest Mode

It is also possible to edit the flowchart or unit while running a retest. This can be useful when adjusting the inspection conditions as you can check the setting results using an image that was stored during the actual inspection operation.

Point

- Image processing via trigger input cannot be executed during a retest.
- The setting changes made during retesting are directly applied to the active program and executed in the image processing after the retest has completed.

1 Switch to Setup mode and select [Utilities] - [Image Viewer].

2 Check the images to retest in the list of archived images on the [Image Viewer] screen (Page 5-4).

3 Select [Retest].

A retest is performed using the current program.

Point

If the retest target is set to [Image Archive Memory], one or more images must be in the archive in order to show thumbnails.

4 On the Flow Editor, change the flowchart and the unit settings as necessary.

Reference

When [Captured Image] is selected in the Flow Editor, the image selected in step 2 is used.

- 5 To retest another image, select the thumbnail of the image to retest from the image bar.**
- 6 End the retest.**

You can end the retest in one of the following ways:

- On the image bar, select [End Retest] or [Image Viewer].
- On the Function menu, select [End Retest].
- On the Utilities menu, select [Image Viewer].

Retesting a Group of Archived Images or OK Master/NG Master Images Simultaneously (Retest Images)

It is possible to specify and retest multiple images in a batch, instead of retesting them one by one. Several images can be retested together after editing the measurement condition settings. This is useful when tracking how the result changes from the previous measurement or judgment results.



Point

- Retest Images cannot be run in Run mode. Switch to Setup mode first before running Retest Images.
- The batch testing results are cleared at the following times.
 - An image on the FTP server is configured as the image bar image or OK/NG master image and the FTP server setting is changed
 - When [Update] is executed
 - When [Image Strip Files] is executed (except when only the sorting or filter was changed)
 - When the settings are changed on the [Options] screen (Page 5-13)

What is an OK Master Image/NG Master Image?

- OK master images are known good images that were obtained from actual measurement, and OK images obtained in an ideal environment, that are saved in the designated folder. Use them to verify during retesting that images which must be judged OK (OK masters) are not judged NG. Conversely, use the NG master images to check during retesting that images which must be judged NG (NG masters) are not judged OK.
- The folder where the OK master/NG master images are saved can be specified on the [Options] screen in the Image Viewer (Page 5-13).

To Add an OK Master Image/NG Master Image

- Check the images you wish to add on the [Image Viewer] screen (Page 5-4), and then select [Add to OK Master Ref.] or [Add to NG Master Ref.]
- It is also possible to add an image on the image bar as an OK master or NG master image. With the cursor positioned over the thumbnail on the image bar, press the No.1 (FUNCTION) button on the handheld controller and select either [Add to Master Ref.: OK Images] or [Add to Master Ref.: NG Images] from [Retest Menu] that appears.

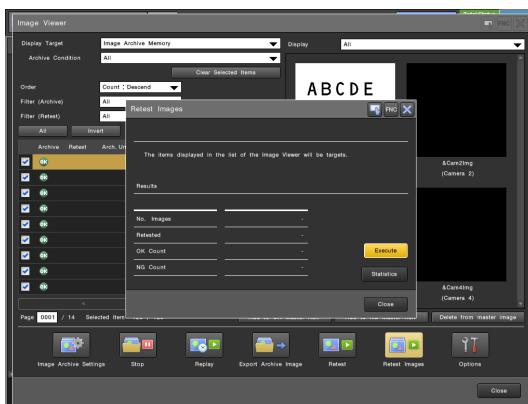
To Delete an OK Master Image/NG Master Image

On the [Image Viewer] screen (Page 5-4), select [Master Reference: Pass (OK)] or [Master Reference: Fail (NG)] as the display target, check the image you wish to delete, and then select [Delete from Master Image].

1 Select the batch test target in [Display Target] on the [Image Viewer] screen (Page 5-4).

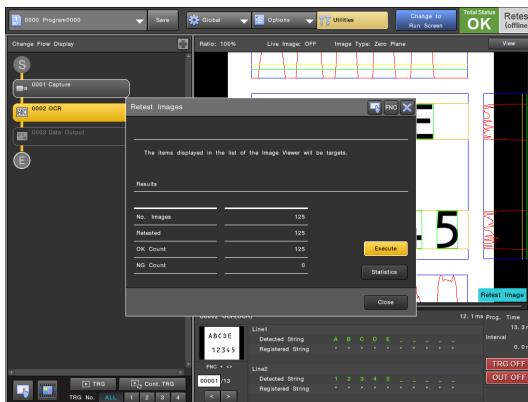
2 Select [Retest Images].

The [Retest Images] screen appears.



3 Select [Execute].

Batch testing is executed and the [Results] appear.



4 After checking the result, select [Close].

It is also possible to interrupt batch testing before it is completed.

In this case, the [Restart] button appears in the batch test results, and when [Restart] is selected, retesting is continued from the point it was interrupted.

Checking the Retest Result on the Statistics Screen

The results of retesting can be checked on the Statistics screen.

Select [Statistics] on the [Retest Images] screen or select [Statistics] on the [Utilities] screen (Page 5-2).

The [Retest Statistics] screen appears.

The operations on the Retest Statistics screen are the same as for standard Statistics, however some functions are different.

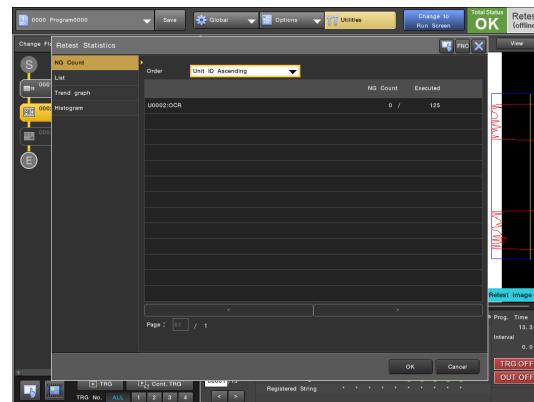


The only statistics displayed are for the batch test results.

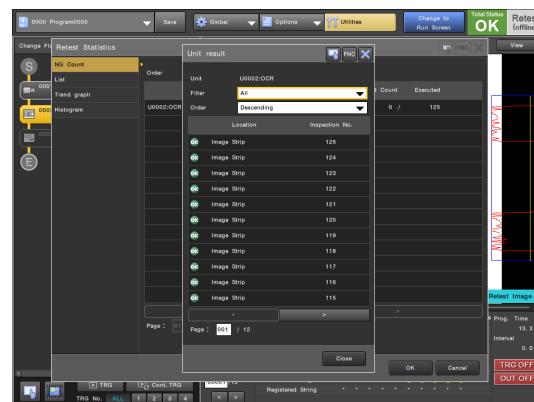
[NG Count] Screen

The NG count for each unit can be checked.

For example, if a result was NG during a batch test of OK master images, then it is possible to select the images from the unit which resulted in the NG and directly adjust the settings against those images.



When a unit is selected for checking results or for adjusting parameters, the [OK/NG] status for each measurement count for the selected unit is displayed on the [Unit result] screen.



When a measurement count is selected on the Unit Result screen, the Unit Properties menu is displayed with the image of the selected measurement count set as the captured image, and the necessary program adjustments can be made.

Reference

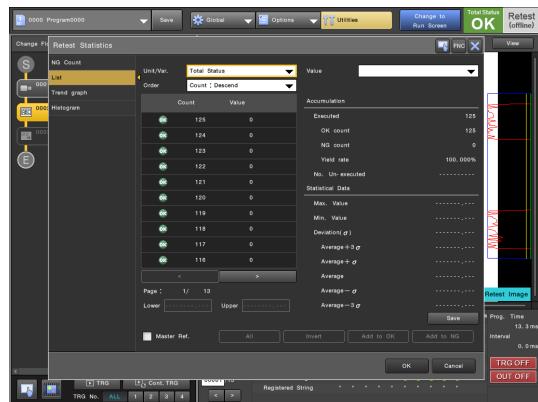
- On the [NG Count] screen, it is possible to change the displayed units and display order, and to display only the desired units.
 - Order:**
 - Unit ID Ascending:** Displays units in ascending order of the Unit IDs.
 - Unit ID Descending:** Displays units in descending order of the Unit IDs.
 - NG Count Ascending:** Displays units in ascending order of their NG counts.
 - NG Count Descending:** Displays units in descending order of their NG counts.
- On the [Unit result] screen, it is also possible to change the filters and display order and display only the desired measurement counts.
 - Filter**
 - NG Only:** Displays only the NG images.
 - OK and non-processed:** Displays only the OK images and images which have not been retested.
 - All:** Displays all images.
 - Order**
 - Ascending:** Displays images in ascending order of the measurement count.
 - Descending:** Displays images in descending order of the measurement count.

Point

Because the measurement count is associated with the file name, if the file name was changed, the image may not be displayed correctly.

[List] Screen

Used to check a list of the measurement values from retesting.



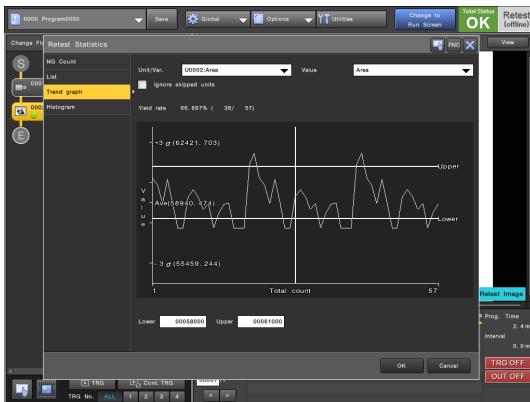
The primary differences with the normal [List] screen (Page 5-17) for [Statistics] are as follows:

- If the [Master Ref.] box is checked, the desired measurement count results data can be added as a master image.
- When [Save] is executed, a file is created for each display target. The names are as shown below.
 - YYMMDD_HHMMSS_SD No. of program_Program No._image.csv: retest measurement result of image bar image (count/total status/statistic item/individual status)
 - YYMMDD_HHMMSS_SD No. of program_Program No._ok.csv: retest measurement result of OK master image (count/total status/statistic item/individual status)
 - YYMMDD_HHMMSS_SD No. of program_Program No._ng.csv: retest measurement result of NG master image (count/total status/statistic item/individual status)
 - YYMMDD_HHMMSS_SD No. of program_Program No._idx.csv: measurement item name

Reference

When the measurement unit results data is displayed in the list, the desired measurement count can be selected and the Unit Properties menu for that measurement unit displayed.

[Trend Graph] Screen

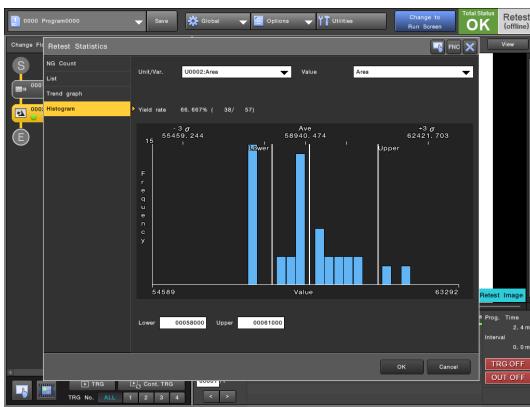


The primary difference with the normal [Trend Graph] screen (Page 5-19) for [Statistics] is as follows:

- The results data for the measurement count selected in the trend graph can be added as a master image.

Reference When the measurement unit results data is displayed in the trend graph, the desired measurement count can be selected and the Unit Properties menu for that measurement unit displayed.

[Histogram] Screen



The primary difference with the normal [Histogram] screen (Page 5-20) for [Statistics] is as follows:

- If the [Master Ref.] box is checked, the desired measurement count results data can be added as a master image.

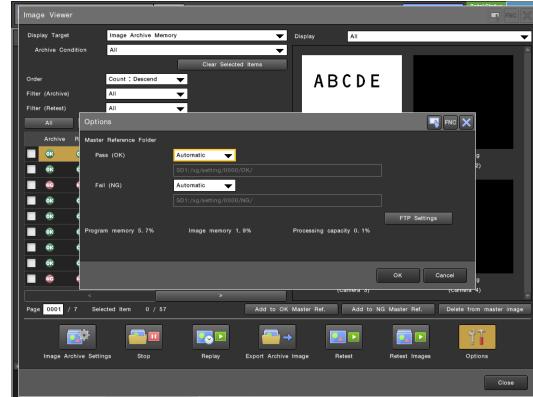
Reference When the measurement unit results data is displayed in the histogram, the desired measurement value can be selected and the Unit Properties menu for that measurement unit displayed.

Changing the Retest Mode Settings (Options)

The settings for retesting can be changed.

- Select [Options] on the [Image Viewer] screen (Page 5-4).

The [Options] menu appears.



- Change the settings as necessary.

Master Reference Folder

Specify the folder where the master images are saved.

- Pass (OK):** Select the location where the OK master images are saved.
- Fail (NG):** Select the location where the NG master images are saved.
- FTP Settings:** Specifies the destination FTP server for when saving images to the FTP server. See "Setting the Server Information for FTP Output (Target FTP Server Settings)" (Page 4-23) for more details.

- Select [OK].

Saving the Image Archive (Export Archive Image)

Save the images and result data that have been archived based on the archive condition being viewed in the Image Viewer to an SD card or USB HDD.

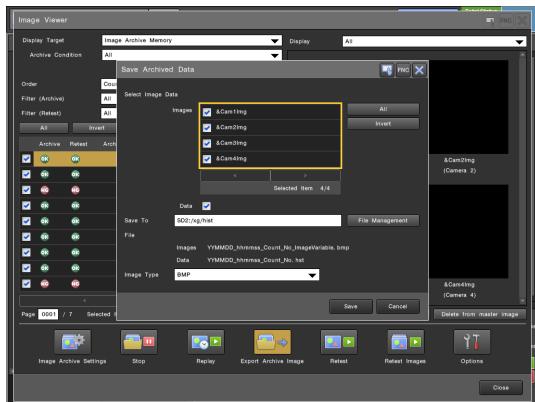
1 Select and check the measurement count to be saved in the archived image list on the [Image Viewer] screen (Page 5-4).

Reference

- Selecting [All] places check marks next to all the items in the image archive list.
- Selecting [Invert] reverses the checked / unchecked state.

2 Select [Export Archive Image].

The [Save Archived Data] menu appears.



3 Specify the save target in the [Select Image Data] field.

Check the image variables to be saved.

To save the result archive as well, check the [Data] box.

4 Specify the save destination in the [Save to] field.

Reference

Alternatively , use [File Management] to specify the folder path from the [File Management] screen (Page 5-43).

5 Specify the save file format for the image data in the [Image Type] field.

- **BMP:** Outputs the image in Windows bitmap format (24-bit color: color camera, 8-bit grayscale: monochrome camera).
- **BMP (1/2 Compression):** Compress the pixel counts in the respective directions vertical and horizontal by 1/2, then output the image in Windows bitmap format (24-bit color: color camera, 8-bit grayscale: monochrome camera).
- **BMP (1/4 Compression):** Compress the pixel counts in the respective directions vertical and horizontal by 1/4, then output the image in Windows bitmap format (24-bit color: color camera, 8-bit grayscale: monochrome camera).
- **BMP (1/8 Compression):** Compress the pixel counts in the respective directions vertical and horizontal by 1/8, then output the image in Windows bitmap format (24-bit color: color camera, 8-bit grayscale: monochrome camera).
- **JPG:** Outputs the image as a JPEG file.

6 Select [Save].

The image and results data from the archive are saved.

The image and data files are named as follows when they are saved.

- **Image:** YYMMDD_HHMMSS_Measurement count_No._Image variable name.bmp (jpg)
- **Data:** YYMMDD_HHMMSS_Measurement count_No_.hst

7 After saving is complete, select [Close].

Point

- Depending on the amount of data, saving can take several tens of seconds or minutes.
- The controller cannot be operated while saving is taking place.
- Image data cannot be saved if the option selected in [Display Target] in the Image Viewer is other than [Image Archive Memory].

Analyzing the Operation Results (Statistics)

Any of the data used or generated from the running of a program and inspection of parts can be recorded for later viewing and analysis through the [Statistics] option in the XG-X VisionEditor or Utility menu on the XG-X2000 Series controller.

In Run mode the items identified for collection can be viewed in real-time, while also allowing for changes to be made directly to upper and lower limits. At the same time any images stored in the image archive can also be directly referenced and viewed based on the statistical analysis.



- Some displays and functions are different when the statistics functions are used in Retest. See "Checking the Retest Result on the Statistics Screen" (Page 5-11) for more details.
- The [Statistics] screen cannot be displayed while the XG-X VisionEditor or any other program is accessing the image archive.
- The maximum number of statistical data points that can be recorded per item is 100,000 (1024 per item for statistics in Retest Mode). If the data exceeds the preset limit the oldest data is overwritten.
- Up to 256 items can be recorded at one time. If the items being recorded contain multiple targets the primary target data is used.
- Only the results generated during the Run mode are recorded.
- Recorded statistical data is deleted in the following situations:
 - When the controller is turned off
 - When the controller is reset
 - When changing programs
 - When the current program is overwritten via an external command
 - When selecting [Clear] on the [Statistics] screen.
 - When the Statistics Data Clear command is executed.
 - When opening the camera settings or white balance settings
 - When editing the targets for statistical analysis or criteria for image archiving
- The statistical data can be viewed during Run mode without affecting image processing, however the refresh rate for the [Statistics] screen maybe slower depending on runtime conditions.

Specifying Items to be Recorded

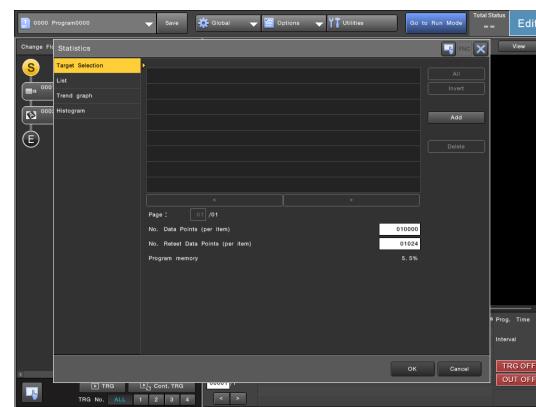
To store statistical results on the controller and during simulation, specify items to gather data from beforehand.



- Up to 256 items can be recorded at one time.
- The statistical analysis function records the results when the program execution reaches the end unit. Thus results for a unit processed multiple times in a loop will be the value from the last execution.
- Specifying items for statistical analysis consumes program memory space.

1 Select [Statistics] on the [Utilities] screen (Page 5-2).

The [Statistics] screen appears.

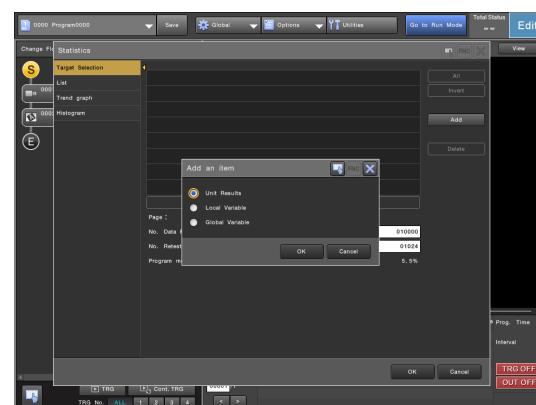


2 Select [Target Selection].

The [Target Selection] screen appears.

3 Select [Add].

The [Add an item] menu appears.

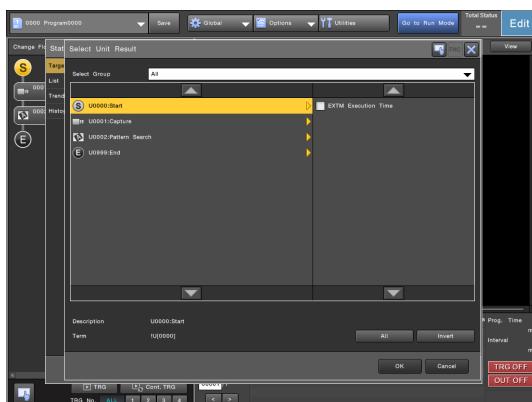


Analyzing the Operation Results (Statistics)

4 Choose the item type, then Select [OK].

A menu to select items and data from for the item type selected appears.

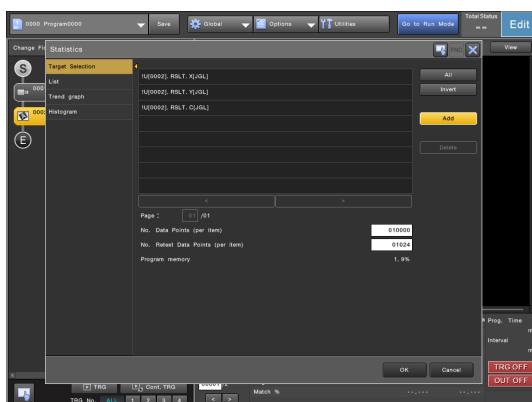
Example shown for [Unit Results]



Point Groups can not be selected for statistical analysis.

5 Select the desired item and data, then Select [OK].

The unit data or variable is added to the list of statistics, and the display returns to the [Statistics] screen.



An item in an array can also be specified by including the index number.

6 Make changes to the controller's statistical processing [Statistics] screen (Page 5-17) as required.

No. Data Points (per item)

Specify the number of data points (from 10 to 100000) to be collected by the statistics function.

- The statistics will set aside as many data points as required to collect all the data.
- When the data exceeds the preset limit, the oldest data will start to be overwritten.

No. Retest Data Points (per item)

Specify the number of data points (from 0 to 30000) to be collected in Retest mode.

- The statistics will set aside as many data points as required to collect all the data.



If the count is set to 0, statistical function for retesting results cannot be used.

7 Select [OK].

Deleting statistical items

In the [Target Selection] screen, select the measured values or variables to delete and Select [Delete].

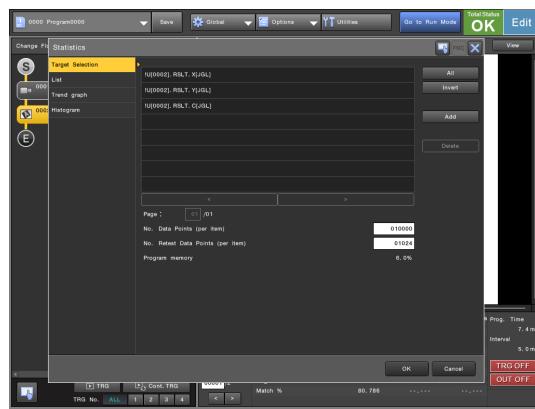
Displaying Statistics (List)

The list view displays the results of items that have been selected for statistical processing.

- Here statistical summary data such as OK/NG counts, standard deviation of each item can be seen and saved to an SD card.
- The cause of rejects can also be analyzed by checking the data against the image archive.
- Upper and lower limits can also be optimized based on the statistical data.

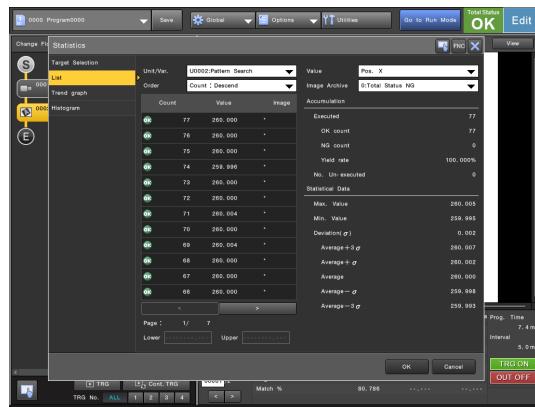
1 Select [Statistics] on the [Utilities] screen (Page 5-2).

The [Statistics] screen appears.



2 Select [List].

The list screen appears.



3 From the drop down menu select the data to see the summary for.

The selected measurement data values appear.



The list does not show data for items not specified for statistical analysis.

4 To view the details for each recorded value move the cursor to the item in the list.

- To change pages, use the 8-way key right and left with the list selected.
- If a NG has occurred, a NG icon appears to the left side of the [Count] column. If the item is OK or no limit is set, an OK icon appears.

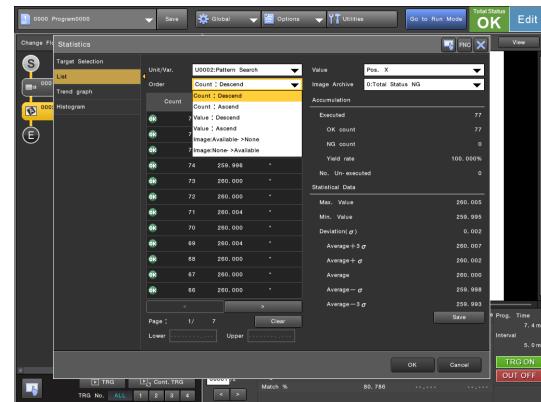
For the ones that cannot be measured

- In the value list, "0" appears in the value column (however, "9999999" appears for the Defect measurement's Total Defect Area).
- Results in the [Counts] group reflect the judgment settings specified for data that cannot be measured.
- Calculations in the [Statistical Value] group do not include items that cannot be measured.

For the unexecuted ones

- The [Value] column in the list displays "-----".
- No OK or NG icon is displayed.
- Calculations in the [Statistical Value] group do not include items that cannot be measured.

5 To sort the displayed order by inspection number, value, or presence of an image, select [Order].



- Count: (Descend/Ascend):** Displays the list in order (ascending or descending) by inspection number.
- Value: (Descend/Ascend):** Displays the list in order (ascending or descending) by the size of the value.
- Image: (Available → None/None → Available):** Displays the list in order giving priority to items with a recorded image.

6 To display the associated image, select the appropriate image archive from [Image Archive]. Then use the data summary to choose which image based on the image flag type, "*" or "+". "*" indicates the image was recorded as it matched the image archive criteria, and "+" indicates the image was recorded as part of a multiple archive series (Page 5-7).

- Select an item that has an image flag and press the No. 0 (ENTER) button to display the images (Page 5-8).
- The images captured in other measurements and the measurement results can be displayed by selecting thumbnail images in the image bar.
- To exit Replay mode, select [Statistics (End Replay)] on the image bar or [End Replay] in the [Function] menu.

 Point

- If the [Image] column does not contain any image flags, there are no images associated between the statistical and image archive data.
- When continuously recording images during Run mode, the image archive updates after the images have been recorded. Thus images may not yet be recorded even if the item shows an image flag.
- If no image archive criteria has been set, no image flags will appear during Run mode.
- When the image bar is closed, move the 8-way key left and right while holding down the No. 1 (FUNCTION) button to scroll through additional images and data in the image archive.
- During a reply, the image bar can be opened/closed using the MENU button.

7 To adjust the tolerance limits, change the values in the [Upper] and [Lower] fields, then select [OK].

The summary data changes as the upper and lower limits are changed. Adjust the values while observing changes to the yield rate.

 Point

- When changing the limits, the summary data is displayed with simulation values for the program. After the [Statistics] screen is closed and reopened, selecting the items again from the list returns the summary data based on the result history.
- If the tolerance limit references a variable, changes in the values will take effect when execution reaches the initial capture/end unit. Otherwise, the changes take effect immediately.
- When no limits are set for the unit, "-----" is displayed and the value cannot be changed. Set an upper/lower limit in the desired unit to be able to change the values.
- Tolerance limits that reference a variable will be shown with a gray or blue background. Limits that reference a system variable (gray background) cannot be changed.
- The upper and lower limits cannot be changed if accessibility is turned off for the current user group.

8 After checking the statistics, select [OK].

Saving recorded results to an SD card

Selecting [Save] with an SD card inserted into the controller saves the recorded data, judgment results, and item name as text data.

Two csv text files are saved into the "/xg/stat" folder of the specified SD card.

- **YYMMDD_HHMMSS_SD No. in program_Program No._dat.csv:** Measurement results (count/total status/statistic item/individual status)
- **YYMMDD_HHMMSS_SD No. in program_Program No._idx.csv:** Measurement item names

 Reference

- The SD card can be specified in the System Settings in XG-X VisionEditor (default: SD2).
- The data in the saved files can be viewed or edited using a text or spreadsheet program.

 Point

- The controller keeps track of the inspection number until it is reset. This allows it to resume properly for the second run and onwards. The upper limit for the inspection count on the controller is 1,000,000,000.
- If the data exceeds the maximum amount of statistical data, the oldest results are overwritten so part of the results may not be saved.
- The [Save] button is disabled if [Save] has been disabled for the user group logged in.

Deleting recorded results (Clear)

Selecting [Clear] deletes the currently recorded statistical data.

 Point

The [Clear] button is disabled if [Clear] has been disabled for the user account logged in.

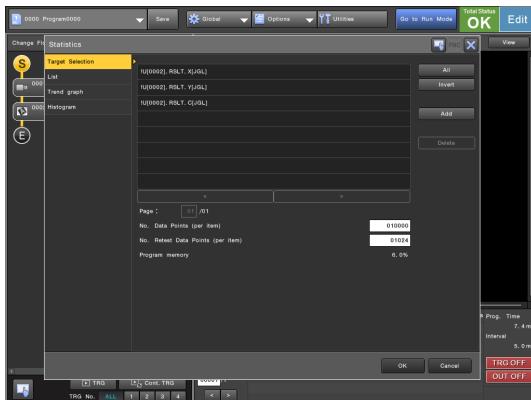
Displaying Data as a Trend Graph

Data can be displayed as a trend graph against the inspection number. This function is useful for checking how data is changing over the course of time or several inspections during Run mode.

- Upper and lower limits can be changed during the Run mode while observing changes in the yield rate and the distribution of data.
- The graph also displays whether image data was recorded with the image archive and allows images to be viewed directly.

1 Select [Statistics] on the [Utilities] screen (Page 5-2).

The [Statistics] screen appears.



2 Select [Trend graph].

The [Trend graph] screen appears.



3 From the drop down menu select the data to see the trend graph for.

The histogram of the selected data appears.



- The list does not show data for items not specified for statistical analysis.
- If the [Ignore skipped units] option is checked, the graph will exclude the data for units that were not executed.

4 To adjust the tolerance limits, change the values in the [Upper] and [Lower] fields, then select [OK].

Select the bar for upper and lower limit, then move the 8-way key up and down to adjust the tolerance.

The judgment results and yield rate change when the upper and lower limits are changed. Adjust the values while observing changes to the yield rate.



- When changing the tolerance, the yield rate is displayed with simulation values for the program. After the [Statistics] screen is closed once and reopened, selecting items again from the list returns the yield rate to the actual result history.
- If the measurement references a variable, changed tolerance values will take effect when execution reaches the initial capture/end unit. Otherwise, the changes take effect immediately.
- When no limits are set for the unit, "----" is displayed and the value cannot be changed. Set an upper/lower limit in the desired unit to be able to change the values.
- Tolerance limits that reference a variable will be shown with a gray or blue background. Limits that reference a system variable (gray background) cannot be changed.
- The upper and lower limits cannot be changed if accessibility is turned off for the current user group.

5 After checking the statistics, select [OK].

Enlarging / Reducing the trend graph size

The trend graph can be enlarged or reduced for easier viewing. During Run mode, select [Stop] to stop updating the graph and zoom in / out of the graph for an enlarged / reduced view.

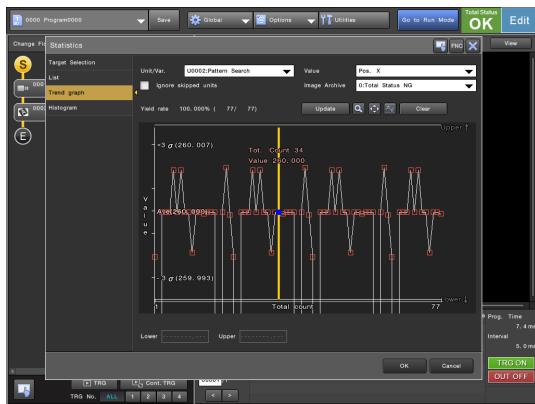
- Use the Zoom icon (magnifying glass) and go to the desired center point for the zoom using the 8-way key up, down, left, and right. The display will zoom in or out centered on the position of the zoom cursor.
- Use the Move icon to scroll around the histogram.
- Use the Fit icon to fit the histogram to the Y axis range.



- The initial display state for the trend graph is to automatically adjust according to the range of data based on the settings below:
 - X direction: Previous 515 inspections
 - Y direction: Results $\pm 3\sigma$ or range between the upper and lower limits, whichever is larger
- After closing the [Trend Graph] screen or updating the screen in Run mode, the zoom ratio in the Y direction returns to the initial state of automatically adjusting to the range of data.
- The zoom ratio in the X direction is maintained until the system is restarted.

Checking the values on the trend graph

Use the vertical data selection cursor on the screen and move the 8-way key left and right. The display will show the inspection number and item data at the position of the cursor.



Viewing images from the trend graph

To check the data against an image that is stored in the archive, move the data selection cursor to the desired point.

- At each data point a square will appear on the graph when an image is available. Place the cursor over a square and press the No. 0 (ENTER) button to display the image from the image archive (Page 5-8).
- Images captured in the previous and next measurement can be displayed by selecting thumbnail images in the image bar.
- To exit Replay mode, select [Statistics (End Replay)] on the image bar or [End Replay] in the [Function] menu.

Point

- Dark blue squares indicates the image was recorded as it matched the image archive criteria, while the light blue squares indicate images recorded as part of a multiple archive series (Page 5-7).
- If the data point does not have a square next to it, there are no images associated between the statistical and image archive data.
- When continuously recording images during Run mode, the image archive updates after the images have been recorded. Thus images may not yet be recorded even if the data point a square.
- If no image archive criteria has been set, no squares will appear on the graph.

Reference

Moving the cursor bar left and right while holding down the No. 1 (FUNCTION) button jumps between data points that have images.

Deleting recorded results (Clear)

Selecting [Clear] deletes the currently recorded statistical data.

Point

The [Clear] button is disabled if [Clear] has been disabled for the user group logged in.

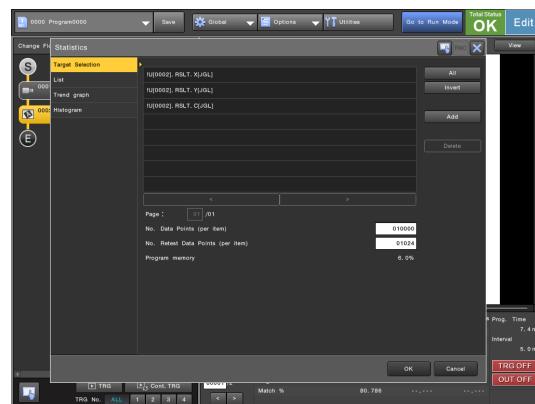
Displaying Data as a Histogram

This can be used to display the distribution of values as a histogram. This function allows the user to grasp the overall dispersion of values, so it is useful when adjusting measurement limits.

- Upper and lower limits can be changed during the Run mode while observing changes in the yield rate and the distribution of data.
- The graph also displays whether image data was recorded with the image archive and allows images to be viewed directly.

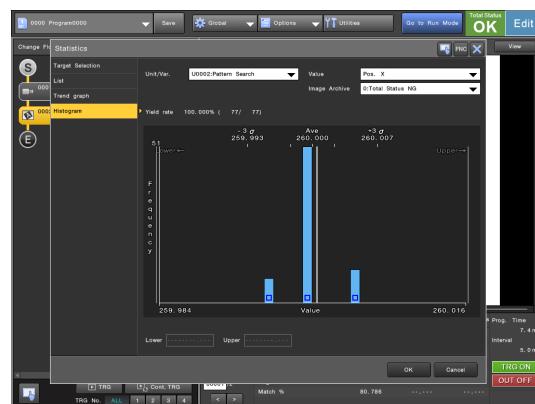
1 Select [Statistics] on the [Utilities] screen (Page 5-2).

The [Statistics] screen appears.



2 Select [Histogram].

The [Histogram] screen appears.



3 From the drop down menu select the data to see the trend graph for.

The histogram of the selected data appears.

Point

The list does not show data for items not specified for statistical analysis.

4 To adjust the tolerance limits, change the values in the [Upper] and [Lower] fields, then select [OK].

Select the bar for upper and lower limit, then move the 8-way key left and right to adjust the tolerance.

The judgment results and yield rate will update when the upper and lower limits are changed. Adjust the values while observing changes to the yield rate.



- When changing the tolerance, the yield rate is displayed with simulation values for the program. After the [Statistics] screen is closed once and reopened, selecting items again from the list returns the yield rate to the actual result history.
- If the measurement references a variable, changed tolerance values will take effect when execution reaches the initial capture/end unit. Otherwise, the changes take effect immediately.
- When no limits are set for the unit, "----" is displayed and the value cannot be changed. Set an upper/lower limit in the desired unit to be able to change the values.
- Tolerance limits that reference a variable will be shown with a gray or blue background. Limits that reference a system variable (gray background) cannot be changed.
- The upper and lower limits cannot be changed if accessibility is turned off for the current user group.

5 After checking the statistics, select [OK].

Enlarging / Reducing the histogram size

The histogram can be enlarged or reduced for easier viewing. During Run mode, select [Stop] to temporarily halt updating the graph and zoom in / out of the graph for an enlarged / reduced view.

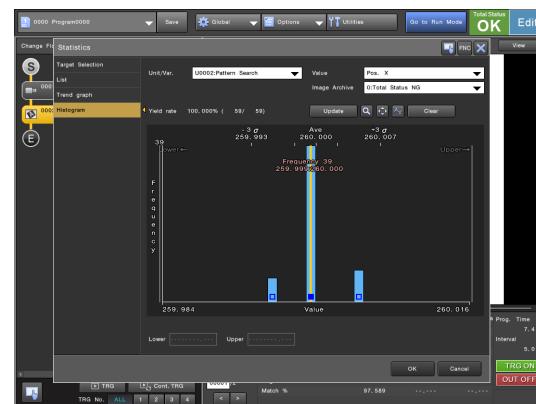
- Use the Zoom icon (magnifying glass) and go to the desired center point for the zoom using the 8-way key up, down, left, and right. The display will zoom in or out centered on the position of the zoom cursor.
- Use the Move icon to scroll around the histogram.
- Use the Fit icon to fit the histogram to the Y axis range.



- The initial display state for the trend graph is to automatically adjust according to the range of data based on the settings below:
 - X direction: Results $\pm 3\sigma$ or the range between the upper and lower limits, whichever is larger
 - Y direction: Maximum frequency
- After closing the [Histogram] screen, or after updating the screen in Run mode, the zoom ratio returns to its initial state of automatically adjusting to the range of data.

Checking values on the histogram

Select the cursor bar on the screen and move the 8-way key left and right. This displays the recorded count and value range at the position of the cursor.



Viewing images from the histogram

To check the data against an image recorded by the image archive use the data selection cursor. At each data point a square will appear on the graph.

- Place the cursor over a square and press the No. 0 (ENTER) button to display the image saved during measurement in archive mode (Page 5-8).
- Images captured in the previous and next measurement can be displayed by selecting thumbnail images in the image bar.
- To exit Replay mode, select [Statistics (End Replay)] on the image bar or [End Replay] in the [Function] menu.



- Dark blue squares indicate the image was recorded as it matched the image archive criteria, while the light blue squares indicate images recorded as part of a multiple archive series (Page 5-7).
- If the data point does not have a square next to it, there are no images associated between the statistical and image archive data.
- When continuously recording images during Run mode, the image archive updates after the images have been recorded. Thus images may not yet be recorded even if the data point has a square.
- If no image archive criteria has been set, no squares will appear on the graph.



Moving the cursor bar left and right while holding down the No. 1 (FUNCTION) button jumps between data points that have images.

Deleting recorded results (Clear)

Selecting [Clear] deletes the currently recorded statistical data.



The [Clear] button is disabled if [Clear] has been disabled for the user group logged in.

Editing the Flowchart in Run Mode

(Edit Flowchart in Run Mode)

The setting values of units can be changed in Run mode. This is useful when carrying out adjustments in the field because the unit setting values can be edited without switching to Setup mode.

Utility

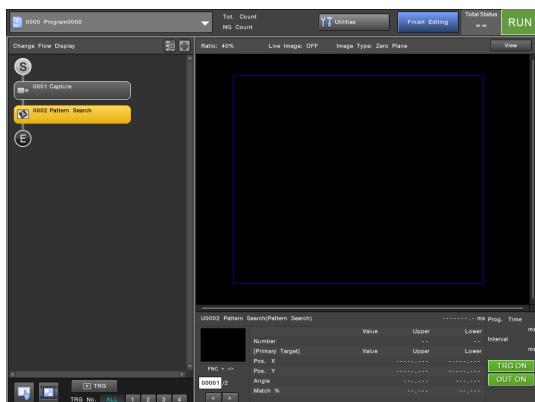
Reference The unit to be edited can also be restricted in the Unit Edit Dialog Settings in XG-X VisionEditor. See the XG-X VisionEditor Reference Manual for more details.

- 1 Select [Edit Flowchart in Run Mode] on the [Utilities] screen (Page 5-2).

A confirmation screen will appear.

- 2 Select [OK].

The flowchart is displayed.



- 3 Edit the flowchart as required.

- 4 To finish the flowchart editing, select [Finish Editing] at the upper right of the screen.



- Point**
- The flowchart structure cannot be changed during flowchart editing in Run mode.
 - In the [Run Mode I/O Control. Prohibit:] setting in [Unit Edit Startup Settings] (Page 4-20), you can configure whether to permit trigger input and whether to prohibit output while the [Edit Flowchart in Run Mode] screen is being displayed.
 - Changing the settings in [Edit Flowchart in Run Mode] during inspection may greatly affect the inspection results. It is recommended to stop the inspection before changing any settings in [Edit Flowchart in Run Mode]. See "Cautions on Flowchart Editing" (Page 2-8) for more details.
 - It is also possible to display the launcher menu of the Edit Unit menu using the DO command. For more details, refer to the XG-X2000 Series Communications Control Manual.

Verifying the Communication Status/Operating Status

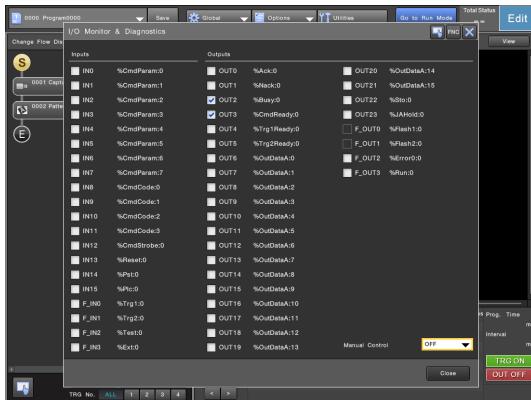
Verifying the Connection Status of Input and Output Terminals (I/O Monitor & Diagnostics)

The I/O Diagnostic tool allows for the checking of the status of incoming and outgoing signals via the inputs and outputs of the terminal block and parallel port. This is very useful for verifying the connection status of external equipment wired to the terminals on the controller.

- Point** Not supported when system variables %Flash1 to 4 are assigned to outputs F_OUT0 to 3. For more details on system variables, refer to "Variables" in the XG-X VisionEditor Reference Manual.

1 Select [I/O Monitor & Diagnostics] on the [Utilities] screen (Page 5-2).

The [I/O Monitor & Diagnostics] menu appears.



2 Verify the connections.

Each input and output is displayed with their respective assigned system variable.

- The status display for each terminal is updated in real time in response to the incoming and outgoing signals. A check mark next to the input / output indicates the terminal is ON (shorted).
- To forcibly turn on specific output terminals, set [Manual Control] to [ON], and put check marks next to the terminals to be turned on (only available during Setup mode).

- Point** In Setup mode, no variables are output except certain system variables. To verify data output, switch to Run mode or use the [Manual Control] function in the I/O Diagnostic tool.

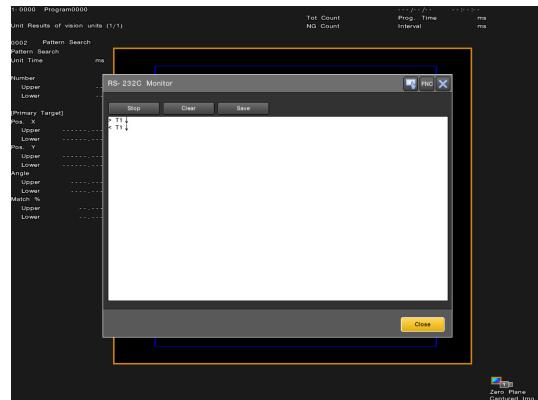
3 Select [Close].

Verifying the Status of RS-232C Communication (RS-232C Monitor)

The RS-232C Diagnostic tool allows for the checking of the status of incoming and outgoing signals via the RS-232C port of the controller. This feature is very useful for verifying the communication status and content between the controller and external equipment. The most recent communication content (up to 10 KB) can also be saved for later review.

1 Select [RS-232C Monitor] on the [Utilities] screen (Page 5-2).

The [RS-232C Monitor] menu appears.



2 Verify the communication status.

The communication data is updated in response to incoming and outgoing RS-232C commands.

- A "<" appears at the beginning of the data when output from the controller, and a ">" appears at the beginning of data received by the controller.
- Characters other than ASCII code are displayed in "■Hexadecimal".

- Point** In Setup mode, the only RS-232C communication output that occurs are responses to commands input from external devices. To check whether data output from the program is functioning correctly, switch to Run mode.

3 Use the following operations as required.

- To stop data being displayed on screen:** Select [Stop].
- To clear the log:** Select [Clear].
- To save the log to the SD card:** Select [Save] to save the log as text data. The log is saved in the "xg\rs_log\" folder on the specified SD card with the name "File creation date YYMMDD_HHMMSS_SD No._ProgramNo.log".

Reference The SD card can be specified in the System Settings in XG-X VisionEditor (default: SD2).

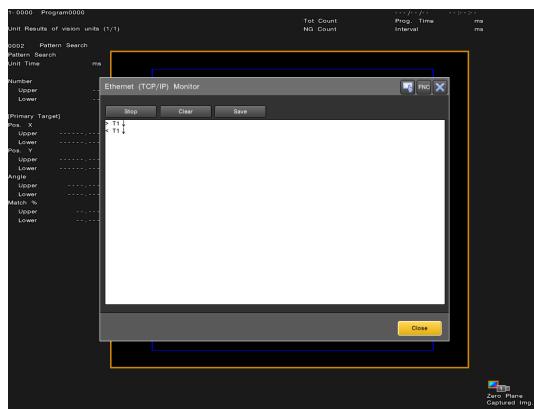
4 Select [Close].

Checking the Ethernet Communication Status (Ethernet (TCP/IP) Monitor)

You can check the system's Ethernet communication status with this function. This function is convenient because it allows you to check communications content when connected to an external device in situations such as when the appropriate data cannot be communicated between connected devices.

1 Select [Ethernet (TCP/IP) Monitor] on the [Utilities] screen (Page 5-2).

The [Ethernet (TCP/IP) Monitor] menu appears.



2 Now check the communication status.

The current communication content is changed real time according to the command input/output.

- "<" is given to the head of the output data from the controller while ">" is given to the head of the input data to the controller.
- Numbers other than ASCII code are displayed in "■Hexadecimal".



In Setup mode, communication output other than response for external input commands is not performed. If you want to check the data output operation, switch to Run mode.

3 Use the following operations as required.

- **To stop data being displayed on screen:** Select [Stop].
- **To clear the log:** Select [Clear].
- **To save the log to the SD card:** Select [Save] to save the log as text data. The log is saved in the "\xg\rs_log\" folder on the specified SD card with the name "File creation date YYMMDD_HHMMSS_SD No._ProgramNo.log".



The SD card can be specified in the System Settings in XG-X VisionEditor (default: SD2).

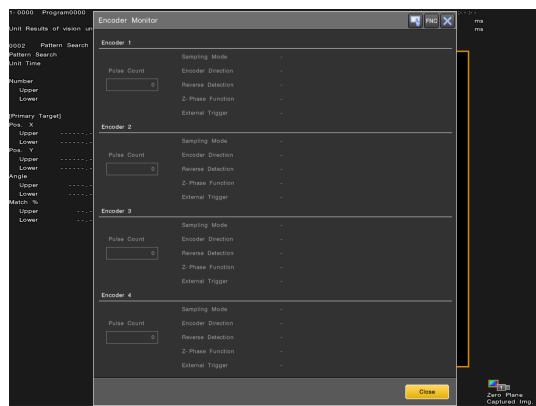
4 Select [Close].

Monitoring the Encoder Input Status (Encoder Monitor)

The encoder operation status can be checked when imaging is performed with an encoder connected.

1 Select [Encoder Monitor] on the [Utilities] screen (Page 5-2).

The [Encoder Monitor] menu appears.



2 Verify the operation status.

The current information for each encoder is displayed.

3 Select [Close].

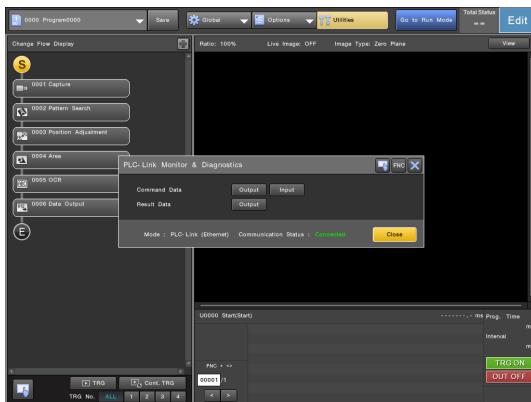
Checking the PLC-Link Communication Status (PLC-Link Monitor & Diagnostics)

You can check the system's PLC-Link I/O signal communication status with this function. This function is convenient because it allows you to check communications content when connected to an external device in situations such as when the appropriate data cannot be communicated between connected devices.

Point The monitor cannot be used when [Mode] for PLC-Link is [Disable] or when PLC-Link is not connected. First establish a PLC-Link connection before using the monitor.

1 Select [PLC-Link Monitor & Diagnostics] on the [Utilities] screen (Page 5-2).

The [PLC-Link Monitor & Diagnostics] screen is displayed.

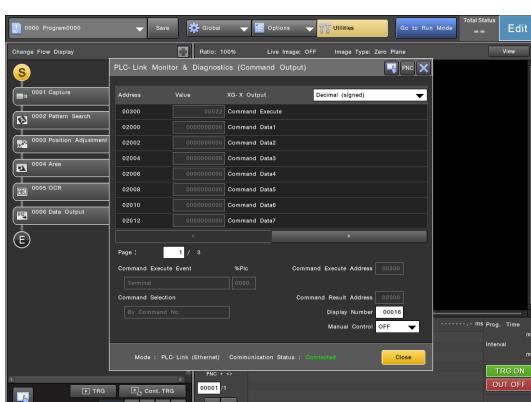


2 Select the item you wish to check.

Select the command data (output from the system/input to the system) or result data.

3 Now check the communication status.

Command Output screen

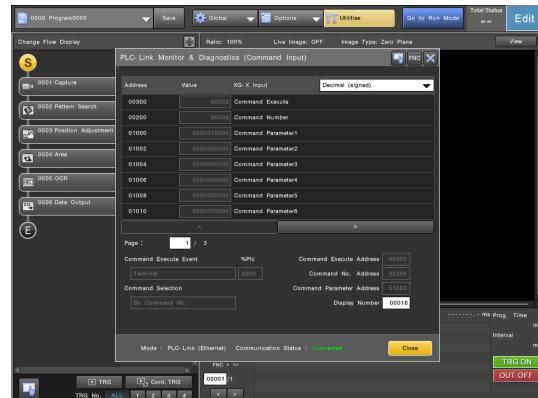


Since the value for Command Execute Address of address 300 is 22, the command to be executed is found to be an error (22 is a parameter error code).

- Command Execute Event:** Displays the command execution method (not to be changed) by the controller selected in the system settings when the PLC-Link is used.
 - %Plc:** It is displayed when the Command Execute Event is "Terminal": It indicates the number of times when %Plc is ON (not to be changed).
 - Command Selection:** Displays the Command Execute Event (not to be changed) selected in the system settings.
 - Command Execute Address:** Displays the command No. input control address (not to be changed) selected in the system settings.
 - Command Result Address:** Displays the command data output address (not to be changed) selected in the system settings.
 - Display Number:** The display number for desired data to be monitored can be set.
 - Manual Control:** ON/OFF is selected only in Setup mode. When it is ON, the address value can be forcibly changed.
- Using the down arrow at the upper right corner of the screen, you can select the value to monitor from Hexadecimal, Decimal (unsigned), or Decimal (signed).

Command Input screen

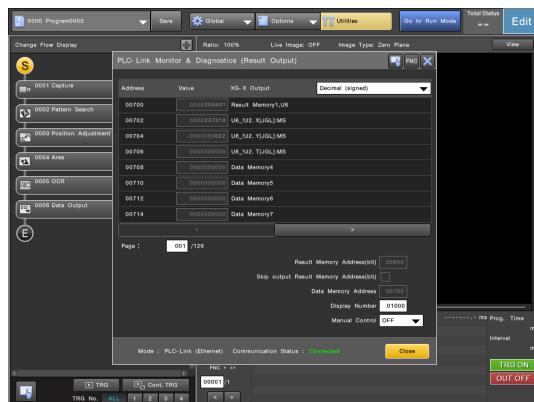
Example when "PW,1,*1" is set to custom command No. 2



When the value for Command No. Address of address 200 is 2 (Program No. is switched) and the command is executed with the Command Parameter 1 of address 1000 being 10000 (switched-to setting No. 10000), the Command Execute Address of address 300 is 22, which points out to a parameter error. (Setting of No. 10000 cannot be selected.)

Result Output screen

Example of the setting where you output the XYθ data of the vision unit 0002 from the data output unit 0006



You can see that the XYθ data of the unit 0002 in the controller is output to address 700 (X), address 702 (Y), and address 704 (θ).

Reference

- Results data in this screen are displayed in a shortened form.
Example:
Normal notation !U[0002].RSLT.X[JGL]:MS
Shortened form !U2.X[JGL]:MS
- In Setup mode, communication output other than response for external input commands is not performed. If you want to check the data output operation, switch to Run mode.

4 Select [Close].

Checking the EtherNet/IP Communication Status (EtherNet/IP Monitor & Diagnostics)

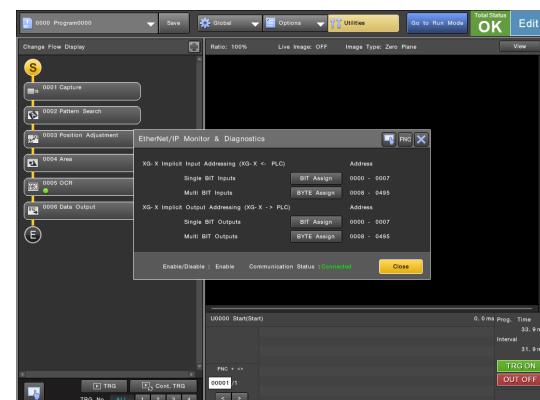
You can check the system's EtherNet/IP I/O signal communication status with this function. This function is convenient because it allows you to check communications content when connected to an external device in situations such as when the appropriate data cannot be communicated between connected devices.



The monitor cannot be used when [Enable/Disable] for EtherNet/IP is [Disable] or when EtherNet/IP is not connected. First establish an EtherNet/IP connection before using the monitor.

1 Select [EtherNet/IP Monitor & Diagnostics] on the [Utilities] screen (Page 5-2).

The [EtherNet/IP Monitor & Diagnostics] screen is displayed.

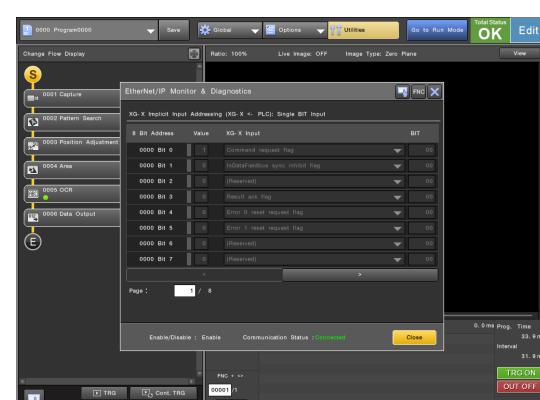


2 Select the item you wish to check.

Select bit information or byte information for the output data (received by the controller) or input data (sent by the controller).

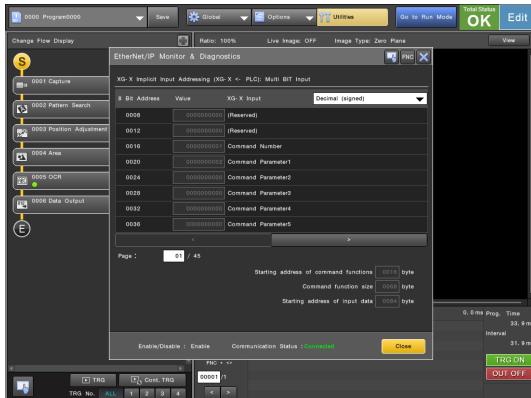
3 Now check the communication status.

XG-X Implicit Input Addressing (XG-X <- PLC): Single BIT Input



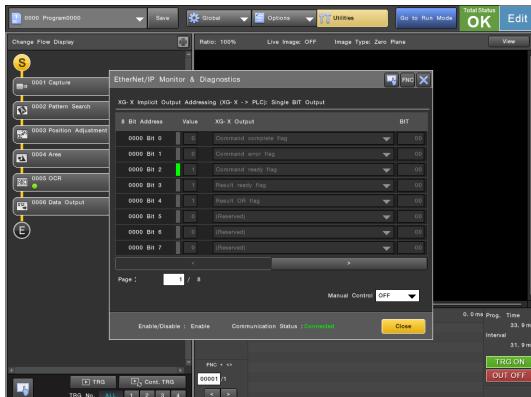
You can see that 1 was sent to Command request flag from the PLC.

XG-X Implicit Input Addressing (XG-X <- PLC): Multi BIT Input



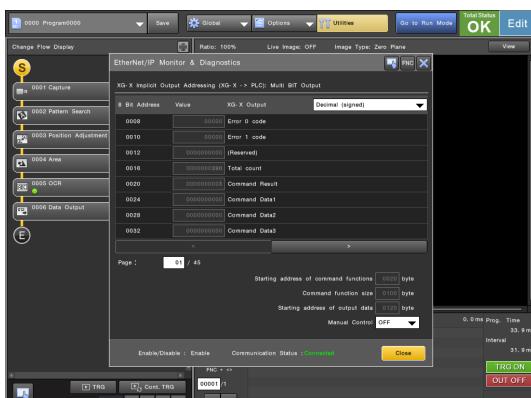
You can see that 1 was input to Command Number and 2 was input to Command Parameter 1 (decimal, unsigned). Using the down arrow at the upper right corner of the screen, you can select the value to monitor from Hexadecimal, Decimal (unsigned), or Decimal (signed).

XG-X Implicit Output Addressing (XG-X > PLC): Single BIT Output



You can see that 1 was sent to Command ready flag, Result ready flag, and Result OR flag from the controller.

XG-X Implicit Output Addressing (XG-X > PLC): Multi BIT Output



You can see that 390 was sent to Total count and 3 was sent to Command Result as a decimal (unsigned) from the controller.

Reference With the input data (sent by the controller) monitor, you can manually change the value for the desired addresses and check those changes on the PLC by selecting ON for Manual Control during Setup mode.

4 Select [Close].

Checking the PROFINET Communication Status (PROFINET Monitor & Diagnostics)

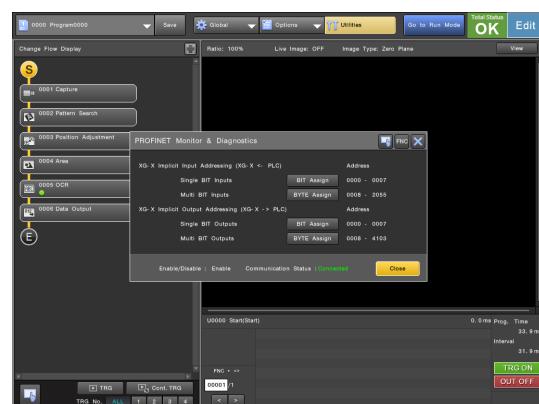
You can check the system's PROFINET I/O signal communication status with this function. This function is convenient because it allows you to check communications content when connected to an external device in situations such as when the appropriate data cannot be communicated between connected devices.



The monitor cannot be used when [Enable/Disable] for PROFINET is [Disable] or when PROFINET is not connected. First establish a PROFINET connection before using the monitor.

1 Select [PROFINET Monitor & Diagnostics] on the [Utilities] screen (Page 5-2).

The [PROFINET Monitor & Diagnostics] screen is displayed.

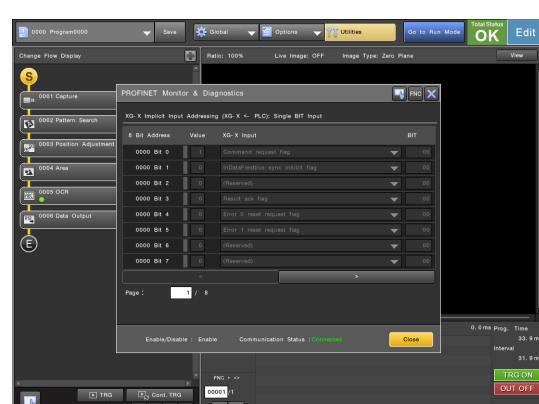


2 Select the item you wish to check.

Select bit information or byte information for the output data (received by the controller) or input data (sent by the controller).

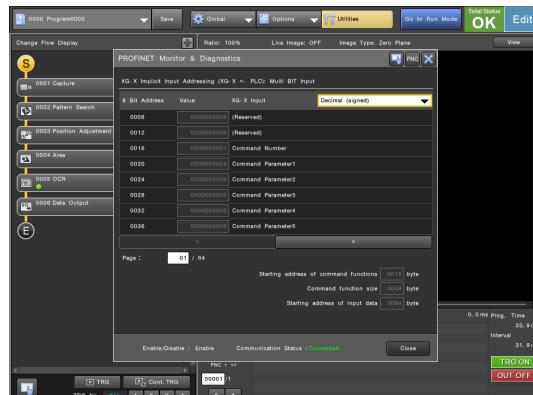
3 Now check the communication status.

XG-X Implicit Input Addressing (XG-X <- PLC): Single BIT Input



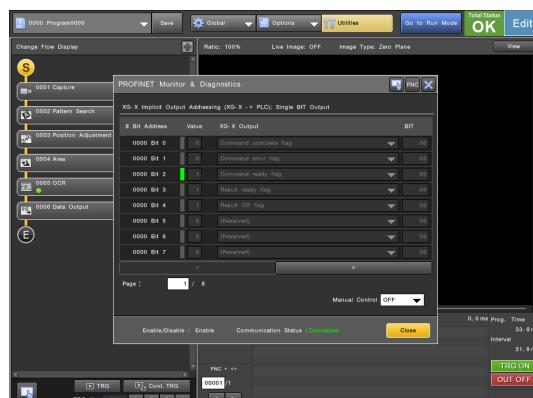
You can see that 1 was sent to Command request flag from the PLC.

XG-X Implicit Input Addressing (XG-X <- PLC): Multi BIT Input



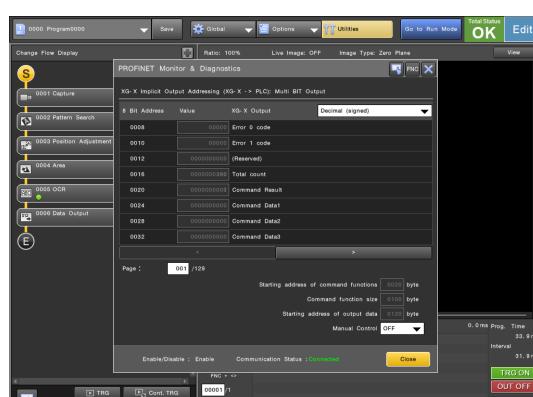
You can see that 1 was input to Command Number and 2 was input to Command Parameter 1 (decimal, unsigned). Using the down arrow at the upper right corner of the screen, you can select the value to monitor from Hexadecimal, Decimal (unsigned), or Decimal (signed).

XG-X Implicit Output Addressing (XG-X -> PLC): Single BIT Output



You can see that 1 was sent to Command ready flag, Result ready flag, and Result OR flag from the controller.

XG-X Implicit Output Addressing (XG-X -> PLC): Multi BIT Output



You can see that 390 was sent to Total count and 3 was sent to Command Result as a decimal (unsigned) from the controller.



With the input data (sent by the controller) monitor, you can manually change the value for the desired addresses and check those changes on the PLC by selecting ON for Manual Control during Setup mode.

4 Select [Close].

Checking the CC-Link Communication Status (CC-Link Monitor & Diagnostics)

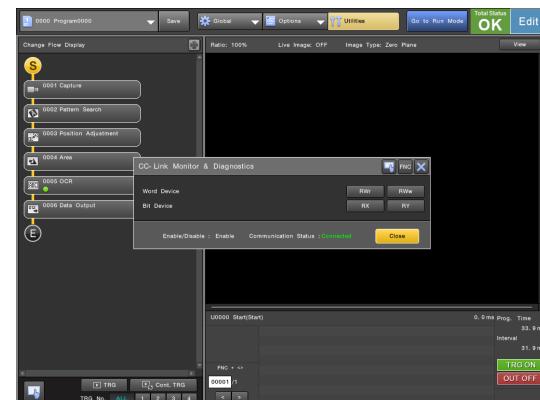
You can check the system's CC-Link I/O signal communication status with this function. This function is convenient because it allows you to check communications content when connected to an external device in situations such as when the appropriate data cannot be communicated between connected devices.



The monitor cannot be used when [Enable/Disable] for CC-Link is [Disable] or when CC-Link is not connected. First establish a CC-Link connection before using the monitor.

1 Select [CC-Link Monitor & Diagnostics] on the [Utilities] screen (Page 5-2).

The [CC-Link Monitor & Diagnostics] screen is displayed.

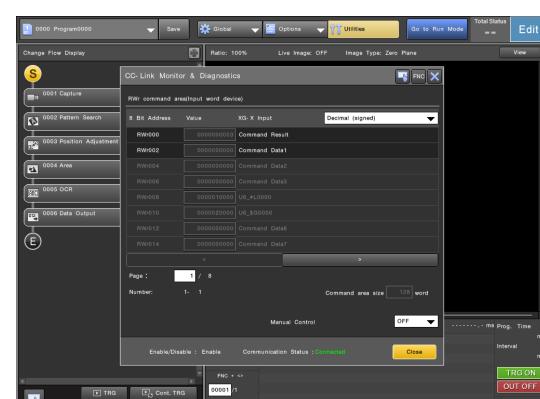


2 Select the item you wish to check.

Select Word Device (RWr/RWw) or Bit Device (RX/RY).

3 Now check the communication status.

RWr command area (Input word device) screen

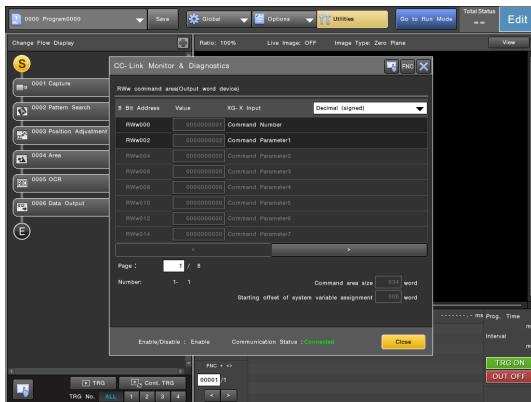


You can see that the result of Command Result was output as the value of RWr000 and the output data specified in the unit 0002 was output as the value of RWr008, RWr010, and RWr012 from the controller.



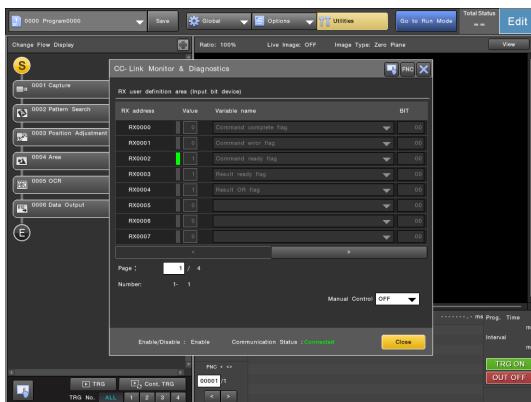
[U6_#L0000] means that #L0000 is set as output data in the data output unit 0006.

RWw command area (Output word device) screen



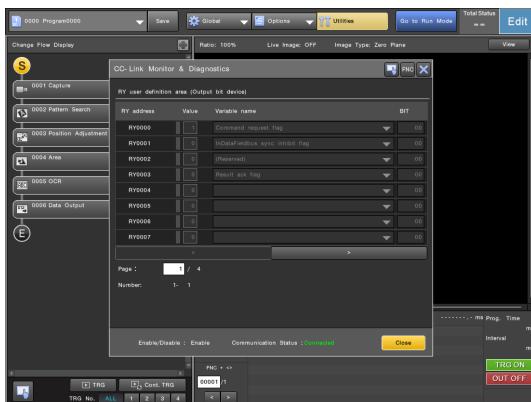
You can see that "1" as the Command Number is input as the value of RWw000 and "2" as the Command Parameter1 is input as the value of RWw002.

RX user definition area (Input bit device) screen



You can see that "1" as the Command ready flag, Result ready flag, and Result OR flag is output from the controller as the value of RX002, RX003, and RX004.

RY user definition area (Output bit device) screen



You can see that "1" as the value of the Command Request flag is input from the PLC side as the value of RY000.

Reference

With the input data (RW_r and RX) monitor, you can manually change the value for the desired addresses and check those changes on the PLC by selecting ON for Manual Control during Setup mode.

4 Select [Close].

Checking the EtherCAT Communication Status (EtherCAT Monitor & Diagnostics)

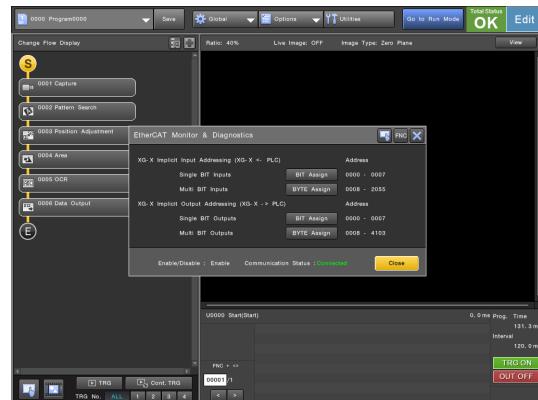
You can check the system's EtherCAT I/O signal communication status with this function. This function is convenient because it allows you to check communications content when connected to an external device in situations such as when the appropriate data cannot be communicated between connected devices.



The monitor cannot be used when [Enable/Disable] for EtherCAT is [Disable] or when EtherCAT is not connected. First establish an EtherCAT connection before using the monitor.

1 Select [EtherCAT Monitor & Diagnostics] on the [Utilities] screen (Page 5-2).

The [EtherCAT Monitor & Diagnostics] screen is displayed.

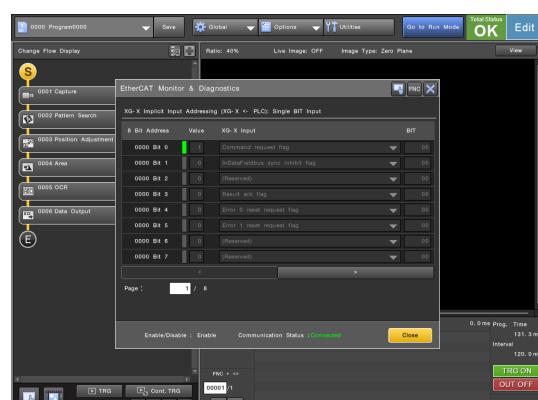


2 Select the item you wish to check.

Select bit information or byte information for the output data (received by the controller) or input data (sent by the controller).

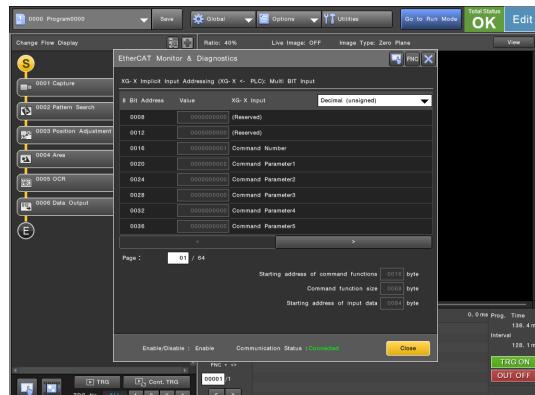
3 Now check the communication status.

XG-X Implicit Input Addressing (XG-X <- PLC): Single BIT Input



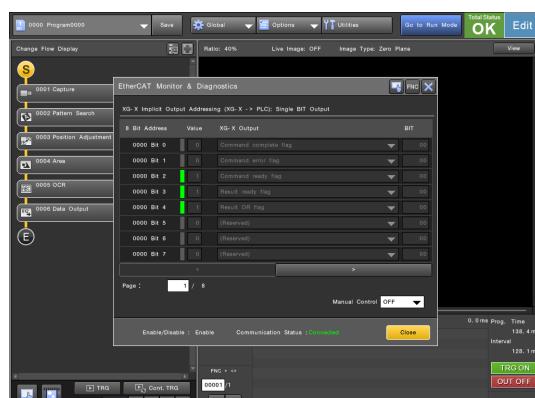
You can see that 1 was sent to Command request flag from the PLC.

XG-X Implicit Input Addressing (XG-X <- PLC): Multi BIT Input



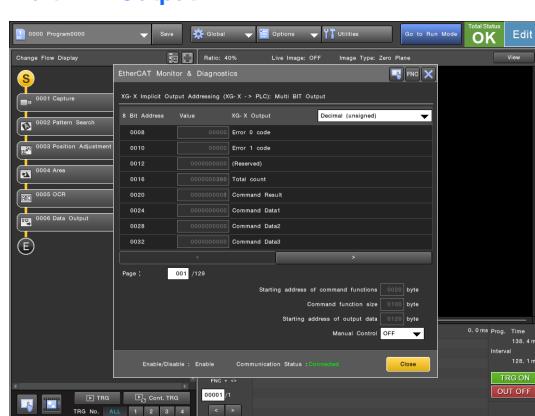
You can see that 1 was input to Command Number and 2 was input to Command Parameter 1 (decimal, unsigned). Using the down arrow at the upper right corner of the screen, you can select the value to monitor from Hexadecimal, Decimal (unsigned), or Decimal (signed).

XG-X Implicit Output Addressing (XG-X -> PLC): Single BIT Output



You can see that 1 was sent to Command ready flag, Result ready flag, and Result OR flag from the controller.

XG-X Implicit Output Addressing (XG-X -> PLC): Multi BIT Output



You can see that 390 was sent to Total count and 3 was sent to Command Result as a decimal (unsigned) from the controller.



With the input data (sent by the controller) monitor, you can manually change the value for the desired addresses and check those changes on the PLC by selecting ON for Manual Control during Setup mode.

4 Select [Close].

Changing a Variable Value (Update Variables)

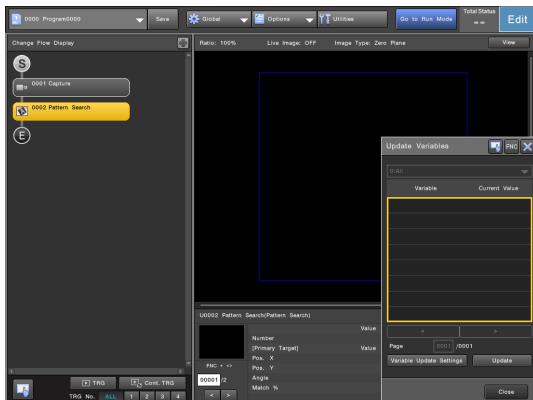
This function allows the easy changing of specified variables within the Update Variables menu.

Changing the Settings to Allow Changing Variables

In order to change the variable values via the controller, the variables which are to be changed need to be specified in advance.

1 Select [Update Variables] on the [Utilities] screen (Page 5-2).

The [Update Variables] menu appears.



2 Select [Variable Update Settings].

The [Variables Update Settings] menu appears.

3 Select [Add].

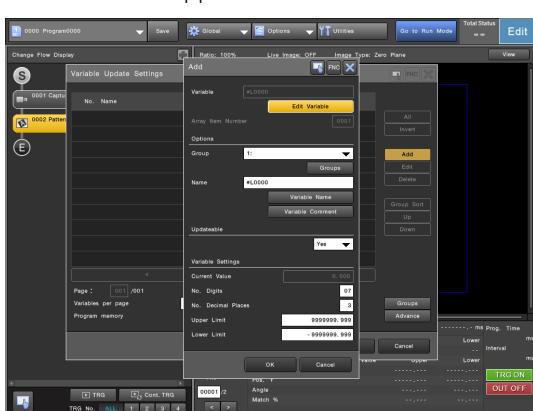
The Variable menu appears.

4 Select the variable type to add and then select [OK].

A selection menu is displayed which lists the variables of the selected type.

5 Select the variable to add to the update list and then Select [OK].

The Add menu appears.



6 Change the variable update settings as necessary.

Array Item Number

If an array type variable is selected, select the number of array items to be able to update.

Group

Select the group which the variable will belong to. When [Groups] is selected, the group name and group order can be changed.

Name

Enter the item name that will be displayed in the Variable Update Settings menu for the selected variable. It is also possible to Select [Variable Name] to use the actual name of the variable as the item name or [Variable Comment] to use the comment of the variable as the item name.

Updateable

Select whether or not to permit the selected variable to be changed during operation (default: Yes).

If a system variable is added, this setting is fixed at [No].

Variable Settings

Set the number of digits and decimal places that can be set for the variable. Additionally, an upper and lower limit can be set so the value cannot be changed outside this set range.

7 When setting is complete, select [OK].

The variable which was selected in step 6 is added to the displayed variables in the Update Variables menu.

8 Select [OK] to close the Variable Update Settings menu.

When a variable is assigned to a program parameter, it is possible to add it to the Variable Update list by selecting [Add to Update List] from the Edit menu of the flowchart.

Changing a Variable Value (Update Variables)

Modifying the variable update settings

Select the desired variable to modify settings for on the Update Variables menu, then select [Edit].

Deleting the registration of a variable in the variable update settings

Select the desired variable to delete from the Update Variables menu, then select [Delete].

Changing the order of the displayed variables

The order for displaying the variables registered in the Update Variables menu can be changed as follows:

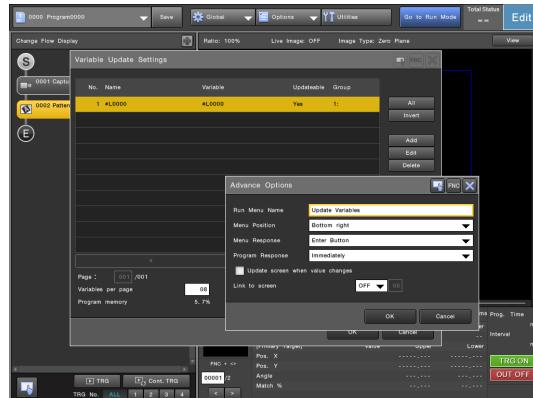
- **Group Sort:** Arrange in ascending order of the group Nos. set for the groups.
- **Up:** Move the selected variable up in the list.
- **Down:** Move the selected variable down in the list.

Changing the number of variables displayed per page on the Update Variables menu

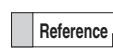
The number of variables to display per page on the Update Variables menu can be set between 1 and 13 by changing [Variables per page] (default: 8).

Changing the Update Variables menu display method

Select [Advance] on the Variable Update Settings menu to change the settings for the way in which the Update Variable menu appears on the screen and the response when a value is changed.



- **Run Menu Name:** Specify the name of the Update Variables menu that is displayed on the controller. (default: Update Variables)
- **Menu Position:** Select the position where the Update Variables menu is displayed on the controller (default: Bottom right).
- **Menu Response:** Select the timing for when a variable update is confirmed (default: Enter Button).
- **Program Response:** Select the timing for when a variable update is applied to the program (default: Immediately).
- **Update screen when value changes:** Check this box to update the camera image and display template while a variable is updated.
- **Link to screen:** Select the display template that is displayed for the Update Variables menu.
 - **ON:** Specify the screen display.
 - **OFF** (default): Do not specify the screen display.



Refer to "Overview of the Creation of Display Templates" (Page 4-26) for more details on screen displays.

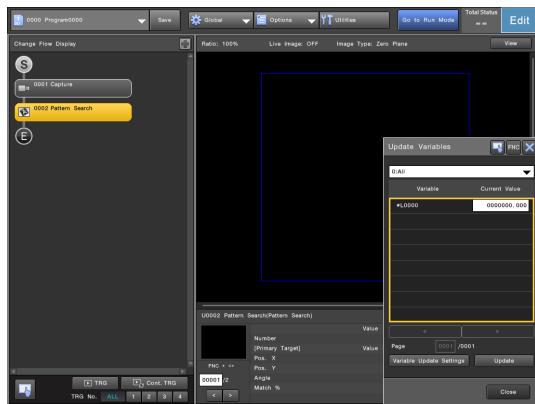


Changes to the Update Variable menu name is not applied on the Menu ID drop-down menu of User Menu units.

Changing a Variable Value on the Update Variables menu

- 1 Select [Update Variables] on the [Utilities] screen (Page 5-2).**

The [Update Variables] menu appears.



- 2 Select the [Current Value] field of the desired variable and change the value.**

To check the most current value of a variable while the Update Variables menu is displayed, select [Update].

- 3 Select [Close].**

The value of the variable selected in step 2 is changed at the timing which was set for [Menu Response] and [Program Response].

Reference If the current value of a variable is changed where [Copy current value to initial value at save] is enabled, then a confirmation screen appears asking whether or not to save the setting.

Storing and Viewing Detected Target Types (Target Classification)

By setting conditions for target classification in advance, it is possible to extract only the locations of targets in the inspection results of the Blob, Grayscale Blob, and Defect (Grouping ON) units, classify the data, and store it in the controller or output it to an external device.

The area or axes ratio can be selected as classification conditions, allowing classification based on defect size and shape (example: long, thin defects).



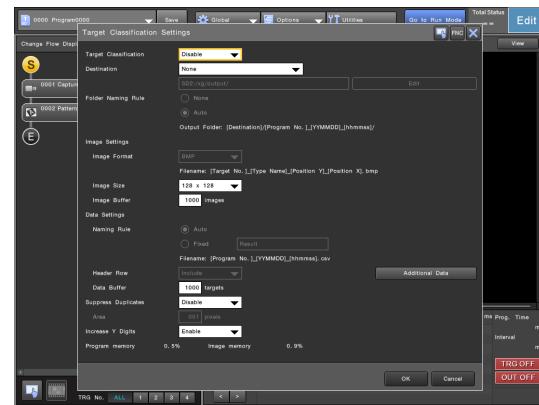
Point Numbers that can be handled for target classification (results output and output data) have up to 6 digits in the integer portion and up to 3 digits in the decimal position.

Setting Output Destinations for Target Classification Data (Target Classification)

Set the method for outputting the target classification data that is stored in the controller.

1 Select [Target Classification Settings] on the [Utilities] screen (Page 5-2).

The [Target Classification Settings] menu appears.



2 Change the target classification settings as necessary.

Target Classification

Select whether or not to use target classification (default: Disable).



If [Disable] is selected, target classification is not performed even if target classification settings have been made.

Destination

Specify the device to automatically output target classification data from the controller to.

- **None** (default): No target classification data is output.
- **SD Card**: Output to the SD card in the controller.
- **FTP**: Output to an FTP server. Select [FTP Settings] and enter the FTP server information.
- **USB HDD**: Outputs data to the external USB HDD.

Folder Naming Rule

Select the naming rule to use for the device folders where the image files and results files will be saved.

- **None**: Output to the folder selected in [Destination].
- **Auto** (default): Output to a created folder with the name "Destination folder name \ Program No._YYMMDD_HHMMSS".

- Reference** The destination folder is created at the time of the first trigger input after:
- The controller is turned on.
 - The controller is reset.
 - The program No. is changed.
 - The destination folder is not available at the destination.
 - The target classification result is cleared.

Image Settings

Select the output settings for the image files in the target classification data that is output from the controller.

- **Image Format:** Specify the image save format.
 - **BMP** (default): Saves images in bitmap format.
 - **JPG**: Saves the images in JPEG format.
- **Filename :** Display the format of the filename to save. The Y coordinate and X coordinate displayed here indicate the coordinate position (pixel value) where the defect was detected.
- **Image Size :** Select the image output size from 32 x 32 pixels, 64 x 64 pixels, 128 x 128 pixels (default), 256 x 256 pixels, 512 x 512 pixels, or 1024 x 1024 pixels.
- **Image Buffer:** Select the number of images for the classification image buffer (maximum 5000 images) (default: 1000).

- Point**
- The size selected for [Image Size] is applied to the sizes of the thumbnails that are displayed in the Target Classification menu on the controller.
 - If the image memory displayed in the [Program memory] field and [Image memory] field are close to 100%, it may not be possible to increase the image buffer.
 - If a large amount of defects for an image is detected uninterruptedly, defect images may not be extracted. In this case, the image is not output and thumbnails are displayed in black.

Data Settings

Select the output settings for the results files (CSV format) in the target classification data that is output from the controller.

- **Naming Rule:** Specify the rule to use for naming files when saved.
 - **Auto** (default): The file name will be "Program No. at time target classification data is output_YYMMDD_HHMMSS.csvv".
 - **Fixed:** The file name will be "Fixed name.csv". Select the string to be used for the fixed name in the [Fixed Name] field. Use up to 64 1-byte alphanumeric characters.
- **Filename :** Displays an example of the format of the filename to save.
- **Header Row:** Select whether or not to output a header row (output item name such as "Defect No.") to the target classification data CSV file (default: Include).
- **Data Buffer:** Select the number of targets for the results data buffer (maximum 5000 targets) (default: 1000).

- Point**
- The result file is created at the time of the first trigger input after:
 - The controller is turned on.
 - The controller is reset.
 - The program No. is changed.
 - The destination folder is not available at the destination.
 - The target classification result is cleared.
 - If the program memory displayed in the [Program memory] field and [Image memory] field are close to 100%, it may not be possible to increase the data buffer.
 - When the amount of the image buffer is specified less than the amount of the result data buffer to extract images based on the result data, the image may not be extracted.
 - The maximum number of defects displayed in the Target Classification menu is the same as the number of result data archives.

Suppress Duplicates

This is used to prevent duplicate detection of targets when using a line scan camera in continuous capture mode. When multiple targets with all matching features are detected by the same inspection unit, one of them is automatically excluded (duplicate exclusion process). It is also possible to suppress duplicates if the same target is detected within a defined area of position coordinates of the first target (duplicate suppression function).

- **Suppress Duplicates:** Select whether or not to suppress duplicate detection.
 - **Disable** (default): Judgment for duplicate exclusion within the designated is not performed, and only defects with all matching features are excluded.
 - **Enable:** Judgment for duplicate exclusion within the designated is performed.
- **Area:** Specify the area for duplicate suppression in pixels (1 – 256) (default: 1).

- Point**
- Enabled only when the camera type is a line scan camera (XG-HL**M or CA-HL**MX) and continuous capture is selected.
 - If the difference in both X and Y coordinates is within the duplicate suppression area, the target is excluded as being the same target.
 - Because the defect unit and grayscale blob unit have their own target detection settings, some deviation in the detection position (center of gravity) may occur.
 - This function is disabled in Retest Mode.

Increase Y Digits

If you enable this setting, the number of integer digits for Gravity Center Y of the following result items will be expanded from 6 to 10.

- Measured value of target classification
- Conditions
- Result data during image/result output

This enables output of large Y coordinates when the Y coordinates are large due to continuously capturing images using a line scan camera or LJ-V series sensor head unit.

Additional Data

Up to three items of arbitrarily specified data can now be added to Target Classification. This function is convenient when you wish to add data that is not output with target classification such as the processing count or detected defect level.

Specify the data that should be shown in Target Classification in items 1 through 3 of the displayed [Additional Data] screen.

The data that can be specified is three items from the result mnemonics, system variables, local variables, and global variables (single, scalar variables only).



- When multiple defects are detected during a single flow process or the content of the data is a single result, the same data is displayed several times for the number of detected defects there are.
- The result mnemonics or variables set to the Additional Data can be searched. To search, first check [Target Classification Settings] under the Search Range for the search conditions and then search (only when the target is [Variables / Setting Parameters / Result Data]).

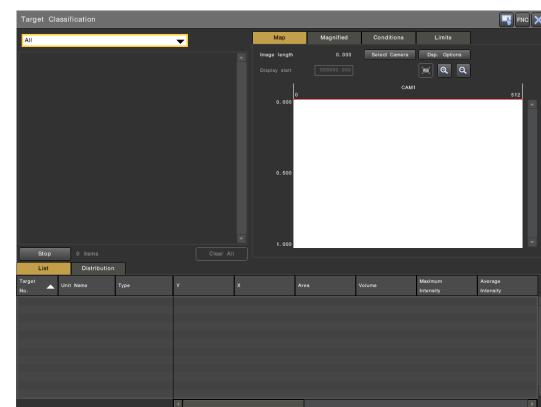
3 Select [OK].

Setting Target Classification Conditions

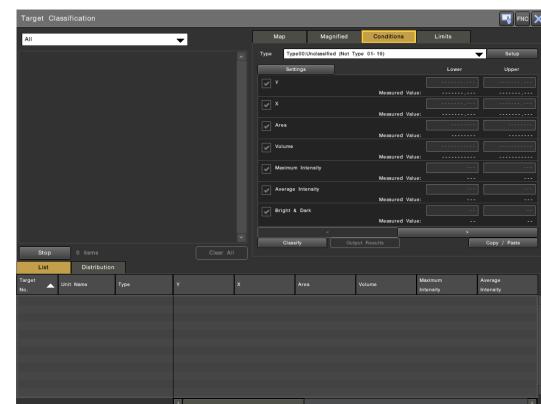
A maximum of 20 target classification conditions can be set. Multiple target classifications conditions are stored independently in the controller. If target classification conditions overlap, the defect data is managed so that priority is given to lower-numbered classification conditions, beginning from No. 01.

1 Select [Target Classification] on the [Utilities] screen (Page 5-2).

The [Target Classification] menu appears.



2 Select [Conditions].



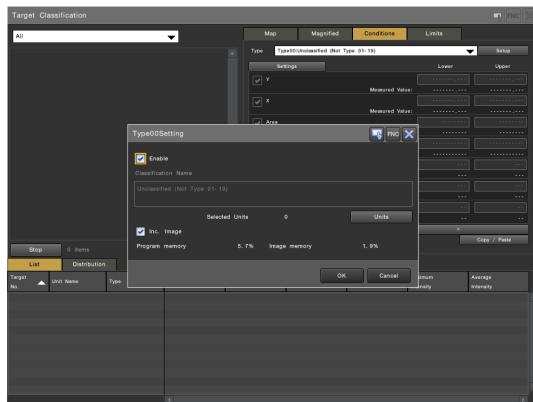
The tab can be changed by holding down the No. 1 (FUNCTION) button on the controller while pressing the 8-way key up/down/left/right. This makes it possible to select targets from the classification conditions with fewer operations.

3 In the [Type] field, select the classification type to edit and then select [Setup].

A confirmation screen appears.

4 Select [Edit].

The Type Setting menu appears.

**5 Change the settings as required.****Enable**

Check this box to enable target classification.

Classification Name

Use this function to assign or edit the classification name.

Reference The language can be selected using the tag characters in the classification name (<J>: Japanese, <E>: English, <T>: Traditional Chinese, <C>: Simplified Chinese, and <G>: German).

Point The name of type No. 00 cannot be changed.

Selected Units

Select [Units] to display the [Unit Selection] menu and select the unit(s) for target classification.

Point When the unit in a loop is selected as the target unit, the remaining data in the defect category is the result of the last execution. However, if the condition is satisfied in a loop ever once, the value of %ClsJg* will be 1.

Inc. Image

Check this box to extract the part of the current image which matches the conditions during classification.

Point When the [Inc. Image] box is unchecked, it is possible to set so that image extraction is not performed for individual type Nos.. In this case the thumbnail display on the controller Target Classification menu shows a black image.

6 Select [OK].

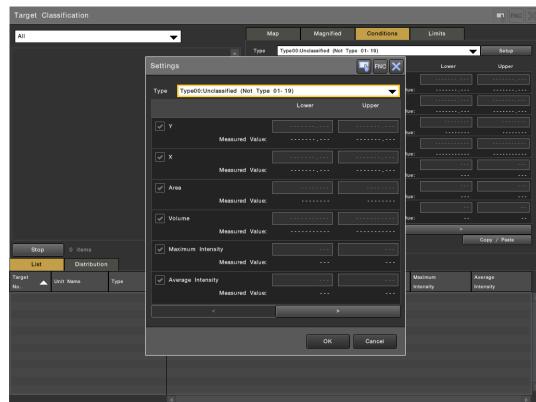
The screen returns to the Target Classification menu.

7 Select [Settings].

A confirmation screen appears.

8 Select [OK].

The Target Classification Settings menu appears.

**9 In the [Type] field, select the type to edit the conditions for.****10 Check the box of the feature to use for the classification condition, then set the upper and lower limit values.**

Measurement results which are contained between the upper and lower limit values are subject to target classification.

Reference When target classification is stopped, selecting a target classification image and then displaying the Settings menu will conveniently display the maximum value and minimum value for the selected image as measurement values.

Point If target classification conditions overlap, the defect data is managed so that priority is given to lower-numbered classification conditions, beginning from No. 01.

11 Select [OK].**Repeating classification and output after the target classification conditions are changed**

Select [Conditions] on the Target Classification menu, then select [Classify].

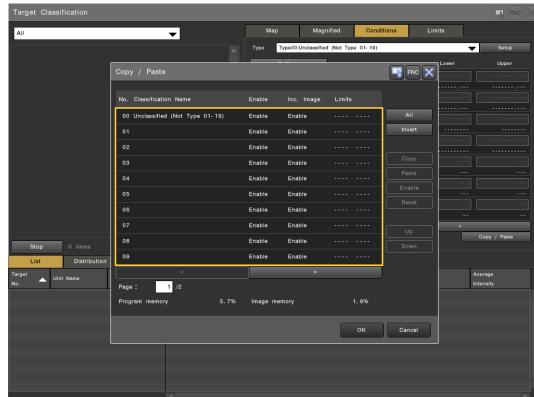
The images saved in the controller are reclassified using the current classification conditions.

- Point**
- After reclassification, selecting [Output Results] will repeat output of the images and results (only in Run Mode).
 - If [None] is selected for the [Destination] in [Target Classification Settings], [Output Results] cannot be executed.

Copying type classification conditions and changing the type order

Select [Copy/Paste] from [Conditions] on the [Target Classification] menu.

The [Copy/Paste] menu appears, and the target classification conditions can be copied or their order can be changed.



- All:** Select all the type classification conditions.
- Invert:** Invert the current selection status of classification conditions.
- Copy:** Copy the currently selected type classification condition.
- Paste:** Paste the copied type classification condition.
- Enable/Disable:** Enable/disable the selected type.
- Reset:** Resets the setting of the selected type classification condition.
- Up:** Move the selected type up.
- Down:** Move the selected type down.

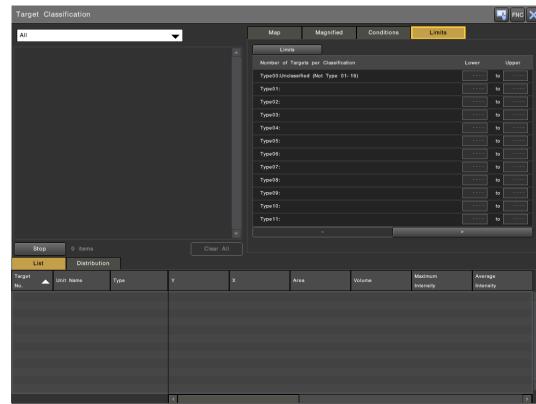
Point

- If multiple nonconsecutive Nos. are selected, movement is not possible.
- When multiple Nos. are selected, [Copy] cannot be executed.
- No. 00 cannot be moved.
- For Nos. 01 – 19, targets are classified with higher priority given to lower numbers.

Executing judgment with the number of classifications per measurement

A judgment process can be carried out using the number of classifications of each type in a single measurement.

1 From the Target Classification menu select [Limits].

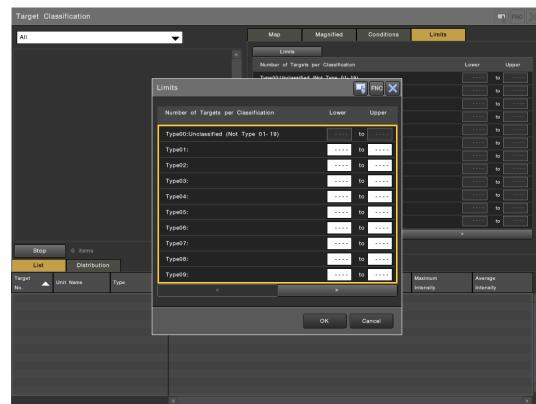


2 Select [Limits] to perform the judgment process using the number of targets of each type in a single measurement.

A confirmation screen appears.

3 Select [OK].

The Limits menu appears.



4 Set the [Upper] and [Lower] limit for each type.

If the set upper/lower limit range is exceeded, the value in %ClsJg01 to %ClsJg19 which corresponds to for that type No. (01 to 19) changes to "1".

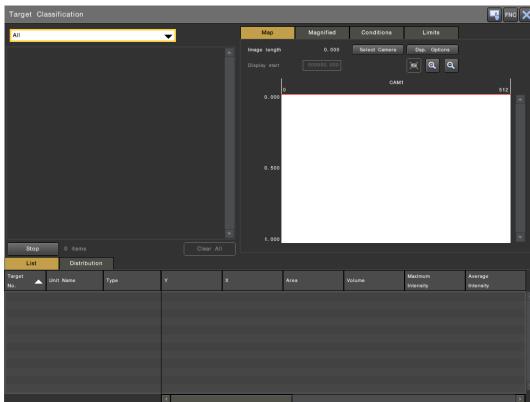
Point

- The judgment value here is not applied to %JgAll and %JAHold.
- Upper and lower limits cannot be set for type No. 00.B

Viewing Classification Results

1 Select [Target Classification] on the [Utilities] screen (Page 5-2).

The [Target Classification] menu appears.



- Select a type from the list at the top left of the screen to display only the selected type.
- The extracted images of the size that was set for [Target Classification Settings] are displayed at the top left of the screen.
- The target No. of the selected image is displayed in blue. (Multiple images can be selected only when classification is stopped.)
- Output On/Off:** Stop or resume output (only in Run Mode).
- Stop/Update:** Stop and resume/update target classification.
- Items:** Displays the number of targets (images) currently selected.
- Clear All:** Deselects all selections.

- Reference**
- The target focus is linked to the thumbnail, list, and map. The focus can be changed in each of these windows.
 - The Defect No. is assigned in ascending order according to unit ID of the unit that is selected in the type setting of classification criteria and in order of label that is detected for each unit.

2 To exit viewing of the classification results, press the No. 2 (ESCAPE) button.

Displaying details of the selected type

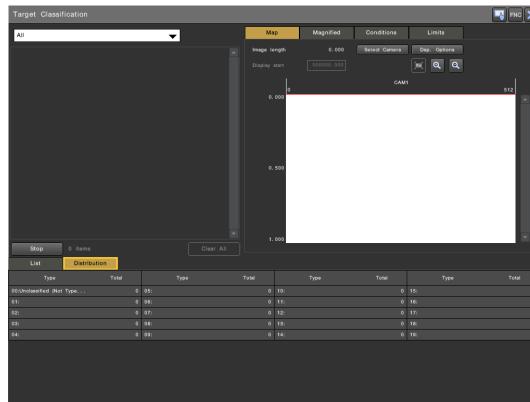
From the Target Classification menu select [List].

When classification is stopped, it is possible to change the displayed order of the selected features.

- Reference**
- The target focus is linked to the thumbnail, list, and map. The focus can be changed in each of these windows.

Displaying the total quantity of the selected type

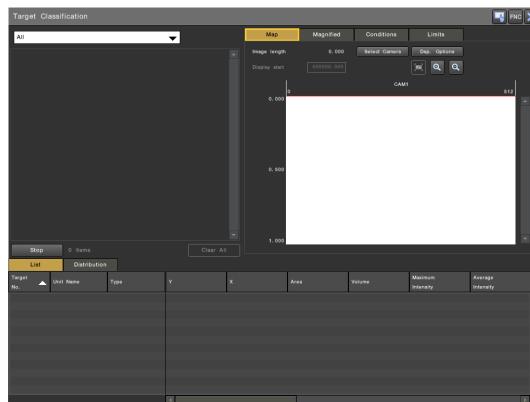
From the Target Classification menu select [Distribution].



The displayed quantity is linked to %CIsNum.

Checking the type data distribution in the map display

From the Target Classification menu select [Map].



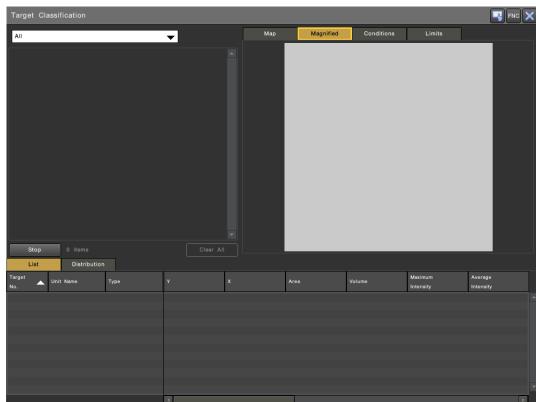
It is possible to select a marker on the map.

- Image length:** Displays the image size for each measurement. (In the case of a line scan camera (continuous capture), displays the cumulative image capture position with the encoder value applied.)
- Display start:** Specify the Y coordinate position displayed as the map origin.
- Zoom:** Automatically selects a display zoom ratio so that the entire map fits in the map display.
- Zoom In:** Zooms in on the map.
- Zoom Out:** Zooms out from the map.
- Select Camera:** Display the Select Camera menu and select the camera No. to display in the map (default: Camera 1 Only).
- Display Options:** Enters the Display Options menu. The shape & color of the detected targets shown on the map display can be changes for each classification type.
- Reference**

 - When a touch panel is used, a marker can also be selected by directly tapping the screen.
 - The target focus is linked to the thumbnail, list, and map. The focus can be changed in each of these windows.

Checking a magnified image of the defect

Select [Magnified] at the top of the Target Classification menu to display a magnified image of the selected thumbnail image.



Changing the Login User (Change Login User)

This function enables a different user to be able to log into the system and operate the controller.

What is a User Account?

A user account belongs to a user which has a defined set of privileges for operating the controller. Depending on which account is logged in different items can be used or displayed based on the user group (UG0 through 4) that account belongs to.

Logging in with a different user account and password changes the user group and allows different control over the information displayed and available options. Handheld controller actions can also be recorded for different users using the system for traceability purposes. Refer to "Logging Handheld Controller Operations (Modification Log (Start/Stop))" (Page 5-42).

Reference Only through the System Settings in XG-X VisionEditor or via external commands can user accounts and groups be added, edited or deleted. For more details on how to setup accounts, refer to "Controller System Settings" in the XG-X VisionEditor Reference Manual.

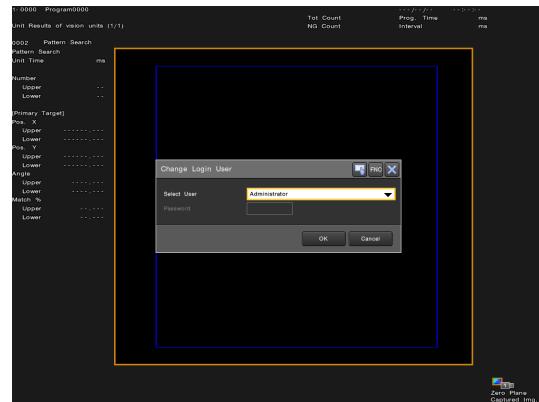
Changing the Login User

Point User accounts cannot be changed in the Setup mode.

1 Select [Change Login User] on the [Utilities] screen (Page 5-2) on Run Mode.

The [Change Login User] menu appears with the currently logged in user account displayed.

Reference "Administrator", registered to user0, is the default logged in account.



2 From the [Select User], choose the desired user account.

Point

- If "Register personal user IDs to the user accounts" is enabled on the XG-X VisionEditor, specify the user ID.
- User accounts can be set without a password.
- If the password is lost, that account cannot be used until a new password is assigned via the XG-X VisionEditor software.

3 Select [OK].

This changes the logged in user.

Point If the controller is turned off and on again, the controller will log in to the start up user account setup through the XG-X VisionEditor software.

Logging Handheld Controller Operations

(Modification Log (Start/Stop))

Use the following procedure to start/stop the logging of controller operations made with the handheld controller and touch panel.

Utility

What is Logging?

Logging is a function which automatically records all the handheld controller and touch panel operations of the controller that are made, along with the user name and a data time stamp, in a CSV text file.

With this function modifications made by the logged in user can be traced and reviewed for traceability purposes (Page 5-41).



- Log settings can only be changed in the System Settings in the XG-X VisionEditor software. For more details on logging, refer to "Controller System Settings" in the XG-X VisionEditor Reference Manual.
- Log files are saved to the controller SD card in the "xg\lop_log" folder under the name "file creation dateYYMMDD_HHMMSS.csv" or "User-defined text.csv".
- The log file cannot be viewed on the controller. To view the logs, use a spreadsheet or text editor to open the file.
- The modification log records operations performed with the handheld controller, mouse and touch panel, as well as some operations performed in Setup mode.

Starting / Stopping the Log

To start logging

- 1 Select [Modification Log (start)] on the [Utilities] screen (Page 5-2). (If controller modification log recording is stopped)

A confirmation screen appears.

- 2 Select [OK].

Logging has started



If the menu shows [Modification Log (stopped)], logging will resume automatically when the controller is turned on if based on the settings set with the XG-X VisionEditor software.

To stop logging

- 1 Select [Modification Log (stop)] on the [Utilities] screen (Page 5-2).

A confirmation screen appears.

- 2 Select [OK].

Logging is stopped



Stopping the log from the menu only works temporarily if it is configured in the XG-X VisionEditor to start automatically when the controller is turned on.

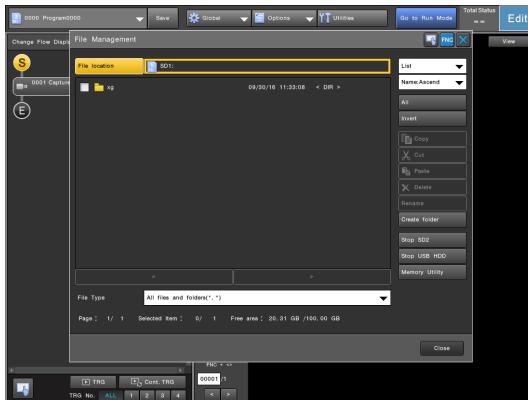
Managing the Files in the SD Cards and the USB HDD (File Management)

On the [File Management] screen, files which are saved on SD cards and USB HDDs can be managed, and SD cards and USB HDDs can be verified/initialized.

Displaying the [File Management] Screen

1 Select [File Management] on the [Utilities] screen (Page 5-2).

The [File Management] screen appears.



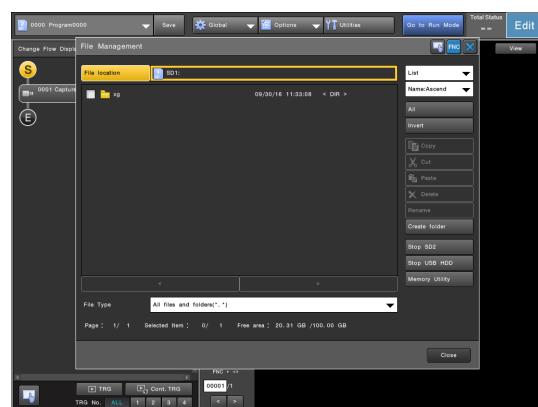
2 Select [Close] to finish managing files.

Viewing Saved Files

1 Select [File location] on the [File Management] screen.

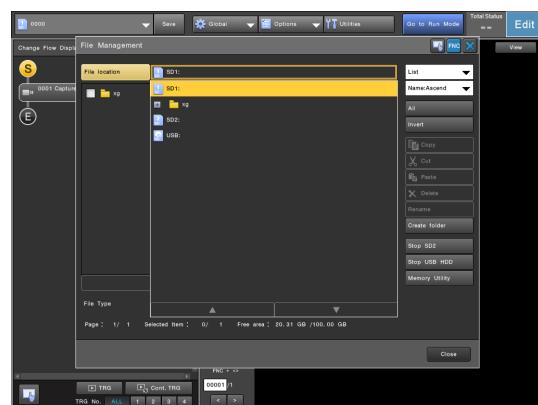
Icons are displayed as per the following for each device.

- SD card 1: SD1
- SD card 2: SD2
- USB HDD: USB



2 Select the drive or folder containing the files to view and move the 8-way key to the right.

Moving the 8-way key to the right expands the folders in the drive or folder.

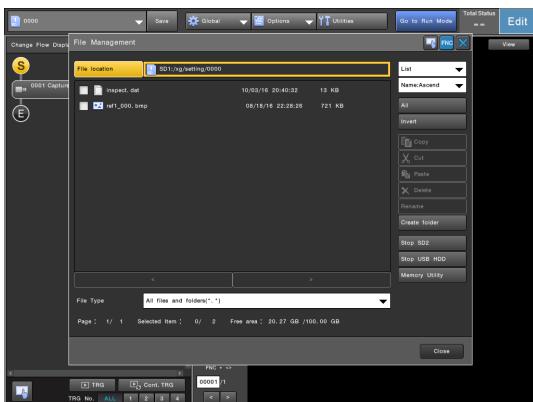


Continue moving the 8-way key to the right to open lower level folders one after another.

Up to 1,024 items can be displayed in the [File Management] screen.

3 To view files within folders or to check a list of files / folders, highlight the desired folder and press the No. 0 (ENTER) button.

A list of files or folders inside the folder is displayed.



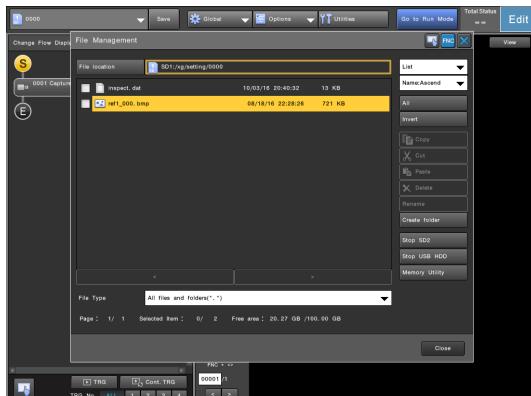
Utility

Switching display methods

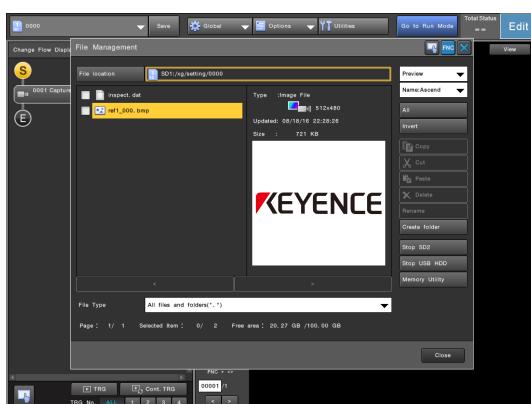
The File Management menu display can be switched between a list and a preview display.

To switch the display method, select the desired method from the menu on the right side of the [File Management] menu.

List



Preview



- The preview display will only show 24-bit color or 8-bit grayscale BMP or JPEG images of a resolution that is supported by the system's camera.
- For an image with a size that cannot be loaded with the camera size assigned for image acquisition, a partial preview is displayed.
- Progressive JPEG images cannot be displayed.

Display order

The order for displaying files and folders can be switched between ascending and descending based on file name, last saved, or file size.

To change the display order, select the desired display order from the menu on the right side of the [File Management] screen.

Managing Folders and Files

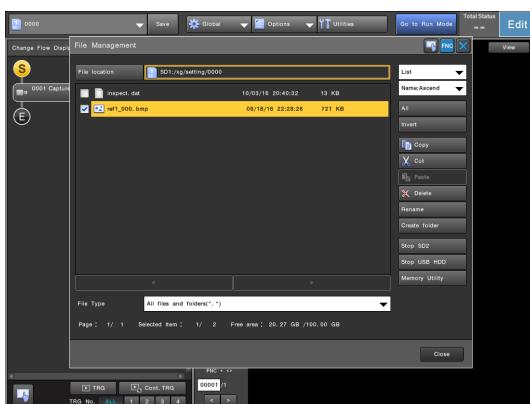
Folders and files in the SD card or USB HDD can be managed just the same as folders and files on a computer.

- Point** The controller may not be able to read saved data correctly if folders are moved or if the names of folders or files are changed.
- Reference**
- Selecting [All] puts a check mark next to all the folders and files displayed in the list.
 - Selecting [Invert] reverses the checked / unchecked state.

Copying folders and files

To replicate folders and files follow this procedure.

1 Select the folders and files to be copied by using check marks.

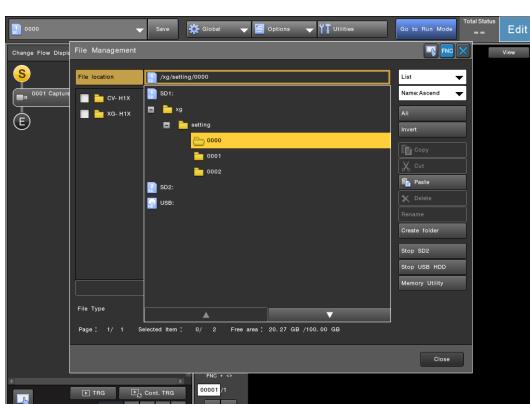


2 Select [Copy].

A confirmation screen appears.

3 Select [Close].

4 Select the folder location to save the replicated files and folders in.



5 Press the No. 0 (ENTER) button to display the destination list.

6 Select [Paste].

A confirmation screen appears.

7 Select [OK].

The selected folders and files are copied and added to the list display screen.

- Point**
- Copying may take several tens of seconds to several minutes, depending on the size of the information.
 - The controller cannot be operated while copying files.
 - Do not turn the controller off or remove the SD card and USB HDD while copying. Doing so may corrupt the data and or damage the SD card or USB HDD.

Moving folders and files

To move folders and files follow this procedure.

- 1 Select the folders and files to be moved by using check marks.**
- 2 Select [Cut].**
A confirmation screen appears.
- 3 Select [Close].**
- 4 Select the location to move the cut folders or files to.**
- 5 Press the No. 0 (ENTER) button to display the destination list.**
- 6 Select [Paste].**
A confirmation screen appears.
- 7 Select [OK].**
The selected folders and files are moved.
- 8 Select [Close].**

Deleting folders and files

 **Point** Once folders or files are deleted, they cannot be restored.

- 1 Select the folders and files to be deleted by using check marks.**
- 2 Select [Delete].**
A confirmation screen appears.
- 3 Select [OK].**
- 4 Select [Close].**

Renaming folders and files

- 1 Select a single folder or file to be renamed and place a check mark next to it.**
- 2 Select [Rename].**
The [Rename] screen appears.
- 3 Change the name of the folder or file and select [OK].**
Refer to "Entering Characters" (Page 1-12) for more details on inputting characters.
A confirmation screen appears.
- 4 Select [Close].**

Creating new folders

- 1 From the [File Location] select the location to create the folder.**
- 2 Press the No. 0 (ENTER) button to display the destination list.**
- 3 Select [Create folder].**
The [Create folder] screen appears.
- 4 Input the name of the folder and select [OK].**
Refer to "Entering Characters" (Page 1-12) for more details on inputting characters.
A confirmation screen appears.
- 5 Select [Close].**

Removing SD Card 2

Choose [Stop SD2] operation, then press the SD card in the SD2 slot inward to release and remove the card.

Point

- Take the following steps to protect the SD card and the data it contains.
- Turn off the controller when removing the SD card in the SD1 slot (SD Card 1).
- If you remove the SD card using a procedure other than that specified, or if power is turned off when the card is being accessed, any writing task will stop resulting in a possible loss of data or damage to the SD card.

1 From the [File Management] menu, select [Stop SD2].

A confirmation screen appears.

2 Select [OK].

The LED indicator turns off, indicating that SD Card 2 can now be removed.

3 Press the SD card in the SD2 slot inward to release and remove the card.

Removing the USB HDD

Remove the USB cable after executing [Stop USB HDD].

Point

- Be sure to follow the procedure to protect the USB HDD and the data it contains.
- If you remove the USB HDD using a procedure other than that specified, or if power is turned off when the USB HDD is being accessed, any writing task will stop resulting in a possible loss of data or damage to the USB HDD.

1 From the [File Management] menu, select [Stop USB HDD].

A confirmation screen will appear.

2 Select [OK].

The access lamp will go off to indicate that the USB HDD can be removed safely.

3 Remove the USB cable connecting the USB HDD.

Checking and Formatting SD Cards/USB HDD

Point

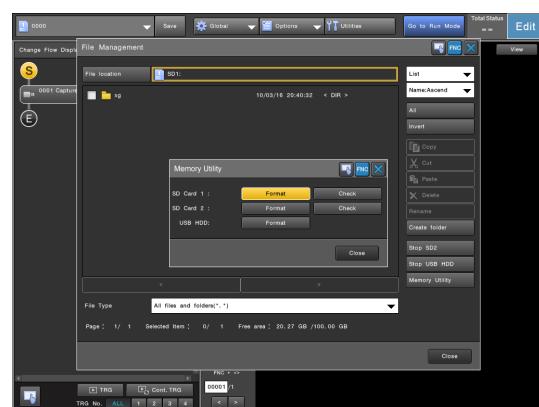
- The Memory Utility function can only be used during Setup mode.
- USB HDD check is not supported. If the USB HDD needs to be checked, connect the USB HDD to the PC and perform the necessary operations.

Checking the SD Card (Check)

If an error occurs with an SD card, it may cause additional problems such as the inability to load files or the loss of files. If these types of problems occur, the Check function can be used to resolve such errors.

1 From the [File Management] menu, select [Memory Utility].

The [Memory Utility] menu appears.



2 Choose [Check] for [SD Card 1] or [SD Card 2].

A confirmation screen appears.

3 Select [OK].

After the check is complete, the "Check is complete" confirmation message appears.

4 Select [Close].

Reference Refer to "Error Messages" (Page 9-35) when abnormal messages are displayed after the Check function has been performed.

Formatting the SD Card and USB HDD (Format)

Be sure to initialize (format) the USB HDD by means of the controller before use. The controller may not be able to correctly recognize the USB HDD in its factory default configuration and/or if it is formatted using a PC.



- Formatting erases all of the data, and data cannot be restored. Format the SD card or USB HDD after copying the data onto another SD card, USB HDD or a computer.

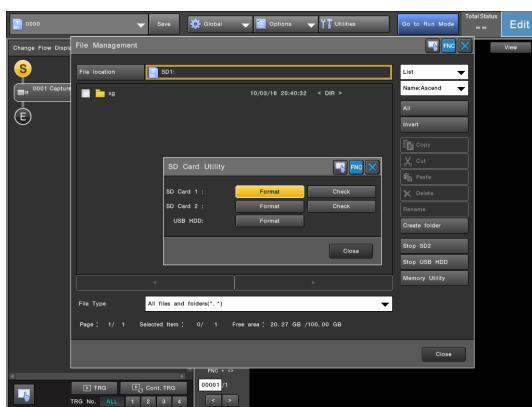
- When formatting an SD card with a PC, it is recommended that a special SD/SDHC card formatter be used.

Visit the below URL to obtain the formatter (English site, as of April 2016).

https://www.sdcard.org/downloads/formatter_4

1 From the [File Management] menu, select [Memory Utility].

The [Memory Utility] menu appears.



2 Choose [Format] for [SD Card 1], [SD Card 2] or [USB HDD].

A confirmation screen appears.

3 Select [OK].

After formatting, a confirmation screen appears.

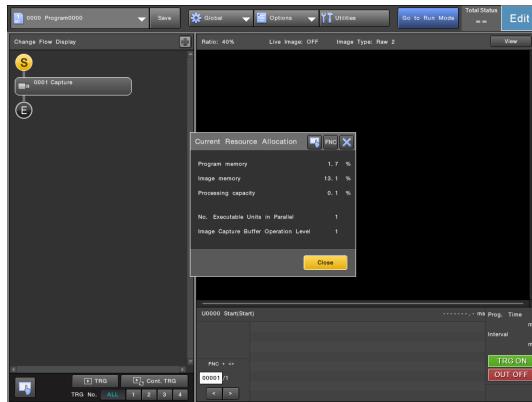
4 Select [Close].

Checking the Controller Memory Usage (Current Resource Allocation)

The usage of the program memory, image memory and work memory varies depending on the program content. The current memory usage can be checked on the [Current Resource Allocation] screen.

1 Select [Current Resource Allocation] on the [Utilities] screen (Page 5-2).

The [Current Resource Allocation] screen appears.



2 Check the status of the memory.

Program memory

This indicates the amount of memory used to retain information such as workflow settings, screen settings, variables, and so on that are necessary for the setting content and operation.

Image memory

This indicates the amount of image memory used to retain images loaded from cameras and files.

Processing capacity

This indicates the amount of processing capacity used by the DSP, which performs image processing, to retain pattern images, measurement parameters, and results.

No. Executable Units in Parallel

This indicates the number of units that can be executed in parallel if [Parallel Unit Execution] (Page 6-8) is enabled.

Image Capture Buffer Operation Level

This indicates the operation status of the image capture buffer.

- **0:** Image capture buffer settings are disabled.
- **1:** Image capture buffer settings are enabled and only one capture unit is set.
- **2:** Image capture buffer settings are enabled, multiple capture units are set, and the image capture buffer must wait for the execution of specific units, such as measurement, calculation, and so on.
- **3:** Image capture buffer settings are enabled, multiple capture units are set, and the image capture buffer does not need to wait for the execution of specific units, such as measurement, calculation, and so on (however, it must wait for other triggers within the same unit).
- **4:** Image capture buffer settings are enabled, multiple capture units are set, and the image capture buffer does not need to wait for the execution of specific units, such as measurement, calculation, and so on, and other triggers within the same unit.

3 Select [Close].

Chapter 6

Global

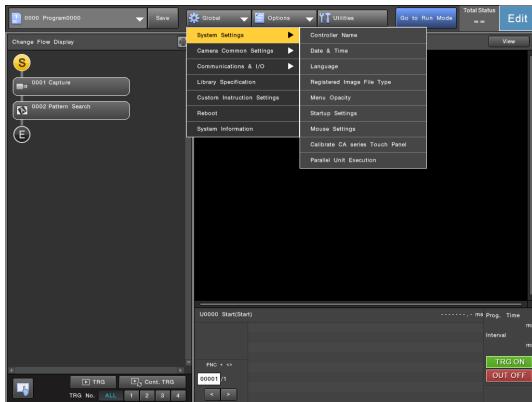
Global

Documentation for the installation and configuration methods of the controller, software, and CAD data can be downloaded from the following URL.

www.keyence.com/xgx_support

Overview of the Global menu

This section explains the functions available in the Global menu.



Global

System Settings

- Controller Name:** Assign and edit the controllers name (Page 6-4).
- Date & Time:** Set the date and time of the controllers internal clock. This function is also available on the [Function] menu in run mode (Page 6-4).
- Language:** Change the language to Japanese, English, German, traditional Chinese, and simplified Chinese (Page 6-5).
- Registered Image File Type:** Set the initial file format for registered images. Registered images are saved in this format when saved via a command from an external device (Page 6-5).
- Menu Opacity:** Choose the initial opacity when displaying menu (Page 6-6).
- Startup Settings:** Choose whether to display the flowchart at startup (Page 6-6).
- Mouse Settings:** Change the mouse pointer speed or switch the left and right mouse buttons (Page 6-7).
- Calibrate CA series Touch Panel:** Performs FOV correction for the CA series touch panel (Page 6-7).
- Parallel Unit Execution:** Choose whether to enable the parallel unit execution of DSP processing with the controller (Page 6-8).

Camera Common Settings

- Light Configuration:** When a light configuration is in use, the settings related to the illumination are configured per light (Page 6-9).
- White Balance:** If a color camera is connected, the RGB levels (white balance) can be adjusted to match the lighting environment of the target area and conditions of the connected camera. (Page 6-10).

Communications & I/O

- Terminal Block & Parallel Port:** Set the default settings for data input and output through the controller's terminals (parallel I/O connector and terminal block) (Page 6-11).
- Encoder:** Change the settings for the encoder input attached to some camera input units of the controller (Page 6-13).
- Ethernet (TCP/IP):** Set the default settings for data input/output over the controller's Ethernet port using TCP/IP (Page 6-14).
- FTP:** Set the FTP client settings (Page 6-16).
- RS-232C:** Set the default settings for RS-232 communication (Page 6-18).
- PLC-Link:** Set the default settings for data input/output over PLC-Link (Page 6-19).
- CC-Link:** Set the default settings for data input/output over CC-Link (Page 6-23).
- EtherNet/IP:** Set the default settings for data input/output over EtherNet/IP (Page 6-27).
- PROFINET:** The settings for data input/output over PROFINET can be changed (Page 6-31).
- EtherCAT:** The settings for data input/output over EtherCAT can be changed (Page 6-34).
- VNC:** Change the VNC server function settings (Page 6-37).
- VisionDatabase:** See the VisionDatabase User's Manual (only when the VisionDatabase (sold separately) function is added)
- Robot Connection Settings:** See the XG-X2000 Series User's Manual (Robot Vision Edition).
- SNTP:** Set this setting to use SNTP to automatically synchronize the controller's clock (Page 6-38).

Library Specification

Select whether to share the OCR library among all programs
(Page 6-39).

Custom Instruction Settings

Input the desired commands for execution to define custom commands for controlling the controller (Page 6-40).

Reboot

Reboot the controller.

System Information

You can check the controller name, version of programs and other files, free space on the SD card, license information, etc.
(Page 6-45)

Changing the Controller Settings (System Settings)

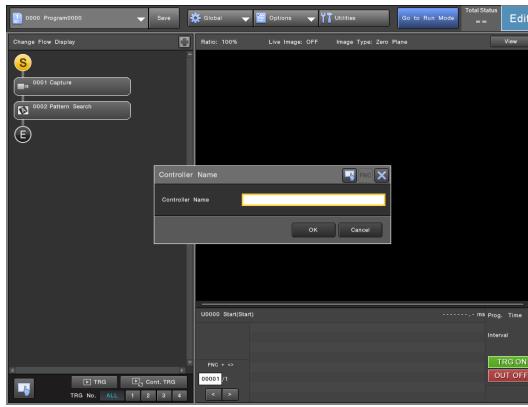
Global

Controller Name

Use this function to assign or edit a controllers name. The assigned name is displayed in the [System Information] menu (Page 6-45).

- 1 From the [Global] menu, select [System Settings] - [Controller Name].

The [Controller Name] menu appears.



- 2 Enter a name in the [Controller Name] field.

A text string of up to 32 characters can be entered for the controller name.

- 3 Select [OK].

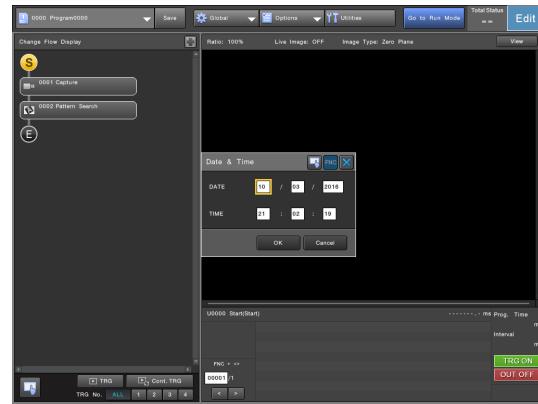
Point The following characters cannot be used in the controller name: \, |, ?, *, <, >, :, " .

Date & Time

Use the following procedure to set the controllers built in clock. The date and time information is used for time stamping purposes, such as when data is transmitted from the controller.

- 1 From the [Global] menu, select [System Settings] - [Date & Time].

The [Date & Time] menu appears.



- 2 Specify the [DATE], [TIME] respectively.

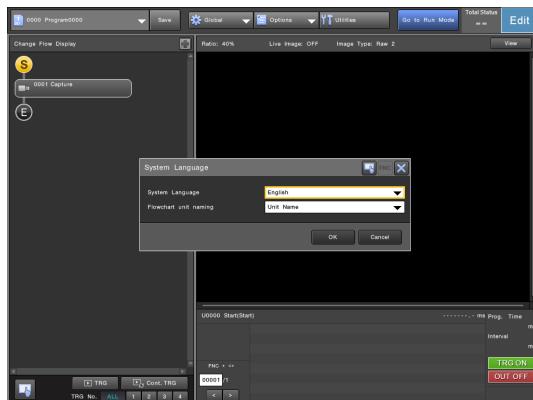
- 3 To finish settings, select [OK].

Language

The language used on the controller can be changed to Japanese, English, traditional Chinese, or simplified Chinese. The unit text on the flowchart screen can be changed to the unit type display associated with the system language.

1 From the [Global] menu, select [System Settings] - [Language].

The [System Language] menu appears.



2 Change the system language setting as required.

- Japanese:** Use Japanese.
- English** (default): Use English.
- Traditional Chinese:** Use traditional Chinese.
- Simplified Chinese:** Use simplified Chinese.
- German:** Use German.

3 Change the setting for the text that is displayed for the unit in the flowchart screen as required.

If [Unit Type] was selected, the unit type text changes according to the controller language setting.

- Unit Name** (default): Displays the text which was set for that unit.
- Unit Type**: Displays a fixed text that indicates the unit type.

4 Select [OK].



- To initiate the language change, the controller must be restarted.
- The controller does not support the display of some simplified Chinese characters.

Registered Image File Type

Use this function to set the initial file format for registered images. Registered images are saved in this format when saved via a command from an external device.

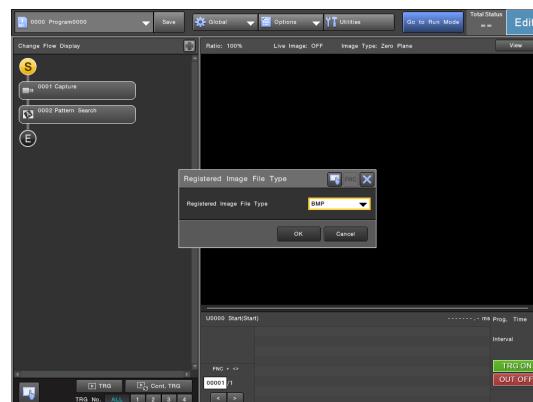


Saving the registered images in JPEG format has the following advantages and disadvantages. Select the save format that best suits the intended use.

- Advantages:**
 - The images are compressed. Smaller files mean more registered images and program Nos. can be saved on the SD card.
- Disadvantages:**
 - As the image is compressed, so the measurement results for the compressed image may differ to results from uncompressed (BMP format) images.
 - When switching program Nos., the controller takes extra time to expand compressed images. Thus it takes more time to switch program Nos. with JPEG v BMP images.
 - The compression rate varies depending on the image. Thus the image file size and max number of images that can be stored can vary.

1 From the [Global] menu, select [System Settings] - [Registered Image File Type].

The [Registered Image File Type] menu appears.



2 Change the settings as required.

- BMP** (default): Saves images in bitmap format.
- JPEG**: Saves the images in JPEG format.

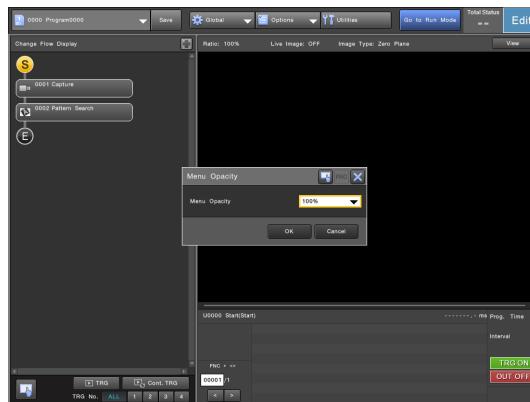
3 Select [OK].

Menu Opacity

Use this function for setting the initial opacity to use when displaying the controller's menus.

- From the [Global] menu, select [System Settings] - [Menu Opacity].

The [Menu Opacity] menu appears.



- Change the settings as required.

Select any transparency from 25% to 100% (default). Menus are opaque at 100% and gradually become transparent as the percentage decreases.

- Select [OK].

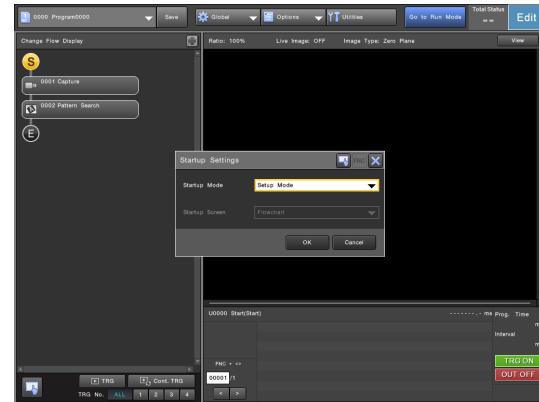
Startup Settings

Select either Setup mode or Run mode as the startup operation mode. Also, specify whether to display the flowchart during startup in Run mode.

Reference The flowchart can also be shown or hidden manually via the [Function] menu (Page 3-4).

- From the [Global] menu, select [System Settings] - [Startup Settings].

The [Startup Settings] menu appears.



- Change the [Startup Mode] as necessary.

- Setup Mode** (Default): Starts up in Setup mode.
- Run Mode**: Starts up in Run mode.

- When starting the controller in Run mode, change the [Startup Screen].

- Screen**: Displays the screen configured in the Screen Editor (Page 4-25).
- Flowchart** (Default): Displays the flowchart.

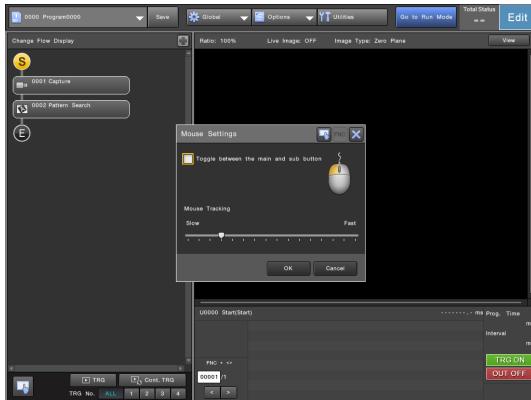
- Select [OK].

Mouse Settings

Change the mouse pointer speed or switch the left and right mouse buttons.

- From the [Global] menu, select [System Settings] - [Mouse Settings].

The [Mouse Settings] screen appears.



- Change the settings as necessary.

Toggle between the main and sub button

Check this option to switch the left and right mouse button functions (Page 1-10).

Mouse Tracking

Set the mouse pointer speed.

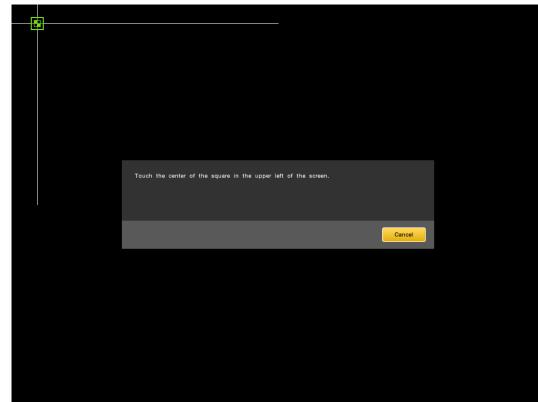
- Select [OK].

Calibrate CA series Touch Panel

When a CA Series touch panel is connected, field of view (FOV) correction can be performed so the touch panel can be operated correctly.

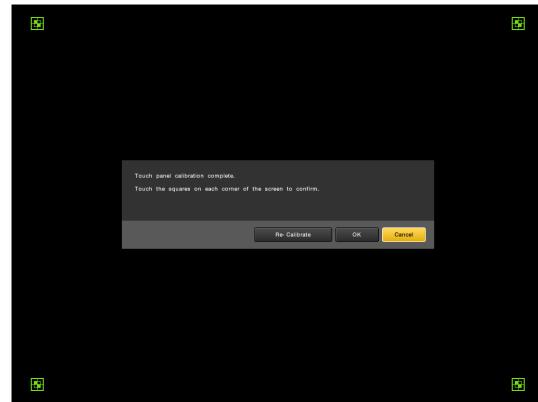
- From the [Global] menu, select [System Settings] - [Calibrate CA series Touch Panel].

- Touch the at the top left of the screen.



- Touch the at the bottom right of the screen.

- Touch the at the four corners of the screen, and verify that the touched locations were each selected correctly.



If one was not selected correctly, the at the touched location turns red.

If FOV correction is not correct, or to perform correction again

Select [Re-Calibrate] and perform correction again.

- When the settings are complete, select [OK].

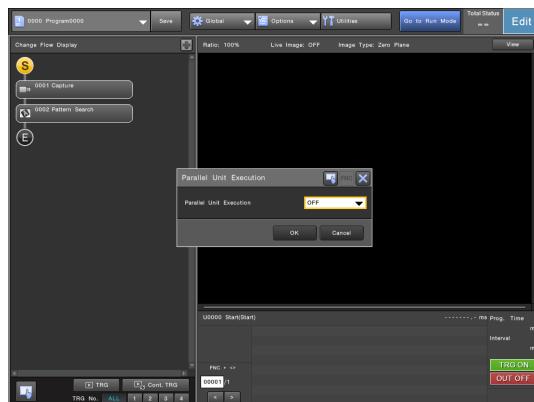
Parallel Unit Execution

Choose whether to enable parallel unit execution of DSP processing with the controller.

Reference The number of DSP cores, which perform the parallel execution, is 3 (XG-X2000/X2200/X2500) or 7 (XG-X2700 /X2800/X2800LJ/X2900).

1 From the [Global] menu, select [System Settings] - [Parallel Unit Execution].

The [Parallel Unit Execution] screen appears.



2 Change the settings as required.

- **ON:** Enables parallel unit execution to speed up the processing time of the unit, which support the parallel unit execution (applies to all programs).
- **OFF** (default): Disables parallel unit execution.

3 Select [OK].



- The following units support the parallel unit execution:
Area, Intensity, Color, Blob, Grayscale Blob, Edge Position, Edge Width, Edge Pitch, Edge Angle, Edge Pairs, Profile Position, Profile Width, Profile Defect, Defect (except for the scan direction Rad./Cir.)
- In the following cases, parallel unit execution will not be performed regardless of the setting:
 - When the program setting is for 3D cameras, LJ-V series head, line scan cameras, or 21-megapixel cameras
 - When the program setting does not include units which support the parallel unit execution
 - When almost no free space is available in the work memory
- Depending on the unit and flow setting details, parallel unit execution may not improve the processing speed. Make sure to check the improvement with the program setting to be used.

Changing the Camera Common Settings (Camera Common Settings)

Change the settings that are applicable to all the connected camera(s), such as the light configuration and white balance settings.

Lighting Configuration

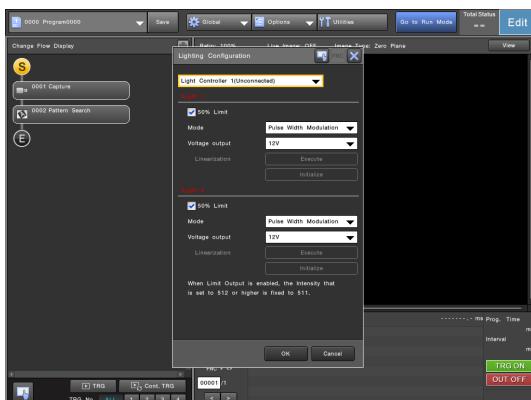
When a lighting controller CA-DC40E/DC50E/DC60E is connected to the controller, the lighting configuration can be set per light.



- The following settings cannot be used when the CA-DC50E is connected.
- Only the intensity limit can be set on the CA-DC60E.

1 From the [Global] menu, select [Camera Common Settings] - [Lighting Configuration].

The [Lighting Configuration] screen appears.



2 Select the light controller where the light to change the basic settings for is connected to.



When multiple lighting controllers are connected, they will be numbered 1 through 8, with 1 being the unit closest to the controller.

3 Change the settings as required.

Settings can be changed for each light connected to the controller.

50% Limit

Use this option to limit the light output to prevent degradation of the LED light through overheating (default: ON).



If this is set to "ON", the light intensity will be fixed at 511 even when the light intensity setting (Page 2-32) is set to 512 or higher.

Mode

Select the lighting mode.

- Pulse Width Modulation** (default): Controls and illuminates the light using PWM.
- D.C.**: Illuminates and controls the light using DC.

Voltage Output (Only When CA-DC40E is Selected)

Select either 12V (Default) or 24V for the voltage to be supplied to the lights controlled by the OUT terminal.



Make sure to set the Voltage Output for the illumination unit of the CA-DC40E light controller correctly. Connecting a 12 V DC illumination unit when the Voltage Output is set at 24 V DC may cause fire, electric shock, or damage to the light and light controller.



When 24V is selected, the voltage is only output from the OUT connector terminal block of the CA-DC40E. The voltage will not be output from the light 1 and light 2 connector.

Linearization (If [Mode] is set to [D.C.])

- Execute**: Adjusts the output automatically according to the characteristics of the light such that the volume and lighting brightness change linearly.
- Initialize**: Initializes the adjustment data for light intensity linearization to the factory default state.



This operation is usually not required as you can readjust the linearization simply by performing the linearizing the light intensity again.

4 When the settings are complete, select [OK].

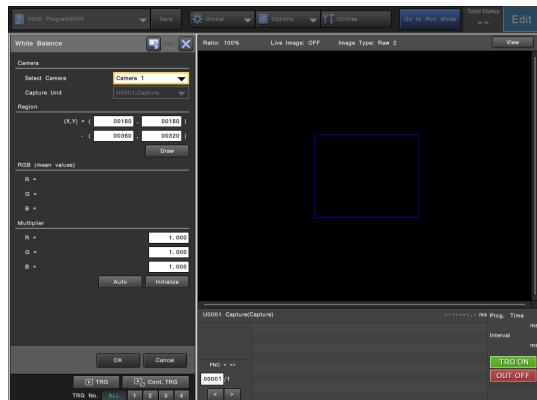
White Balance

If a color camera is connected, the RGB levels (white balance) can be adjusted to match the lighting environment of the target area. Perform such adjustment when installing a new system or when changing cameras or lighting.

- ! Point
 - The color extraction result may change due to changes in the white balance setting. Be sure to verify the operation after changing the white balance setting.
 - Any unsaved settings, results and archive data will be cleared (Page 5-4) when changing the white balance.
 - In Run mode, this setting only affects capture units that have the use system settings option enabled.

1 From the [Global] menu, select [Camera Common Settings] - [White Balance].

The [White Balance] screen appears.



2 Select the camera to be adjusted.

! Reference Individual camera settings (such as shutter speed), for making adjustments can be set in the Capture unit.

3 Specify the reference area for adjusting the white balance.

Enter a numerical value or select [Draw] to specify the area.

! Point The monochrome camera cannot be set when the camera numbers which are to be connected are selected.

4 Place a white piece of paper (or other white target) in the area specified in step 3, and then press the No. 3 (TRIGGER) button on the handheld controller, or press [TRG] on the screen.

The average color values (R, G, B values) are displayed in the [RGB (mean values)] field.

5 Adjust the screen brightness so that the average RGB values are each within the range of 100 to 200.

If the Trigger button (Button No. 3) is held down for 3 seconds, the controller will continuously update the image. When the image is updated continuously, the R, G, and B values will also update continuously.

6 Select [Auto].

The multipliers are calculated automatically so that the white color is within the standard range (in the same way as the RGB values).

! Reference The RGB multiplier can also be specified within the range of 0.000 to 5.000.

7 When the settings are complete, select [OK].

To reset the multiplier

Select [Initialize] to return all multipliers to [1.000].

Changing the Terminal Input / Output Settings

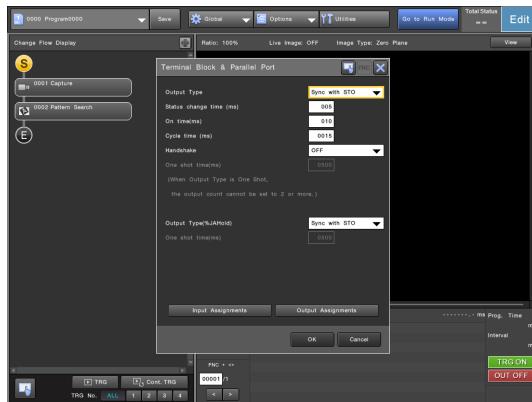
(Terminal Block & Parallel Port)

Settings for controlling the input and output of data through the controllers terminals (parallel and terminal block) can be changed. For more information about input/output with external devices, see the XG-X2000 Series Communications Control Manual.

1 From the [Global] menu, select [Communications & I/O] - [Terminal Block & Parallel Port].

The [Terminal Block & Parallel Port] screen appears.

2 Change the settings as required.



Output Type

Output from the parallel terminal output unit can be selected from [Sync with STO] or [One shot] (Default: [Sync with STO]).

Status change time (ms)

Set the length of time from when the data is ready for output to the leading edge of %Sto within the range 1 to 999 (ms). (Default: 5 ms)

On time (ms)

Set the time from the leading edge of %Sto to the trailing edge of %Sto within the range 1 to 999 (ms). (Default: 10 ms)



- This setting is used in common with the output on time for %Ack and %Nack.
- Only when [Handshake: ON] is selected, 0 ms can be set. When 0 ms is set, the timeout function of handshaking is cancelled. The duration of %Ack and %Nack is changed simultaneously when the cycle time is reached.

Cycle time (ms)

Set the time between two consecutive leading edges of %Sto within the range 2 to 1000 (ms). (Default: 15 ms)



- When the [On time (ms)] is set to 0 ms, set [Cycle time (ms)] from 1 to 1000 ms.

Handshake

Select [OFF] (default) or [ON] to perform handshaking for parallel terminal input and output.

One shot time (ms)

[One shot time (ms)] can be set from 1 to 9999 ms (Default: 500 ms). It is only enabled when the [Output Type] is set to [One shot].



- [One shot] cannot be selected as the [Output Type] when [Output Type (%JAHold)] is set to [Sync with STO].

Output Type (%JAHold)

Select the method used to control the behavior of %JAHold.

- Latching:** Latches the output when a NG result occurs. (To unlatch, either reset the program, change the program, or turn the outputs off.)
- Sync with STO** (default): Turns the output ON/OFF in synchronization with the %Sto output (Page 2-447).
- One shot:** Turn the output on for the time specified in [One shot time (ms)] and turn off immediately after.



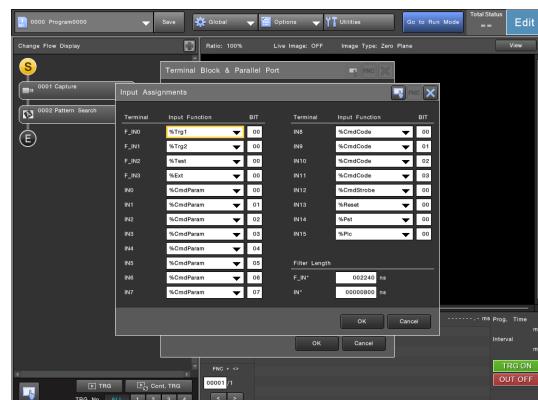
- Even if [Sync with STO] is selected, %Sto will not be output unless at least one parallel terminal output unit is executed in the flowchart.
- A parallel terminal output unit must be executed to synchronize the output of %JAHold with %Sto. The parallel terminal output unit does not have to contain output data if there is no data to output via the parallel port.

One shot time (ms)

Set the [One shot time] within the range of 1 to 9999 (ms) (default: 500 ms). This is only valid if the [Output Type (%JAHold)] is set to [One shot].

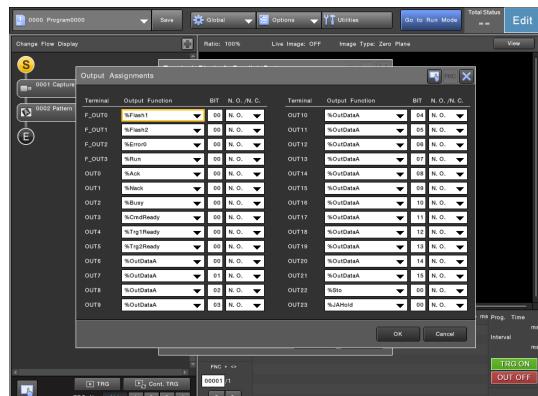
Input Assignments

Review/edit input assignments. A filter length can also be set separately for F_IN* and IN* signals.



Output Assignments

Review/edit output assignments. The signal polarity can also be selected from normally open (N.O.) or normally closed (N.C.).



3 When the settings are complete, select [OK].

- The strobe output settings can be changed by using the capture unit [External Flash Settings] menu (Page 2-33).
- For more details on the system variables that can be assigned, refer to the XG-X2000 Series Communications Control Manual.

- Redundant assignment of the same bit on the same system variable to input terminals on the parallel port, RY addresses using CC-Link, output data bit area of EtherNet/IP, PROFINET and EtherCAT is not allowed.
- The controller must be restarted if changes are made to the input assignments or output assignments.

Notes on selecting [One shot]

- You cannot use both One shot and STO synchronization at the same time with each terminal or parallel terminal output unit. If you select One shot, the [Timing] setting in [System Settings] (XG-X VisionEditor) or [Terminal block & Parallel Port] setting (Controller) in [Global] will be the common settings for all terminals and parallel terminal output units.
- If output from other parallel terminal output units overlaps during one-shot output, the output time will be extended as is.
- When enabling [Busy Signal] – [Outputting Data] in the XG-X VisionEditor and setting a busy status during output (i.e. turn %Busy ON), %Busy will turn ON only for the duration of a one-shot time (However, %Busy will not turn ON during %JAHold output).
- The [No. Items] specified in the parallel terminal output unit will only be once when One shot is selected.

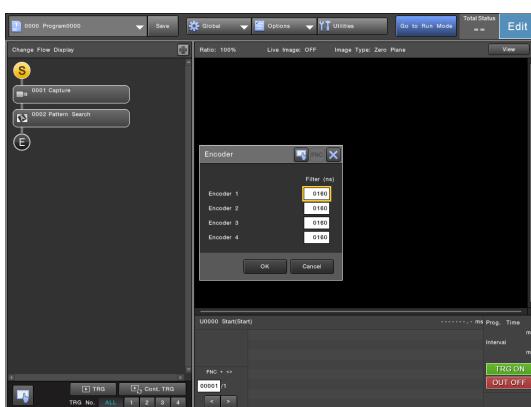
Changing the Encoder Filter Settings (Encoder)

Adjust the linkage timing between the controller and external device when the encoder is connected to the encoder input terminal of the line camera input unit and LJ-V input unit.

**1 From the [Global] menu, select [Communications & I/O]
- [Encoder].**

The [Encoder] screen appears.

2 Specify the [Filter (nsec)] for each encoder.



Point The [Filter (nsec)] is for removing noise signals from the encoder signals. Signal change in the specified time period is ignored. Unless required, it is recommended that the initial setting be left unchanged.

- Reference**
- For details on the settings when an encoder is connected, refer to the XG-X2000 Series Setup Manual.
 - For details on signal input/output with external devices, refer to the XG-X2000 Series Communications Control Manual.

3 When the settings are complete, select [OK].

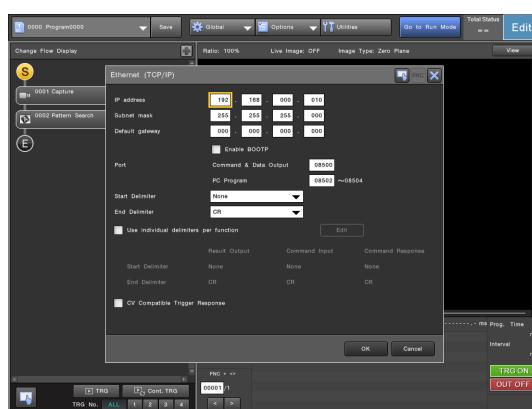
Changing the Network Settings (Ethernet (TCP/IP))

Settings for controlling the input and output of data through the Ethernet port can be changed. For more information about input/output with external devices, see the XG-X2000 Series Communications Control Manual.

1 From the [Global] menu, select [Communications & I/O] - [Ethernet (TCP/IP)].

The [Ethernet (TCP/IP)] menu appears.

2 Change the settings as required.



Point If any incorrect settings are made, not only the controller but also other equipment on the network may not work properly. Consult your system or network administrator for information on setting values.

IP address

Specify the IP address of the controller (default: 192.168.0.10).

Subnet mask

Specify a subnet mask (Default value: 255.255.255.0).

Default gateway

Specify a default gateway IP address (Default value: 0.0.0.0).

- Point**
- The IP address specified as the destination for archive data using FTP (Page 5-5) must be unique.
 - If the PLC-Link (Ethernet) is enabled, the IP address must not be the same as the IP address on the other end of the PLC link.
 - If the settings are changed, the controller must be restarted for the changes to take effect.

Enable BOOTP

If BOOTP is enabled on the network that the controller is on, the network settings can automatically be populated in the Ethernet (TCP/IP) settings. If retrieval of network settings from the BOOTP server fails, the last saved settings will be used.



- When BOOTP is being used, the settings of the IP address, sub-net mask, and default gateway cannot be changed on the [Ethernet (TCP/IP)] menu.
- If the BOOTP server is not started, the controller retries BOOTP processing for about 30 seconds at startup.
- If time-out of retry occurs or if a retry is interrupted, the system starts operation with the network setting saved in the system settings.
- BOOTP is available through:
 - IP Setting Tool by Keyence
 - BOOTP-DHCP server by Rockwell Automation
 - BootP server by WAGO

Port

Enter the port number used for data I/O on the controller.

- Command & Data Output:** Enter the port number used for non-protocol specific commands and data output. (Default: 8500).

- PC Program:** Enter the port used to communicate with PC programs (XG-X VisionEditor, XG-X VisionTerminal, and ActiveX controls). (Default: 8502). Note that PC programs use three consecutive ports from the specified number. For example, when 8710 is specified, ports 8710 to 8712 are used by PC programs; and when 10108 is specified, ports 10108 to 10110 are used.



The same port number cannot be specified for [Command & Data Output] and [PC Program] or [VNC Server Setup].

Start Delimiter

The specified delimiter is output at the head of the output data.

- **STX**: STX (=0x02) is output as the start delimiter.
- **ENQ**: ENQ (=0x05) is output as the start delimiter.
- **ASCII Code**: The desired ASCII code value is output as the start delimiter. You can use this to output STX, ETX, and other control codes.
- **None** (default): The start delimiter is not output.

End Delimiter

The specified delimiter is output at the end of the output data.

- **CR**(default): CR (=0x0D) is output as the end delimiter.
- **CR + LF**: CR (=0x0D) + LF (=0x0A) is output as the end delimiter.
- **LF**: LF (=0x0A) is output as the end delimiter.
- **ETX**: ETX (=0x03) is output as the end delimiter.
- **ASCII Code**: The desired ASCII code value is output as the end delimiter. You can use this to output STX, ETX, and other control codes.

Use individual delimiters per function

When this option is checked, for each of the result data output, command reception, and command response, the start/end delimiters can be specified for each function.

- For the controller, select [Edit] to specify a desired value.
- The values which can be specified as the start/end delimiters are the same as those which can be specified with normal [Start Delimiter] and [End Delimiter] settings.

Point When the [Use individual delimiters per function] option is checked, normal [Start Delimiter] and [End Delimiter] settings are not operated.

CV Compatible Trigger Response

Check this option to change the trigger command response to the format compatible with the CV-3000/5000 Series controller.

Point For more details on the operations in CV compatible mode, see the XG-X2000 Series Communications Control Manual.

MAC Address

MAC address of the controller is displayed (change is not allowed).

3 When the settings are complete, select [OK].

Changing the FTP Client/Server Settings (FTP)

Change the settings for outputting images and data from the controller to an external FTP server using the archive function (Page 5-3).

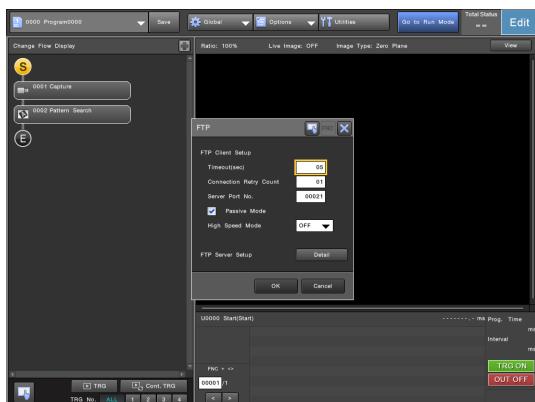


- For details on the settings for outputting archived data to an FTP server, see [Image Archive Settings] (Page 5-4) and [Target FTP Server Settings] (Page 4-23).
- If there is a firewall on the FTP server or on the network route to the FTP server, connection may fail. You need to disable the firewall or find another way to connect to the FTP server. For details, check with your network administrator or computer manufacturer.

1 From the [Global] menu, select [Communications & I/O] - [FTP].

The [FTP] menu appears.

2 Change the settings as required.



Timeout (sec)

Enter the timeout period in seconds to wait for a response from the FTP server during data output (default: 30 seconds).

Connection Retry Count

Enter the number of attempts to log in when connection to the FTP server fails (default: 1).

Server Port No.

Enter the port number of the FTP server used for control (default: 21).

Passive Mode

Check this option when using FTP in passive mode (default: ON (passive mode)).

High Speed Mode

Select whether or not to use High Speed Mode. This setting will raise the FTP output level in order to shorten output time.

- ON:** Perform FTP output in High Speed Mode.
- OFF (default):** Perform normal FTP output operations.



- When [ON] is selected, display updates and outputs other than FTP may be slower.
- To enable the change to High Speed Mode, it is necessary to restart the controller.

FTP Server Setup

When the system's FTP server functions are to be used, change the settings. For details, refer to "Using the Controller as an FTP Server (FTP Server Setup)" (Page 6-17).

3 When the settings are complete, select [OK].

Using the Controller as an FTP Server (FTP Server Setup)

The controller can function as an FTP server for enabling direct access to the SD card in the controller from an external FTP client to perform sending, receiving, and deleting of files and creating and deleting of folders.



- This function does not affect measurements.
- The FTP server function can be used simultaneously with the FTP client function.
- To access the controller from an FTP client, use the user account and password set in the global settings.
- Function limitations based on the user account (Page 5-41) are shown below.
 - Users belonging to user 0: No restrictions
 - Users belonging to user 1 to 4: File acquisition only is allowed.
- When an FTP client accesses the controller, the default folder is [/SD1/]. To access SD2, directly enter [/SD2/].
- If a file or folder name is not comprised of alphanumeric characters, accessing it may fail.
- Up to two users are allowed to access simultaneously.
- If there is a firewall on the FTP server or on the network route to the FTP server, connection may fail. You need to disable the firewall or find another way to connect to the FTP server. For details, check with your network administrator or computer manufacturer.

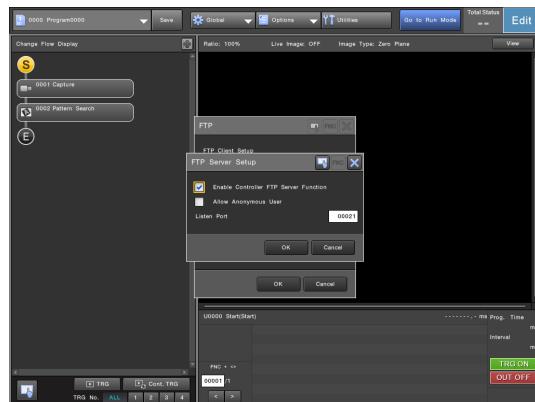
1 From the [Global] menu, select [Communications & I/O]

- [FTP].

The [FTP] menu appears.

2 Select [Details] in the [FTP Server Setup].

The [FTP Server Setup] menu appears.



3 Change the settings as required.

Enable Controller FTP Server Function

Check this option when using the controller as an FTP server (default: Enabled).



To ensure that the change to your [Enable controller FTP Server Function] setting takes effect, reboot the controller.

Allow Anonymous User

Check this option when allowing the access of anonymous users (default: disabled).



When accessed by an anonymous user, operation of controller-side files and folders and transfer of files to the controller side is not allowed (file acquisition only is allowed).

Listen Port

Enter the port number opened for FTP clients (default: 21).



To ensure that the change to your [Listen Port] setting takes effect, reboot the controller.

4 When the settings are complete, select [OK].

5 Select [OK].

Changing RS-232 Network Settings (RS-232C)

Settings for controlling the input and output of data through the RS-232 port can be changed. For the signal input/output with external devices, see the XG-X2000 Series Communications Control Manual.



- When using the PLC-Link (RS-232C), the settings for [Baud rate], [Stop Bit], [Parity Bit], [Flow Control], and Start/End delimiter are disabled.
- Data length is fixed at 8 bits.

Global

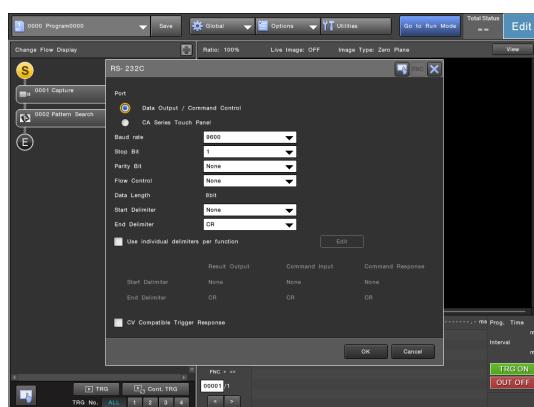
1 From the [Global] menu, select [Communications & I/O] - [RS-232C].

The [RS-232C] menu appears.



This item cannot be selected if PLC-Link (RS-232C) is enabled.

2 Change the settings as required.



Port

Select the RS-232C port function.

- Data Output/Command Control** (Default): Connects the port to the PC, PLC, robot, etc. for data output and command controls.
- Touch Panel**: Perform touch panel operations by connecting the port to the CA Series touch panel.

Baud rate

Select 9600 (default), 19200, 38400, 57600, 115200, or 230400 (bps) for the baud rate.

Stop Bit

Select [1] (default) or [2] for the stop bit.

Parity Bit

Select [None] (default), [Odd], or [Even] for the parity bit.

Flow Control

Select [None] (default) or [CTS/RTS] for the flow control.

Start Delimiter

The specified delimiter is output at the head of the output data.

- STX**: STX (=0x02) is output as the start delimiter.
- ENQ**: ENQ (=0x05) is output as the start delimiter.
- ASCII Code**: The desired ASCII code value is output as the start delimiter. You can use this to output STX, ETX, and other control codes.
- None** (default): The start delimiter is not output.

End Delimiter

The specified delimiter is output at the end of the output data.

- CR**(default): CR (=0x0D) is output as the end delimiter.
- CR + LF**: CR (=0x0D) + LF (=0x0A) is output as the end delimiter.
- LF**: LF (=0x0A) is output as the end delimiter.
- ETX**: ETX (=0x03) is output as the end delimiter.
- ASCII Code**: The desired ASCII code value is output as the end delimiter. You can use this to output STX, ETX, and other control codes.

Use individual delimiters per function

When this option is checked, for each of the result data output, command reception, and command response, the start/end delimiters can be specified for each function.

- For the controller, select [Edit] to specify a desired value.
- The values which can be specified as the start/end delimiters are the same as those which can be specified with normal [Start Delimiter] and [End Delimiter] settings.



When the [Use individual delimiters per function] option is checked, normal [Start Delimiter] and [End Delimiter] settings are not operated.

CV Compatible Trigger Response

Check this option to change the trigger command response to the format compatible with the CV-3000/5000 Series controller.



For more details on the operations in CV compatible mode, see the XG-X2000 Series Communications Control Manual.

3 When the settings are complete, select [OK].

Changing the PLC-Link Settings (PLC-Link)

Settings for controlling the input and output of data through PLC Link can be changed.

Reference For more details about PLC's compatible with the controller, refer to the XG-X2000 Series Communications Control Manual.

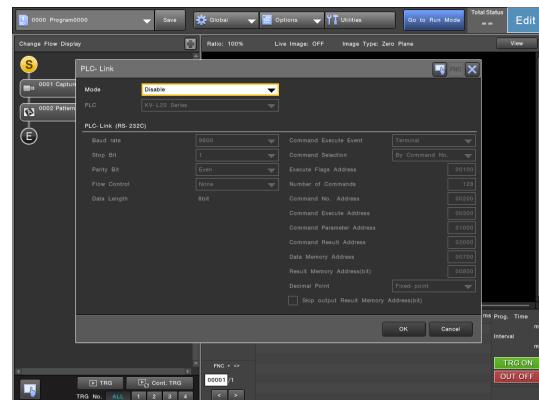
- Point**
- If [PLC-Link] is enabled, [CC-Link], [EtherNet/IP], [PROFINET] and [EtherCAT] cannot be enabled.
 - If the communication mode and PLC-Link mode settings are changed, the controller must be restarted for changes to take effect.
 - If the communication mode is changed to [PLC-Link], a message "Initializing PLC-Link *th" appears in the lower right of the screen and disappears after the connection is established.
 - If you change to run mode after establishing the [PLC-Link] communication mode, the controller will repeat the initialization process until a connection to the PLC is established. If there is no response from the connected PLC, the warning "PLC communication has failed" is displayed each time initialization is performed. If the warning continues to appear, check to see the PLC is connected correctly.

Using the PLC Link via RS-232C

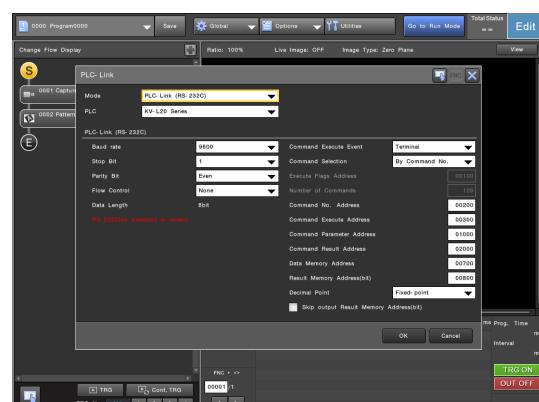
Use the following procedures when using the PLC-Link via RS-232C between the controller and PLC connected with a RS-232C link unit. For more information about data addressing, refer to the XG-X2000 Series Communications Control Manual.

1 From the [Global] menu, select [Communications & I/O] - [PLC-Link].

The [PLC-Link] menu appears.



2 Select [PLC-link (RS-232C)] in [Mode].



3 Select the Series name to be connected in [PLC].

The settings for the selected PLC type appear.

Changing the PLC-Link Settings (PLC-Link)

4 Change the settings as required.

The settings on the left side of the menu relate to the PLC link via RS-232C settings. Refer to "PLC-Link Common Settings" (Page 6-21) for details on the settings shown on the right.

Baud rate

Select 9600 (default), 19200, 38400, 57600, 115200, or 230400 (bps) for the baud rate.



- If you selected [SYSMAC C series] in [PLC], only [19200] or [9600] can be selected.
- When [MELSEC FX Series] is selected for [PLC], the available options are [38400], [19200] and [9600].
- [230400] is selected only when [KV-L20 Series], [MELSEC Q/L Series], or [SYSMAC CJ/CS1/CP1 Series] is selected for [PLC].

Stop Bit

Select [1] (default) or [2] for the stop bit.



- If you selected [KV-L20 Series] in [PLC], the stop bit is fixed to [1].

Parity Bit

Select [None], [Odd] (default), or [Even] for the parity bit.



- If you selected [KV-L20 Series] in [PLC], the parity bit is fixed to [Even].

Flow Control

Select [None] (default) or [CTS/RTS] for the flow control.



- If [MELSEC AnN Series] or [MELSEC Q/L Series] is selected for [PLC], the flow control is fixed to [CTS/RTS]. If [KV-L20 Series], [SYSMAC C Series], [SYSMAC CJ/CS1/CP1 Series], or [YASKAWA MP Series] is selected, the flow control is fixed to [None].

Data Length

Fixed at 8 bits.

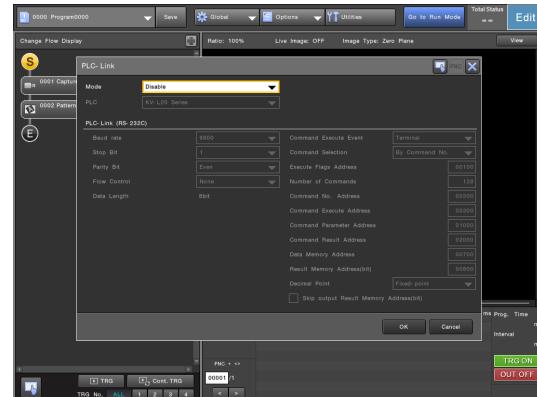
5 When the settings are complete, select [OK].

Using PLC-Link Via the Ethernet

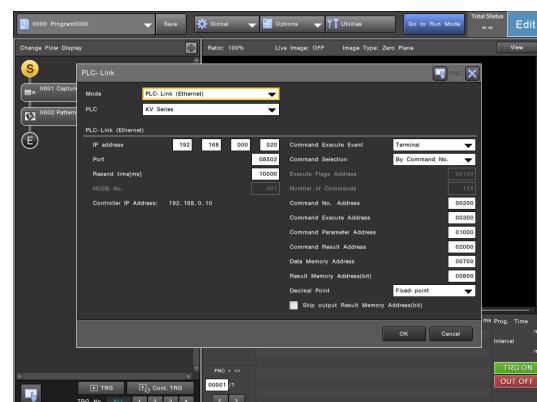
Use the following procedures when using the PLC-Link via the Ethernet between the controller and PLC connected with an Ethernet unit. For more information about data addressing, refer to the XG-X2000 Series Communications Control Manual.

1 From the [Global] menu, select [Communications & I/O] - [PLC-Link].

The [PLC-Link] menu appears.



2 Select [PLC-Link (Ethernet)] in [Mode].



3 Select the Series name to be connected in [PLC].

The settings for the selected PLC type appear.

4 Change the settings as required.

The settings on the left side of the menu relate to the PLC link via RS-232 settings. Refer to "PLC-Link Common Settings" (Page 6-21) for details on the settings shown on the right.

IP address

Enter the IP address for the unit that the controller is communicating with (default: 192.168.0.20).



Point The IP address must be different from the controller's IP address.

Port

Enter the port number of the port using the PLC-Link (default: 8502 for the KV-LE20 Series, 5000 for the MELSEC Q/L Series, and 9600 for the SYSMAC CJ/CS1/CP1 Series, and 1024 for the YASKAWA MP Series).



Point Changing the [PLC] returns the values to their initial settings.

Resend time (ms)

Enter the [Resend Time (ms)] for use if a communication error occurs (default: 10000 ms).

NODE No.

Specify the node number (available only when [SYSMAC CJ/CS1/CP1 Series] is selected).

Controller IP Address

Shows the IP address of the controller.

5 When the settings are complete, select [OK].

PLC-Link Common Settings

Common settings for the PLC-link

PLC-Link settings regardless of communication type.

Command Execute Event

Choose the method used for executing commands sent via PLC-Link.

- **Terminal** (default): Execute commands on the leading edge of the terminal assigned as the PLC terminal.
- **Polling**: Execute commands when the value in a data memory designated as the control address changes from 0 to 1.



- Point**
- Only custom commands can be executed using the PLC-Link.
 - Depending on the communication quality, [Polling] may result in slower command execution when compared to using [Terminal].



- Reference**
- For details on custom commands that can be used via PLC-Link, refer to the XG-X2000 Series Communications Control Manual.
 - For details on custom commands defined by default, see "List of Custom Instructions" (Page 6-42).

Command Selection

Select the method used to specify commands sent via PLC-Link.

- **By Command No.** (default): Commands are specified by using the custom command number in the data memory designated as the [Command No. Address].
- **By Execute Flags**: Commands are specified by using "1"s in data memory words that correspond to the custom command to be executed. This data memory begins at the [Execute Flags Address].

Specifying commands (By Execute Flags)

Execute Flags Address

Specify the starting address (default: 00100) of the data memory used for specifying commands individually.

- This function uses the number of data memory addresses is specified in the [Number of Commands] field (1 word per command, max 128 words).
- In addition to specifying individual commands to execute and verifying command results, this address is also used to execute commands by polling.



- Point**
- Custom commands are always specified from a 0-based address. Non 0-based addresses cannot be used.
 - If a "1" is entered in two or more data memory words at the same time, only the command from the smaller address will be executed.

Number of Commands

Specify the number of data memory words (commands) used when executing commands by flags. (0 to 128, default: 128)

-  **Point** Response time for executing commands using the polling method can be improved by specifying the smallest number required.

Specifying commands (By Command No.)

Command No. Address

Specify the address (default: 00200) of the data memory used for custom command numbers.

- Use 1 word addresses.
- The command is executed by entering the number of the custom command (0 to 127).

Command Execute Address

Specify the address (default: 00300) of the data memory word used for executing commands that are entered by their command number. This address is used to verify command results (0: Success, Error Code: Fail), and for executing commands using the polling method (1: execute). The function uses 1 word addresses.

Common settings for commands

Command Parameter Address

Specify the starting address (default: 01000) of the data memory used for command parameters (*01 to *16).

- This function uses 2 words of addresses for each parameter from the data address (max 32 words for 16 parameters).
- Enter values for the parameters defined in commands and specify the command parameters for execution.

-  **Point** For commands that use text string parameters, the parser will read 2 words per character (1 byte) from the designated parameter data address (terminate strings with a "0" or "NULL").

Command Result Address

Specify the starting address (default: 02000) of the data memory used for storing data from commands that return results.

- This function uses 2 words per data item (or 2 words per character (1 byte) if the command returns text strings).
- The actual range of data memory used to receive command results depends on how the command is defined.

Specifying result data output

Data Memory Address

Specify the starting address (default: 00700) of the data memory used for storing data from data output units.

- This function uses 2 words per data item (or 2 words per character (1 byte) if the command returns text strings).
- The range of data memories required for storing data depends on the settings in the [Item] tab of the data output unit (Page 2-449).

Result Memory Address (bit)

Specify the address (default: 00800) of the data memory used for confirming the data has been output.

- The specification uses 1 word addresses.
- A "1" will be written if the result output for one data output unit completes normally.
- The location in the data memory where the result output completion status is written depends on the settings in the [Item] tab of the data output unit (Page 2-449).

Decimal Point

Choose the method for handling numbers from output units, parameters used with MW/MR/MS/MWX/MRX/MXS commands, and for command data and results.

- **Fixed-point** (default): Process the number by multiplying it by 1000 and storing it as 32 bits of signed integer data in the data memory (address m: lower 16 bits, address m+1: upper 16 bits).
- **Floating-point**: Processes the number as single-precision floating point data (32 bits) in the data memory.

Skip output Result Memory Adress (bit)

When the box is checked and the function enabled, writing to the Result Memory Address (bit) is not performed (default: disabled).

-  **Point** When this setting is enabled, the communication time for writing the Result Memory Address signal can be reduced. However, it is necessary to pay attention to the data reception timing control at the PLC side.

Changing the CC-Link Settings (cc-Link)

Use the following procedures to setup and communicate with the optional CC-Link module CA-NCL20E. For more details about synchronizing CC-Link variables, refer to the XG-X2000 Series Communications Control Manual.

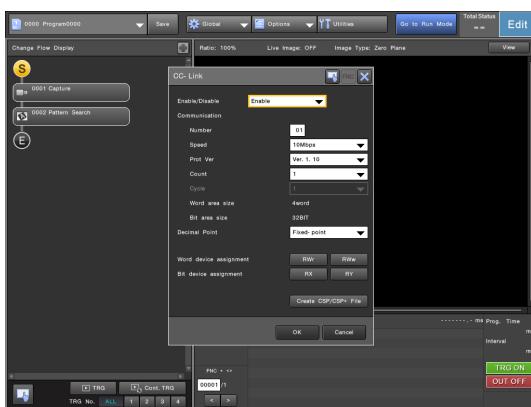
Point

- If any settings other than the [Decimal Point] settings are changed, the controller must be restarted for changes to take effect.
- After restarting with the CC-Link set to [Enable], the controller will repeat the initialization process until a connection to the CC-Link unit is established. If there is no response from the connected CC-Link unit, the confirmation menu "CC-Link communication has failed" is displayed each time initialization fails.

1 From the [Global] menu, select [Communications & I/O] - [CC-Link].

The [CC-Link] menu appears.

2 Specify [Enable] in the [Enable/Disable] field.



Point

- CC-Link cannot be used if PLC-Link (Page 6-19), EtherNet/IP (Page 6-27), PROFINET (Page 6-31) or EtherCAT (Page 6-34) is enabled.
- If the input terminal assignment and coinciding system variable/bit is set to RY, the [OK] button will remain disabled, preventing changes to be confirmed, even when choosing [Enable] selecting [Enable]. Change the input assignment or coinciding RY setting, then choose [Enable].

3 Change the settings as required.

Number

Select station number (1 to 64) of the CC-Link on the controller (Default: 1). With the CC-Link, up to 64 stations can be connected to one master station (fixed to 0). The controller has exclusive use of the number of stations set in [Count] starting from the number set in [Number]. For example, if [Number] is set to 10 and [Count] is set to 4 stations, the controller will have exclusive use of station numbers 10, 11, 12, and 13.

Point

- Set the station numbers so that the same number is not used on multiple devices.

Speed

Select 156 Kbps, 625 Kbps, 2.5 Mbps, 5 Mbps, or 10 Mbps (default) for the communication speed.

Point

- The speed should be set to the same setting as the master station.
- The maximum transmission distance changes depending on the selected speed. Refer to the XG-X2000 Series Communications Control Manual for more details.

Prot Ver

Select the CC-Link protocol version.

- Ver.1.10** (default): Communication with Ver.1.10.
- Ver.2.00**: Communication with version 2.00. This can only be used when the master station is compatible to Ver. 2.00. Using version 2.00 means the cyclic settings can be configured.

Point

Lowering the protocol version from Ver. 2.00 to Ver. 1.10 will disable any previously set word device assignments.

Count

Set the number of stations (1 to 4) reserved by the controller (default: 1). Increasing the number of stations increases the amount of data that can be transferred.

Cycle

If [Ver. 2.00] is selected for [Prot Ver], set the number of cycles (1 to 8) in the cycle settings (default: 1).

Increasing the number of cycles increases the amount of data that can be sent or received with the same number of stations.

Point

- Increasing the number of multiples slows down the response time.
- Reducing the number of stations may disable the previously configured word and bit device assignment settings and prevent output. After changing the number of stations and cycles, check the assignment status display to see if the necessary inputs and outputs are enabled.
- The number of data points allocated by setting the number of stations and cycles includes the data range used by the system. The actual number of data points available to the user are listed below.
- The word device uses two words for each item, excluding the Command Result and Command Number items.

Changing the CC-Link Settings (CC-Link)

Cycle: 1x

Data type	Word device		Bit device	
	RWr	RWw	RX	RY
1 exclusive stations	4	4	11	12
2 exclusive stations	8	8	43	44
3 exclusive stations	12	12	75	76
4 exclusive stations	16	16	107	108

Cycle: 2x

Data type	Word device		Bit device	
	RWr	RWw	RX	RY
1 exclusive stations	8	8	11	12
2 exclusive stations	16	16	75	76
3 exclusive stations	24	24	139	140
4 exclusive stations	32	32	203	204

Cycle: 4x

Data type	Word device		Bit device	
	RWr	RWw	RX	RY
1 exclusive stations	16	16	43	44
2 exclusive stations	32	32	171	172
3 exclusive stations	48	48	299	300
4 exclusive stations	64	64	427	428

Cycle: 8x

Data type	Word device		Bit device	
	RWr	RWw	RX	RY
1 exclusive stations	32	32	107	108
2 exclusive stations	64	64	363	364
3 exclusive stations	96	96	619	620
4 exclusive stations	128	128	875	876

4 Change the [Decimal Point] settings as required.

Choose the appropriate data expression method for each command parameter MW/MR/MS/MWX/MRX/MSX, commands data output, and result data output for the word device input and output.

- Fixed-point** (default): Processes the number by multiplying it by 1000 and storing it as 32 bits of signed integer data in the word device.
- Floating-point**: Processes the number as singleprecision floating point data (32 bits) in the word device output (RWrX: lower 16 bits, RWrX+1: upper 16 bits).

Point

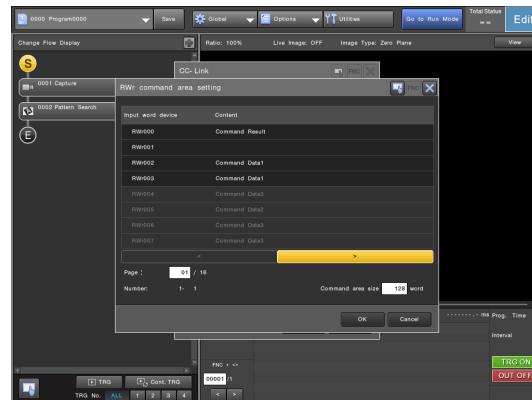
If a command uses an integer, the controller will read the command parameter as an integer by rounding off the tenth digit regardless of the setting, and write the command data output as an integer.

5 Confirm the word device assignment as necessary.

This function shows the word device output and input and is useful for finding unused ranges.

RWr

A list of word outputs appear in the [RWr command area setting] menu.



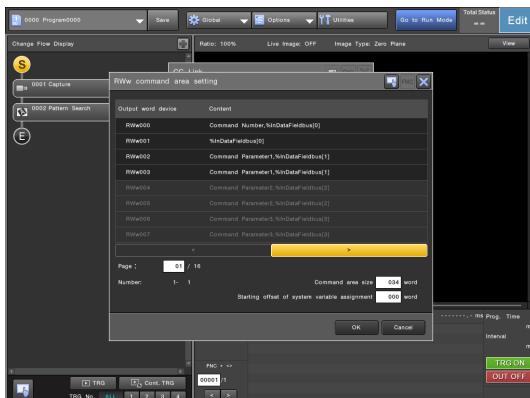
- Data output units (Page 2-449) used in the flowchart that specify CC-Link as the destination are listed by their unit ID in the write data range.
- The items used by commands are written to the continuous 128 words block (by default). The command result is written to RWr000 and command data1 to 63 is written to RWr002 to RWr127.
- Reducing the command area size reduces the command area 2 words at a time from RWr127.
- Any device ranges that cannot be used in the current settings are grayed out.
- The result data Command Data1 to 63 is registered using the method chosen in [Decimal Point].

Point

If data outputs and commands are used at the same time, their data ranges may overlap. Avoid this by reducing the command area size to the least amount of words required, and by changing the starting address for outputting results in the [Offset of RWr] setting for the data output unit. Refer to "Data Output Unit" (Page 2-449) and "Control/Data Output via CC-Link" in the XG-X2000 Series Communications Control Manual for more details.

RWw

A list of word inputs appear in the [RWw command area setting] menu.



- By default, the system variables for variable synchronizing starting at %InDataFieldbus [0] are assigned to RWw000, 2 words for each item.
- The items used by commands are written to the continuous 34 words block (by default). The command number is written to RWr000 and command parameter1 to 16 is written to RWw002 to RWw034.
- Reducing the command area size reduces the command area 2 words at a time from RWw033.
- Any device ranges that cannot be used in the current settings are grayed out.
- Data that includes decimal points and is used in Command Parameter1 to 16 is registered using the method chosen in [Decimal Point].

Point

- Only custom commands can be executed using CC-Link.
- If command control and variable synchronization are used via CC-Link at the same time, their data ranges may overlap in the word devices used for RWw even when their default settings are used. Avoid this by reducing the command area size to the least amount of words required, and by changing the starting address for synchronizing variables in the [Starting offset of system variable assignment] setting on the variable synchronization unit. Refer to "Controlling and Outputting Data with CC-Link" in the XG-X2000 Series Communications Control Manual for more details.

Reference

- For details on custom commands that can be used via CC-Link refer to the XG-X2000 Series Communications Control Manual.
- For details on default custom commands, see "List of Custom Instructions" (Page 6-42).

6 Change the bit assignments as required.

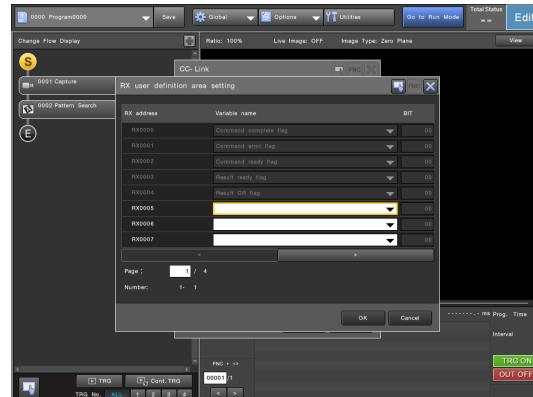
Any user-specified system variable related to parallel output control can be assigned to bit device outputs and inputs. Only devices available with the current settings are displayed.

Point

- As CC-Link performs communication by scanning the links, high speed switching may not be picked up. The scan cycle changes depending on the number of stations, cycles, and settings of other devices on the network. Be sure to check the signal reliability of signals when using CC-Link.
- The bits required for commands and data outputs are assigned to a reserved area and cannot be changed. For more information about device assignments, refer to the XG-X2000 Series Communications Control Manual.

RX

The [RX user definition area setting] menu appears. Use this menu to assign system variable outputs and their bits to the devices address.



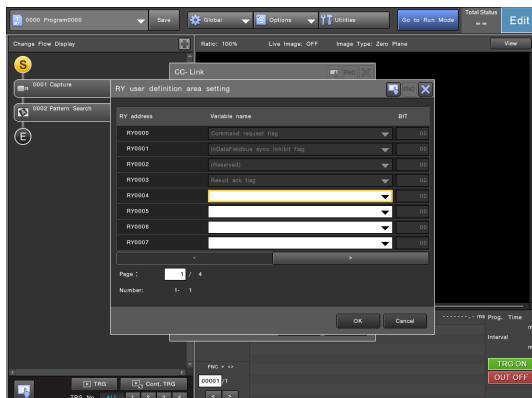
- Use the columns under [Variable name] and [BIT] to assign the desired output-type system variable and its bit to an RX address. Only system variables related to parallel port control can be assigned.
- Any device ranges that cannot be used in the current settings are not displayed.

Reference

For more details on the system variables that can be assigned, refer to the XG-X2000 Series Communications Control Manual.

RY

The [RY user definition area setting] menu appears. Use this menu to assign system variable inputs and their bits to the devices address.



- Use the columns under [Variable name] and [BIT] to assign the desired input-type system variable and its bit to an RY address. Only system variables related to parallel port control can be assigned.
- Any device ranges that cannot be used in the current settings are not displayed.

Point It is not possible to assign the same bit of the same system variable to multiple RY addresses and input terminals on the parallel port.

Reference For more details on the system variables that can be assigned, refer to the XG-X2000 Series Communications Control Manual.

7 Select [Create CSP/CSP+ File] to create a CSP file.

This outputs a CSP file and a CSP+ file that are used when the master station references the controller CC-Link settings.

CSP/CSP+ file naming rules

- When Ver.1.10 is used: CA-NCL20E_[No. of exclusive stations].csp
- When Ver.2.00 is used: CA-NCL20E_[No. of exclusive stations]_V2-00_E[Cycle value].csp

CSP+ File contents

- 0x0658_CA-NCL20E_1.0.0_ja.zip (Japanese)
 - 0x0658_CA-NCL20E_1.0.0_ja.cspp
 - CA-NCL20E.ico
 - CA-NCL20E.bmp
- 0x0658_CA-NCL20E_1.0.0_en.zip (Other than Japanese)
 - 0x0658_CA-NCL20E_1.0.0_en.cspp
 - CA-NCL20E.ico
 - CA-NCL20E.bmp

Point

- The output path of the file in the controller is: SD2:/xg/CSP
- Since the CSP+ file does not include the information set or changed in the system settings of the controller and the XG-X VisionEditor, the content of the prepared CSP+ file is always the same.
- The CSP/CSP+ file cannot be used during setup on the Keyence KV Series controllers.

8 When the settings are complete, select [OK].

Changing the EtherNet/IP Settings (EtherNet/IP)

Follow the procedure below for communication and control using EtherNet/IP. For more information about synchronizing EtherNet/IP variables, refer to the XG-X2000 Series Communications Control Manual.

Reference

- IP address, subnet mask, and other controller Ethernet settings are changed from the Ethernet menu (Page 6-14).
- For more details on the methods of using the EtherNet/IP for control, see "Control/Data Output via EtherNet/IP" in the XG-X VisionEditor Reference Manual (Data/Control Edition).

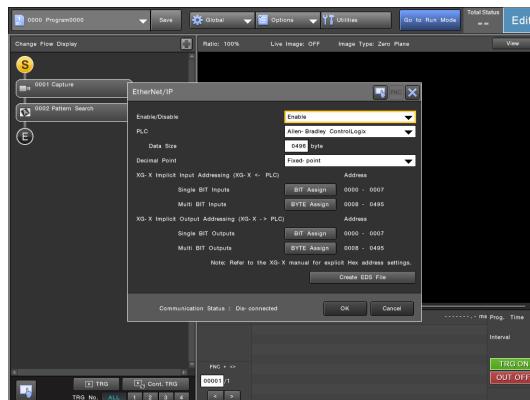
Point

- If any settings other than the [Decimal Point] and [Starting address of output data] on [XG-X Implicit Output Addressing (XG-X → PLC): Multi BIT Output Settings] are changed, the controller must be restarted for changes to take effect.
- Cyclic communication settings such as cycle (RPI), data size, time out, transmission trigger, etc. are specified at the PLC. During cyclic communication with the controller, set the RPI value to 5 ms or more. When COS (Change Of State) for the PLC (Keyence's KV-3000/5000/5500/7300/7500/Nano, etc.) that allows selection of the communication trigger is selected, set the minimum transmission interval (Inhibit Time) to 5 ms or more.
- If RPI is set to 5 ms or more, use of other communications such as measurement settings, dialog operation, command, FTP, remote desktop, etc. of the controller may give excessive load to the controller. This may result in delay of processing or temporary time-out of the communication. In this case, it is necessary to review the cyclic communication settings, operating conditions. Be sure to verify if the performance is acceptable before operation.
- In the network connecting to a lot devices including the EtherNet/IP device, if a large load applies to the network continuously/temporarily, delay or packet loss may occur. Before operation, be sure to perform enough verification.

- 1 From the [Global] menu, select [Communications & I/O] - [EtherNet/IP].**

The [EtherNet/IP] menu appears.

- 2 Select [Enable] in the [Enable/Disable] field.**



Point

EtherNet/IP cannot be used if PLC-Link (Page 6-19), CC-Link (Page 6-23), PROFINET (Page 6-31) or EtherCAT (Page 6-34) is enabled.

- 3 Change the settings as required.**

PLC

Select the type of connection.

The settings for the selected PLC type appear. Refer to "Controlling and Outputting Data with EtherNet/IP" in the XG-X2000 Series Communications Control Manual for more details.

Point

Changing the PLC types will initialize some of the EtherNet/IP settings.

Data Size

Specify the data size assigned to the EtherNet/IP cyclic communication (4 bytes increments). From the starting address of the cyclic communication, various data areas are assigned to the area for the size specified in this setting. The range that can be specified and the default value vary depending on the PLC type selected.

- Allen-Bradley ControlLogix:** 16 to 496 bytes (Default value: 496 bytes)
- Allen-Bradley SLC5/05:** 16 to 248 bytes (Default value: 248 bytes)
- Keyence KV Series:** 16 to 1436 bytes (Default value: 496 bytes)
- OMRON SYSMAC:** 16 to 1436 bytes (default: 496 bytes)
- Other:** 16 to 1436 bytes (Default value: 496 bytes)

Point

- The data size which is actually sent/received is in accordance with the PLC settings. Although it is acceptable to set the cyclic communication data size differently between the PLC and controller, it is recommended to set the value the same between the two devices so data is sent and received correctly.
- The value set here is used as the data size to gain access to the input data (instance 100, attribute 3) and output data (instance 101, attribute 3) of the Assembly Object in the message communication.

4 Change the [Decimal Point] settings as required.

Choose the appropriate data expression method for each command parameter MW/MR/MS/MWX/MRX/MSX, commands data output, and result data output for input and output.

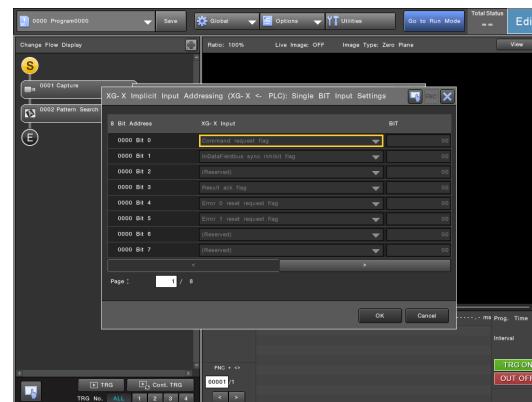
- Fixed-point**(default): Processes the number by multiplying it by 1000 and storing it as 32-bits of signed integer data.
When the integer of the calculation result is 7 digits, write
±999999999. (The sign is either + or -.)
- Floating-point**: Processes the number as singleprecision floating point data (32 bits) in the data memory.

Point

If a command uses an integer, the controller will read the command parameter as an integer by rounding off the tenth digit regardless of the setting, and write the command data output as an integer.

5 Check the allocation of input data (data to the controller) as necessary.**BIT Assign**

The [XG-X Implicit Input Addressing (XG-X <- PLC): Single BIT Input Settings] menu, which is an assignment list of the input data (data to the controller) bit information, is displayed.



Use the columns under [Variable name] and [BIT] to assign the desired input-type system variable and its bit to an address. Only system variables related to parallel port control can be assigned.

Reference

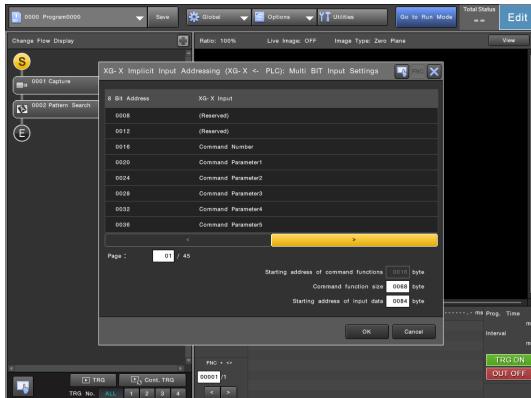
For more details on the system variables that can be assigned, refer to the "List of System Variables" in the XG-X2000 Series Communications Control Manual.

Point

- The system variables which have been assigned to the input terminals on the parallel port cannot be used as another assignment for the EtherNet/IP.
- Assignment of the same bit on the same system variable to multiple output data (reception of the controller) addresses and input terminals on the parallel port is not allowed.

BYTE Assign

The [XG-X Implicit Input Addressing (XG-X <- PLC): Multi BIT Input Settings] menu, which is an assignment list of the input data (data to the controller) byte information, is displayed.



- Starting address of command functions:**

Specifies the position to start assignment of items necessary for command control. In the controller, it is fixed to 16 bytes and cannot be changed.

- Command function size:** Items necessary for command control are assigned up to 68 bytes which are the area size upper limit (default). Command Numbers are assigned from 16 to 19 bytes, and Command Parameter 1 to 16 are assigned from 20 to 83 bytes.

- Starting address of input data:** Specifies the position to start assignment of %InDataFieldbus[] in system variable synchronization. In the default, 4 bytes for each item from the 84th byte have already been assigned.

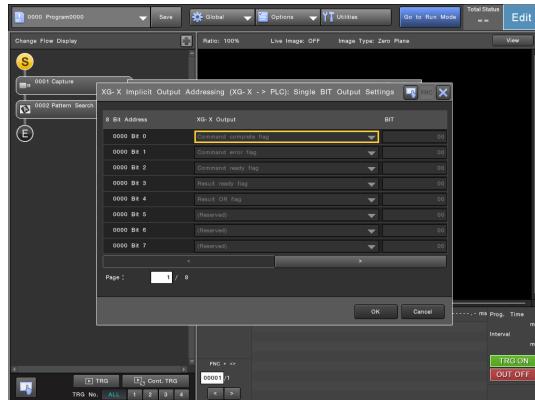
Point

- Any device ranges that cannot be used in the current settings are grayed out.
- The decimal data written to Command Parameter is expressed using the method set in [Decimal Point].
- Only custom commands can be executed using the EtherNet/IP.

6 Check the allocation of output data (data from the controller) as necessary.

BIT Assign

The [XG-X Implicit Output Addressing (XG-X -> PLC): Single BIT Output Settings] menu, which is an assignment list of the output data (data from the controller) bit information, is displayed.



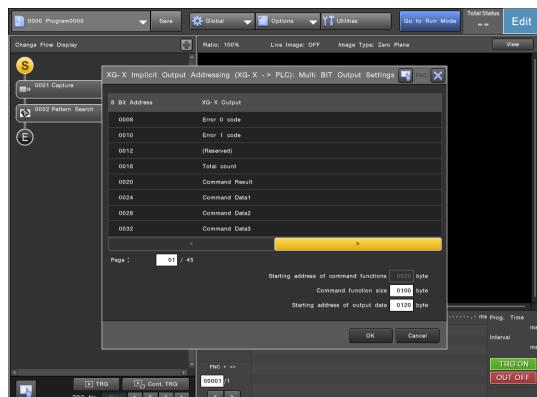
Use the columns under [Variable name] and [BIT] to assign the desired output-type system variable and its bit to an address. Only system variables related to parallel port control can be assigned.



For more details on the system variables that can be assigned, refer to the "List of System Variables" in the XG-X2000 Series Communications Control Manual

BYTE Assign

The [XG-X Implicit Output Addressing (XG-X → PLC): Multi BIT Output Settings] menu, which is an assignment list of the output data (data from the controller) byte information, is displayed.



- Starting address of command functions:**

Specifies the position to start assignment of items necessary for command control. In the controller, it is fixed to 20 bytes and cannot be changed.

- Command function size:** Items necessary for command control are assigned to 100 bytes of the area size (default). Command Results are assigned from 20 to 23 bytes and Command Data1 to 24 are assigned from 24 to 119 bytes.

- Starting address of output data:** The starting address for output data can be set here. If the data output size is not sufficient, reduce the command area size to the least amount required, and change the starting address position for outputting results in the [Starting address of output data] setting.

Point

- Any address ranges that cannot be used in the current settings are grayed out.
- The decimal data in the Command Data is expressed using the method set in [Decimal Point].
- The data range, which is actually used for a command response, varies depending on the command. Be sure to provide a sufficient area for the command response of the command used. For details, see "Results Output Unit" (Page 2-449) and also "Control/ Data Output via EtherNet/IP" in the XG-X2000 Series Communications Control Manual.

7 Select [Create EDS File] to create an EDS file.

The EDS file including the information for the EtherNet/IP function of the controller is output. A EDS file is named based on the following naming rules.

- Keyence_5004_0101.eds

Point

- The output path of the file in the controller is SD2:/xg/EDS.
- Since the EDS file does not include the information set or changed by the controller or the XG-X VisionEditor global settings, the prepared EDS file is always the same.
- The BMP icon file for the controller is XG-X2000Series.ico that is located in the "Doc" folder in the XG-X VisionEditor installation folder.
- The EDS file cannot be used during setup on the Keyence KV Series controllers.

8 When the settings are complete, select [OK].

Changing the PROFINET Settings (PROFINET)

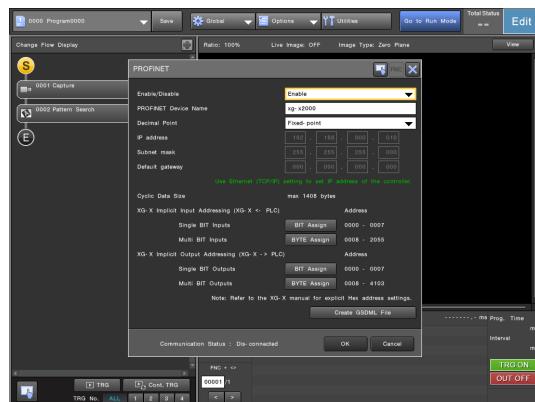
If performing communication or control using PROFINET, proceed with the settings using the procedure below. For details on PROFINET variable synchronization, refer to the XG-X2000 Series Communications Control Manual.

Reference The Ethernet settings of the controller, such as the IP address and subnet mask, are changed on the [Ethernet (TCP/IP)] screen.

- Point**
- If any settings other than the [Decimal Point] and [Starting address of output data] on [XG-X Implicit Output Addressing (XG-X → PLC): Multi BIT Output Settings] are changed, the controller must be restarted for changes to take effect.
 - The update time, data size, and timeout time are set on the PLC. Be sure to set the update time of 4 ms or longer for the cyclic communication with the controller.
 - Even if you specify the update time of the cyclic communication to 4 ms or longer, the processing may be delayed or the communication may be disconnected by temporary timeout due to the excessive load applied to the controller temporarily or continuously when there are other communication functions being used in the controller, such as measurement settings, dialog operations, commands, FTP, or remote desktop. When this occurs, review the cyclic communication settings and conditions used. Be sure to check for these and other problems in the operating performance before entering production.
 - In a network where many devices including a PROFINET device are connected, delay or packet loss may occur sometimes when a heavy load is applied to the network constantly or temporarily. Be sure to make thorough verification before entering production.

1 From the [Global] menu, select [Communications & I/O] - [PROFINET].

The [PROFINET] menu appears.



2 Select [Enable] for [Enable/Disable].

Point PROFINET cannot be used when the PLC-Link (Page 6-19), CC-Link (Page 6-23), EtherNet/IP (Page 6-27) or EtherCAT (Page 6-34) is enabled.

3 Specify the device name in [PROFINET Device Name].

Set the device name of the XG-X Series used for the PROFINET communication. This name must be the same as the name set on the PLC.

4 Change the [Decimal Point] settings as required.

Choose the appropriate data expression method for each command parameter MW/MR/MS/MWX/MRX/MSX, commands data output, and result data output for input and output.

- Fixed-point** (Default): Multiplies the output data by 1000 and uses it as 32-bit signed integer data. If the integer value of the calculation result reaches 7 digits, ±999999999 is written.
- Floating-point**: Uses the output data as single-precision floating point data (32 bits) (little endian).

Point For a command dealing with integers only, this setting is ignored and the system rounds off a value to the nearest integer and reads command parameters as integers or writes command data in integers.

5 Check the IP address setting and the cyclic communication data size.

IP address

The IP address of the controller is displayed.

Subnet mask

The subnet mask is displayed.

Default gateway

The IP address of the default gateway is displayed.

Cyclic Data Size

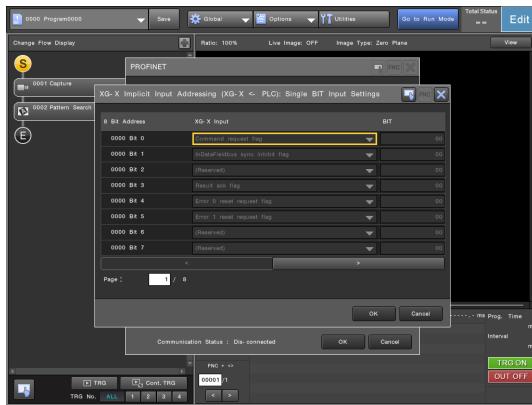
The maximum data size for the cyclic communication available with the XG-X Series is displayed (1408 bytes).

Point The actual data size to be sent or received will depend on the setting on the PLC.

6 Check the allocation of output data (receiving by the controller) as necessary.

BIT Assign

The [XG-X Implicit Input Addressing (XG-X <- PLC): Single BIT Input Settings] screen is displayed. This screen lists the bit address assignment of output data (received by the controller).



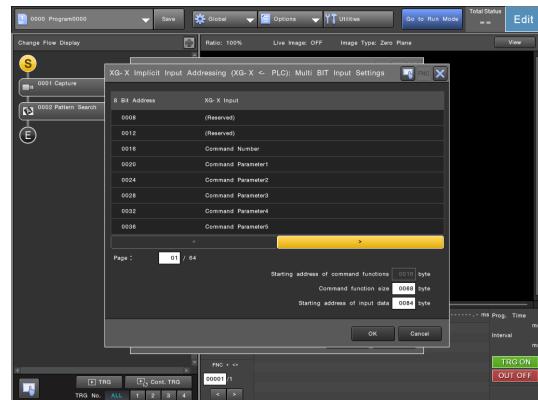
In the [XG-X Input] and [BIT] columns, you can assign a desired input-type system variable related to terminal control and its bit to each address.

Point

- The system variables which have already been assigned to the input terminals in the terminal block & parallel port cannot be assigned again for PROFINET.
- The same bit of the same system variable cannot be assigned to multiple output data (received by the controller) addresses or be assigned again to the input terminal in the terminal block & parallel port.

BYTE Assign

The [XG-X Implicit Input Addressing (XG-X <- PLC): Multi BIT Input Settings] screen is displayed. This screen lists the byte address assignment of output data (received by the controller).



- Starting address of command functions:** Specify the position to start assignment of items necessary for command control. With the controller, this address is fixed to byte 16 and cannot be changed.
- Command function size:** Items necessary for command control are assigned up to 68 bytes (default) which is the area size upper limit. The custom instruction No. (Command Number) is assigned from bytes 16 to 19, and command parameters (Command Parameter1 to 16) are assigned from bytes 20 to 83.
- Starting address of input data:** Specify the position to start assignment of %InDataFieldbus[] for system variable synchronization. By default, the position has already been assigned from byte 84, four bytes for each item.

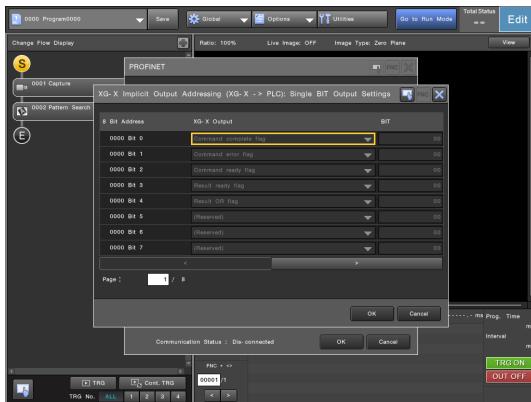
Point

- Bytes 8 to 1408 can be used for the cyclic communication. For the record data communication, all byte addresses can be used.
- The data representation format when decimal data is written as Command Parameter depends on the format specified at [Decimal Point].
- Only custom instructions can be executed with PROFINET.

7 Check the allocation of input data (sent by the controller) as necessary.

BIT Assign

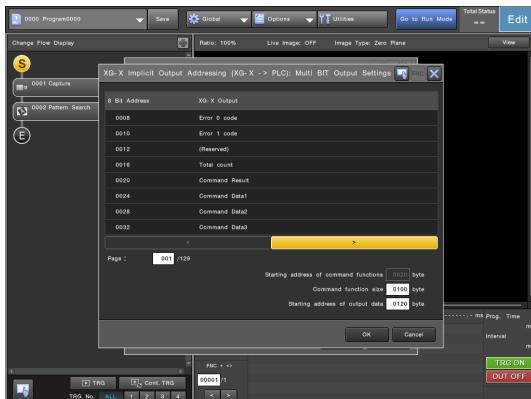
The [XG-X Implicit Output Addressing (XG-X → PLC): Single BIT Output Settings] screen is displayed. This screen lists the bit address assignment of input data (sent from the controller).



In the [XG-X Output] and [BIT] columns, you can assign a desired output-type system variable related to terminal control and its bit to each address.

BYTE Assign

The [XG-X Implicit Output Addressing (XG-X → PLC): Multi BIT Output Settings] screen is displayed. This screen lists the byte address assignment of input data (sent from the controller).



- Starting address of command functions:** Specify the position to start assignment of items necessary for command control. With the controller, this address is fixed to byte 20 and cannot be changed.
- Command function size:** Items necessary for command control are assigned up to 100 bytes (default) which is the area size. The command result (Command Result) is assigned from bytes 20 to 23, and command response data (Command Data1 to 24) are assigned from bytes 24 to 119.

- Starting address of output data:** The data output unit which uses PROFINET as an output device can output data to the assignment range starting from this address within the area set at [Cyclic Data Size]. If the data output size is insufficient, minimize the command function size to the least amount required, and change the starting address for the data output assignment in the [Starting address of output data] setting.



- Bytes 8 to 1408 can be used for the cyclic communication. For the record data communication, all byte addresses can be used.
- The decimal data representation format in Command Data depends on the format specified at [Decimal Point].
- The data range actually used for a command response varies depending on the command. Be sure to provide a sufficient area for the command response of the command to be used.

8 Select [Create GSDML File] to create an GSDML file.

This option is used to output the GSDML and icon files which contain the information about the PROFINET functions of the controller. The files are named based on the following naming rules:

- GSDML-V2.31-Keyence-XG-X2000-20160102.xml
- GSDML-01FD-XG-X2000.bmp



- These files are not created if any of the parameter settings are incorrect. Correct the incorrect settings and then try again.
- The output path of the file in the controller is SD2:/xg/GSDML.
- Since the GSDML file does not contain the information set or changed with the controller or the system settings of the XG-X VisionEditor, the content of the created GSDML file is always the same.

9 When the settings are complete, select [OK].

Changing the EtherCAT Settings (EtherCAT)

If performing communication or control using EtherCAT, proceed with the settings using the procedure below. For details on EtherCAT variable synchronization, refer to the XG-X2000 Series Communications Control Manual.

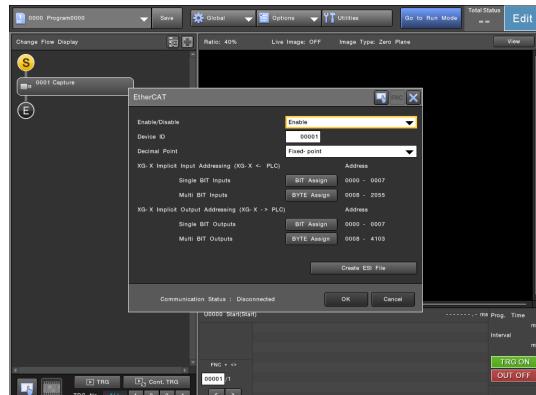
Reference EtherCAT is an open source real time Ethernet that is developed by Beckhoff.

Point

- If any settings other than the [Decimal Point] and [Starting address of output data] on [XG-X Implicit Output Addressing (XG-X -> PLC): Multi BIT Output Settings] are changed, the controller must be restarted for changes to take effect.
- The update time, data size, and timeout time are set on the PLC. Be sure to set the update time of 500 µs or longer for the cyclic communication with the controller.
- Even if you specify the update time of the cyclic communication to 500 µs or longer, the processing may be delayed or the communication may be disconnected by temporary timeout due to the excessive load applied to the controller temporarily or continuously when there are other communication functions being used in the controller, such as measurement condition settings, dialog operations, commands, FTP, or remote desktop. When this occurs, review the cyclic communication settings and conditions used. Be sure to check for these and other problems in the operating performance before entering production.
- In a network where many devices including an EtherCAT device are connected, delay or packet loss may occur sometimes when a heavy load is applied to the network constantly or temporarily. Be sure to make thorough verification before entering production.

1 From the [Global] menu, select [Communications & I/O] - [EtherCAT].

The [EtherCAT] menu appears.



2 Select [Enable] for [Enable/Disable].

Point

EtherCAT cannot be used when the PLC-Link (Page 6-19), CC-Link (Page 6-23), EtherNet/IP (Page 6-27) or PROFINET (Page 6-31) is enabled.

3 Specify the [Device ID].

Set the Device ID of the XG-X Series used for the EtherCAT communication. This must be the same as what is set on the PLC.

4 Change the [Decimal Point] setting as required.

Choose the appropriate data expression method for each command parameter of MW/MR/MS/MWX/MRX/MSX, commands data output, and input and output of result output data.

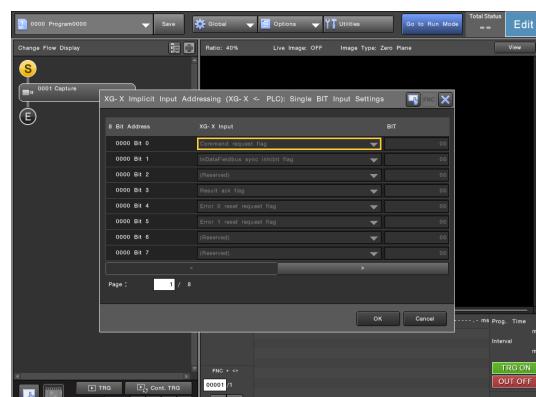
- Fixed-point** (Default): Multiplies the output data by 1000 and uses it as 32-bit signed integer data. If the integer value of the calculation result reaches 7 digits, ±999999999 is written (the sign is either one of + or -).
- Floating-point**: Uses the output data as single-precision floating point data (32 bits) (little endian).

Point For a command dealing with integers only, this setting is ignored and the system rounds off a value to the nearest integer and reads command parameters as integers and writes command data output in integers.

5 Check the allocation of output data (receiving by the controller) as necessary.

BIT Assign

The [XG-X Implicit Input Addressing (XG-X -< PLC): Single BIT Input Settings] screen is displayed. This screen lists the bit address assignment of output data (received by the controller).



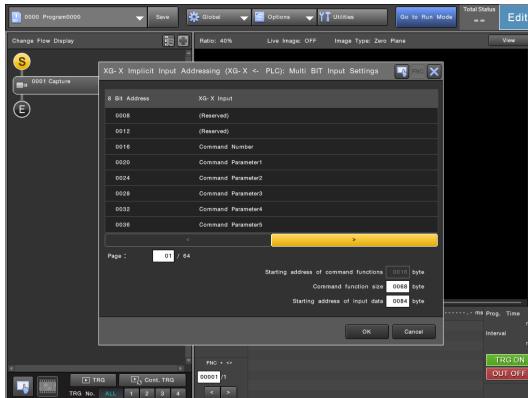
In the [XG-X Input] and [BIT] columns, you can assign a desired input-type system variable related to terminal control and its bit to each address.

Point

- The system variables which have already been assigned to the input terminals in the terminal block & parallel port cannot be assigned again for EtherCAT.
- The same bit of the same system variable cannot be assigned to multiple output data (received by the controller) addresses or be assigned again to the input terminal in the terminal block & parallel port.

BYTE Assign

The [XG-X Implicit Input Addressing (XG-X <- PLC): Multi BIT Input Settings] screen is displayed. This screen lists the byte address assignment of output data (received by the controller).



- Starting address of command functions:** Specify the position to start assignment of items necessary for command control. With the controller, this address is fixed to byte 16 and cannot be changed.
- Command function size:** Items necessary for command control are assigned up to 68 bytes (default) which is the area size upper limit. The custom instruction No. (Command Number) is assigned from bytes 16 to 19, and command parameters (Command Parameter1 to 16) are assigned from bytes 20 to 83.
- Starting address of input data:** Specify the position to start assignment of %InDataFieldbus[] for system variable synchronization. By default, the position has already been assigned from byte 84, four bytes for each item.

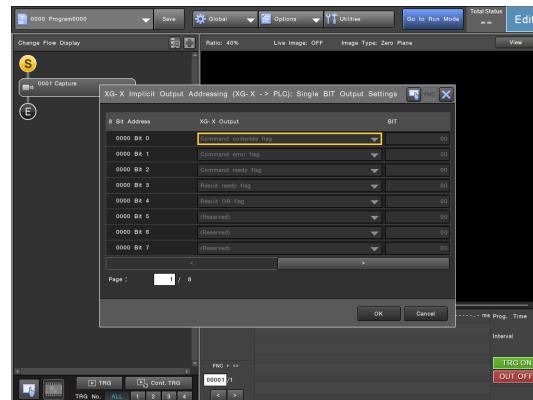
Point

- Up to byte 536 (input) and 532 (output) can be used for the cyclic communication. For non-cyclic communication, all byte addresses can be used.
- The data representation format when decimal data is written as Command Parameter depends on the format specified at [Decimal Point].
- Only custom instructions can be executed with EtherCAT.

6 Check the allocation of input data (sent by the controller) as necessary.

BIT Assign

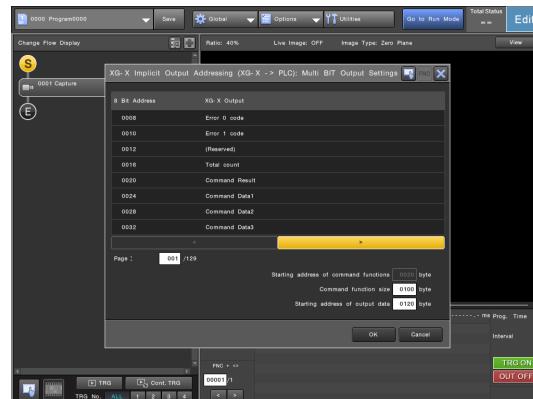
The [XG-X Implicit Output Addressing (XG-X → PLC): Single BIT Output Settings] screen is displayed. This screen lists the bit address assignment of input data (sent from the controller).



In the [XG-X Output] and [BIT] columns, you can assign a desired output-type system variable related to terminal control and its bit to each address.

BYTE Assign

The [XG-X Implicit Output Addressing (XG-X → PLC): Multi BIT Output Settings] screen is displayed. This screen lists the byte address assignment of input data (sent from the controller).



- Starting address of command functions:** Specify the position to start assignment of items necessary for command control. With the controller, this address is fixed to byte 20 and cannot be changed.
- Command function size:** Items necessary for command control are assigned up to 100 bytes (default) which is the area size. The command result (Command Result) is assigned from bytes 20 to 23, and command response data (Command Data1 to 24) are assigned from bytes 24 to 119.

- **Starting address of output data:** The data output unit which uses EtherCAT as an output device can output data to the assignment range starting from this address within the area set at [Cyclic Data Size]. If the data output size is insufficient, minimize the command function size to the least amount required, and change the starting address for the data output assignment in the [Starting address of output data] setting.

! Point

- Up to byte 536 (input) and 532 (output) can be used for the cyclic communication. For non-cyclic communication, all byte addresses can be used.
- The decimal data representation format in Command Data depends on the format specified at [Decimal Point].
- The data range actually used for a command response varies depending on the command. Be sure to provide a sufficient area for the command response of the command to be used.

7 Select [Create ESI File] to create an ESI file.

This option is used to output the ESI file which contains the information about the EtherCAT function of the controller. The following file is output:

Keyence XG-X2xxx_CCA-NEC20E.xml

! Point

- The file is not created if any of the parameter settings are incorrect. Correct the incorrect settings and then try again.
- The output path of the file in the controller is SD2:/xg/ESI.
- Since the ESI file does not contain information that is set or changed in the system settings of the controller and the XG-X VisionEditor, the content of the created ESI file is always the same.

8 When the settings are complete, select [OK].

Changing the VNC Server Function Settings (VNC)

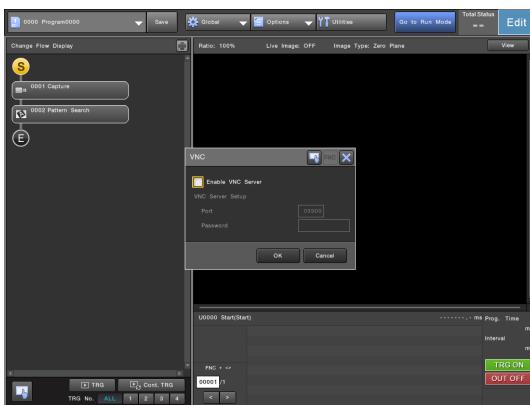
Change the VNC server function settings.

- Point** To apply a change to the enabled/disabled setting of VNC server functions, it is necessary to restart the controller.

- From the [Global] menu, select [Communications & I/O] - [VNC].

The [VNC] menu appears.

- Change the settings as required.



Enable VNC Server

Check the box to use the VNC server function.

VNC Server Setup

- Port:** Specify the communications port No. which is used with the VNC server functions (default: 5900).
- Password:** Enter the password for access to the VNC server.

- Point** The same port number cannot be specified for both [Ethernet (TCP/IP)] (Page 6-14) [Command & Data Output] and [PC Program].

- When the settings are complete, select [OK].

Tested VNC clients

Keyence has verified the connections with the following VNC clients (as of March 2011).

PC software

- UltraVNC_1.0.8.2

Touch panel displays (Supports monitor screen display only.)

- Keyence VT3-X15/S12/S10, VT5-W10/W07/W07M
- Digital Electronics Corporation GP-3700/GP-3600 Series

Using SNTP to Automatically Synchronize the Controller's Clock (SNTP)

You can use SNTP to automatically synchronize the controller's clock with an SNTP server. This function is useful when you are using multiple controllers and want to prevent the devices from becoming out of sync.

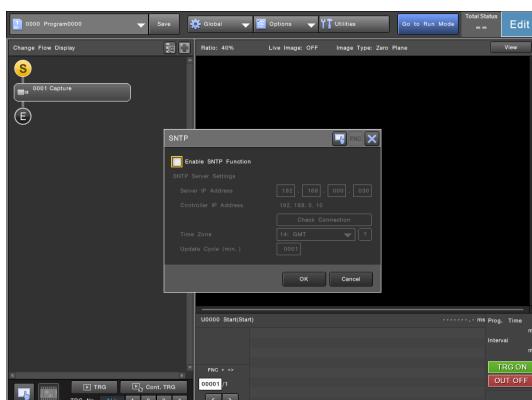
Global

- Point**
- To apply a change to the enabled/disabled setting of the SNTP function, it is necessary to restart the controller.
 - To use SNTP, you need to allow communications that use port 123 on the network that the controller is installed on. For details, check with your network administrator.

- 1 From the [Global] menu, select [Communications & I/O] - [SNTP].

The [SNTP] screen appears.

- 2 Change the settings as required.



Enable SNTP Function

Select the check box to use the SNTP function.

SNTP Server Settings

- **Server IP Address:** Sets the IP address for the SNTP server to be referenced (default setting: 192.168.0.30).
- **Check Connection:** Check whether you can connect to the specified server IP address.
- **Time Zone:** Select the time zone that matches the location where the controller is installed. For a controller that is installed in Japan, select [28:GMT+9:00].
- **Update Cycle:** Specifies the frequency to check the SNTP server in minutes (default setting: 1).

- Point** The IP address must be different from the controller's IP address.

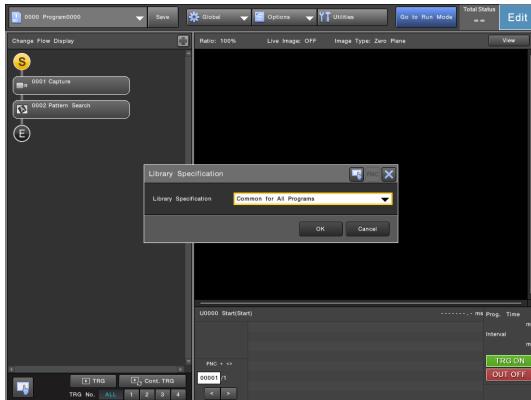
- 3 When the settings are complete, select [OK].

Sharing an OCR Library Among Programs (Library Specification)

The OCR library type can be selected.

1 From the [Global] menu, select [Library Specification].

The [Library Specification] screen appears.



2 Select the OCR library type.

- **By Program:** Manages OCR libraries by program.
- **Common for All Programs** (Default): The OCR library is shared by all programs.

3 When the setting is complete, select [OK].

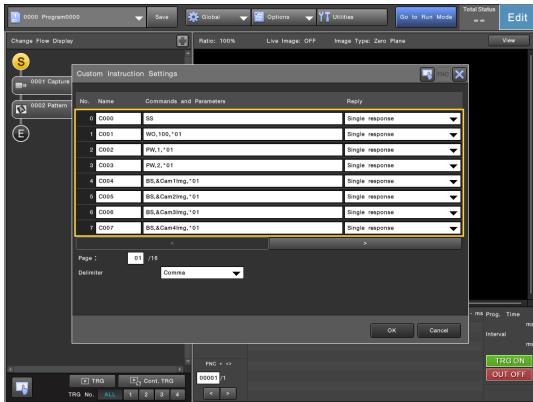
Defining the Custom Instruction (Custom Instruction Settings)

Input the commands and parameters for any standard instruction to create custom instructions for controlling the system.

Reference See the XG-X2000 Series Communications Control Manual for more details on the standard instructions and custom instructions.

1 From the [Global] menu, select [Custom Instruction Settings].

The [Custom Instruction Settings] screen appears.



2 Change the necessary settings for the custom instruction number (0 to 127) that you want to define as a custom instruction.

Reference

- Commonly used commands have already been assigned by default. Change the setting as necessary.
- For details on custom commands defined by default, see "List of Custom Instructions" (Page 6-42).
- See the XG-X2000 Series Communications Control Manual for more details on the assigned standard instructions.

Command name

Enter the name of the custom instruction to be defined using up to 31 single-byte alphanumeric characters.

Reference When no protocol communication is used, you can execute the custom instruction by directly entering this name and necessary arguments.

Point

- The name of a custom instruction is case-sensitive.
- 1-byte symbols may be used, however a comma (,) cannot be used in the name of a custom instruction.
- The name must be unique among the standard instructions and existing custom instructions.
- Using names consisting of three or less uppercase characters and numbers is not recommended. A name with those characteristics may be used as standard instruction in a future version upgrade. It is recommended to use four or more characters or to include at least one lowercase character for the name of a custom instruction.

Commands and Parameters

The current content of the custom instruction is displayed. To edit the contents of a command, select the line of the command to edit.

- Up to 256 single-byte alphanumeric characters can be used in one custom instruction (A line feed is counted as two characters.).
- See the XG-X2000 Series Communications Control Manual for more details on how to enter the contents to execute.
- To execute several standard instructions sequentially, separate them with a line feed. Up to 16 standard instructions can be executed in sequence.

Reply

Select the method to return the command execution result to the controller.

- Single response:** The execution results are returned from each of the standard instructions included in the custom instruction.
- Each command in string:** The execution result is returned when all standard instructions included in the custom instruction have been executed.
- No response:** No execution result is returned for either the custom instruction as a whole or the individual standard instructions.



- In the case of [Single response], even if a command contains a return value, it will not be returned. If custom commands include a command that contains a return value, select [Each command in string].
- When a custom instruction consists of several standard instructions and one of the standard instructions encounters an error, the subsequent standard instructions are not executed. When [Single response] is selected for [Reply], the error code of the standard instruction which encountered an error is returned as the response. If a custom instruction includes a standard instruction which is not supported by the device used to issue the instruction, the custom instruction itself is not executed. See the XG-X2000 Series Communications Control Manual for more details on the handling of command devices.
- For command execution via the terminal block & parallel port, PLC Link, CC-Link, EtherNet/IP, PROFINET and EtherCAT, the execution result is always returned as [Single response] even when [Each command in string] is selected for [Reply].
- When using with a command unit, console command assignment, and dialog part, there is no response regardless of the setting.

Delimiter

- **Comma** (default): Comma is output as the delimiter.
- **Tab**: Tab is output as the delimiter.
- **Space**: Space (blank) is output as the delimiter.
- **ASCII Code**: The desired ASCII code value is output as the delimiter.



- If the following errors occur due to input of the built-in command, the delimiter set here is applied.
- 02: Command error (There is no applicable command.)
 - 91: Time out error

3 When the settings are complete, select [OK].

List of Custom Instructions

This list shows the default custom commands (and their assignments) that can be used for control purposes and in the command unit (Page 2-465).

 For more information on the individual commands and their parameters, refer to the XG-X2000 Series Communications Control Manual.

Custom instruction No.	Assigned commands	Description
0	SS	Save program
1	WO,100,*01	Write terminal offset
2	PW,1,*01	Switch program No. (SD1)
3	PW,2,*01	Switch program No. (SD2)
4	BS,&Cam1Img,*01	Register image (Camera1)
5	BS,&Cam2Img,*01	Register image (Camera 2)
6	BS,&Cam3Img,*01	Register image (Camera3)
7	BS,&Cam4Img,*01	Register image (Camera 4)
8	RR,AL	Update position reference using the current image
9	BC	Capture image
10	HS,IM,*01,AL,AL	Save archived data
11	UW,FC,*01	Change display unit ID
12	VW,*01	Change display template ID
13	GW,*01	Switch page No.
14	TS,2,\xg\stat	Save statistical data
15	T1	Issue trigger
16	T2	Issue trigger
17	T3	Issue trigger
18	T4	Issue trigger
19	BPL,1,*01,*02	Load Setting in the Background
20	BPL,2,*01,*02	Load Setting in the Background
21	BPW,1,*01	Change Setting in the Background
22	BPW,2,*01	Change Setting in the Background
23	TA	Issue all triggers
24	TE,*01	Enable/disable trigger input
25	TQ	Read trigger acceptance
26	LK,*01,*02,*03	Enable/disable device input
27	OE,*01	Enable/disable output
28	R0	Switch to run mode
29	S0	Switch to setup mode
30	RM	Read run/setup mode
31	PW,*01,*02	Switch program No.
32	PR	Program No. readout
33	RS	Reset
34	RB	Reboot
35	SS	Save program
36	NW,AL,*01	Write registered image No.
37	NW,*01,*02	Write registered image No.
38	NR,*01	Read registered image No.
39	NU,AL	Update referenced registered image No.
40	NU,*01	Update referenced registered image No.
41	CE,*01	Clear error
42	RE	Return to beginning of flowchart

Custom instruction No.	Assigned commands	Description
43	WG,*01	Waiting status release
44	RR,AL,*01	Updating the reference position adjustment value
45	RR,*01,*02	Updating the reference position adjustment value
46	RU,AL	Update image reference
47	RU,*01	Update image reference
48	TG,*01	Teaching
49	UT,*01,*02	Test Unit
50	UE	Reset unit after test
51	CA,*01,*02,*03,*04	Register character to library
52	CA,*01,*02,*03,*04,*05,*06	Register character to library
53	CD,*01,*02	Delete character from library
54	CW,*01	Write REG
55	CW,*01,*02,*03	Write REG
56	CR,*01,*02	Read REG
57	WO,*01,*02	Write terminal offset
58	VW,*01	Change display template ID
59	VW,PV	Change display template ID
60	VW,NX	Change display template ID
61	VR	Read display template ID
62	GW,*01	Switch page No.
63	GW,PV	Switch page No.
64	GW,NX	Switch page No.
65	GR	Read page No.
66	UW,FC,*01	Change display unit ID
67	UW,FC,PV	Change display unit ID
68	UW,FC,NX	Change display unit ID
69	UR,FC	Read display unit ID
70	FW,*01	Change camera screen
71	FW,PV	Change camera screen
72	FW,NX	Change camera screen
73	FR	Read camera screen No.
74	WI,FC,*01	Change image type
75	RI,FC	Read image type
76	ZM,FC,*01,*02,*03,*04	Zoom
77	SC,FC,*01,*02	Scroll
78	FT,FC	Fit
79	DC,*01,*02	Close dialog
80	DC,AL	Close dialog
81	DO,*01	Open dialog
82	DR	Read dialog ID
83	BU,*01,*02	Open unit properties dialog
84	TC	Statistics data clear
85	TS,*01,\xg\stat	Save statistical data
86	HE,*01	Start/stop archive
87	HR,*01	Read archive status
88	HC,*01	Clear archived data
89	HC,AL	Clear archived data
90	HS,IM,*01,AL,AL	Save archived data
91	HS,AL,*01,AL,AL	Save archived data
92	LE,*01	Start/stop modification logging

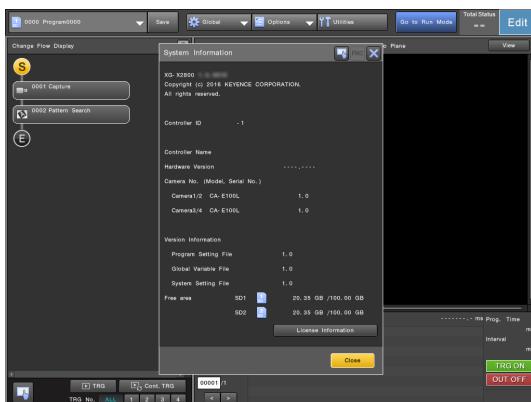
Custom instruction No.	Assigned commands	Description
93	LQ	Read modification logging status
94	BC	Capture image
95	PS,Administrator,*01,*02	Change password
96	PS,Operator,*01,*02	Change password
97	WH	Read user account
98	UC,Administrator,*01	Change login user
99	UC,Operator,*01	Change login user
100	TW,*01,*02,*03,*04,*05,*06	Write date/time
101	TR	Read date/time
102	PC,*01,*02,*03,*04	Copy program
103	PM,*01,*02,*03,*04	Move program
104	PD,*01,*02	Delete program
105	OW,*01,*02	Change fixed name in file naming rule
106	OR,*01	Read fixed name in file naming rule
107		
108		
109	FV,*01	Show flowchart in run mode
110	FI	Read show/hide flowchart status
111	KY,*01	Console virtual input
112	KY,*01,*02	Console virtual input
113	VI	Version information readout

Review the Information of the Controller (System Information)

Use this option to display information about the controller, including the controller name, controller hardware version, program file version, and available space.

1 From the [Global] menu, select [System Information].

The [System Information] menu appears.



2 Review the information.

- Model (version):** Shows the controller model and firmware version.
- Serial No.:** Shows the serial number of the controller.
- Controller ID:** Shows the unique ID of the controller.
- MAC Address:** Shows the MAC address of the controller. (Cannot be changed.)
- Controller Name:** Shows the name assigned to the controller.
- Hardware Version:** Shows the hardware version of the controller.
- Camera No. (Model, Serial No.):** Shows the information for the currently connected camera.
- Version Information:** Shows the versions of the program files currently on the controller.
- Free area:** Shows the available memory on each SD card displayed in the form "available memory / total capacity".
- License Information:** Displays the license information of the software components developed by KEYENCE and the applicable open-source software components.



- The [Controller Name] field will be empty if a name has not been set for the controller (Page 6-4).
- If an SD card is not inserted, the "Free area" field will display "0 KB/ 0 KB".

3 Select [Close].

Chapter 7

Capture Mode

Capture Mode

Documentation for the installation and configuration methods of the controller, software, and CAD data can be downloaded from the following URL.

www.keyence.com/xgx_support

Overview of Capture Modes

► Overview of Capture Modes

LumiTrax Mode

LumiTrax Specular Reflection Mode

MultiSpectrum Mode

Standard Lighting Mode
(MultiSpectrum light)

Capture Modes Available with This Controller

By using specified cameras and lighting, the following capture modes can be used with this product:

- LumiTrax Mode (Pages 7-8)
- LumiTrax Specular Reflection Mode (Pages 7-29)
- MultiSpectrum Mode (Pages 7-59)
- Standard Lighting Mode (MultiSpectrum light) (Pages 7-85)

Capturing Images Using Lights from Multiple Directions (LumiTrax Mode)

Images captured by lighting the target object from different directions are analyzed, and shape (irregularities) and texture (pattern) images can be generated (LumiTrax Mode). You can perform measurement that is focused on the [Work Shape] or the [Surface Pattern (Texture)] by eliminating the variation of the work and the influence of the surrounding environment which prevent stable inspections.

Processing Flow

Conventional image processing

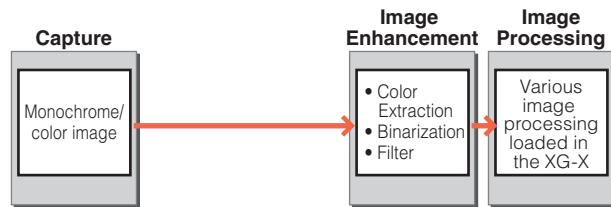
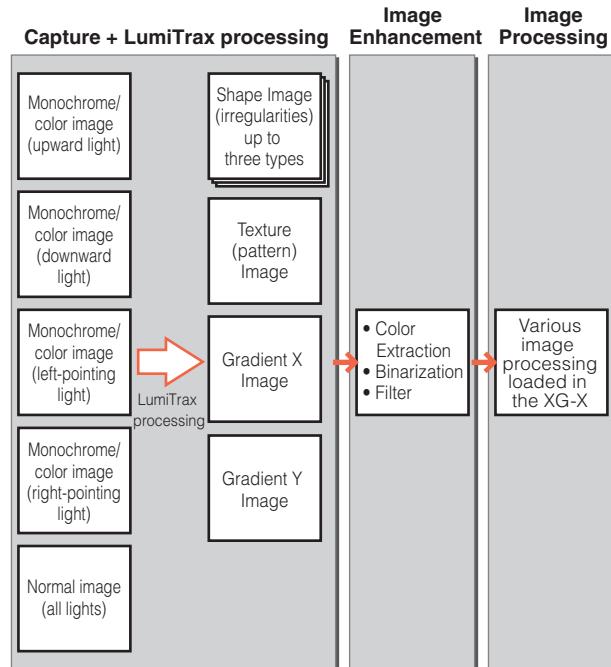


Image processing with LumiTrax



You can select target images for processing for each measuring unit.

Example of LumiTrax Advanced Processing

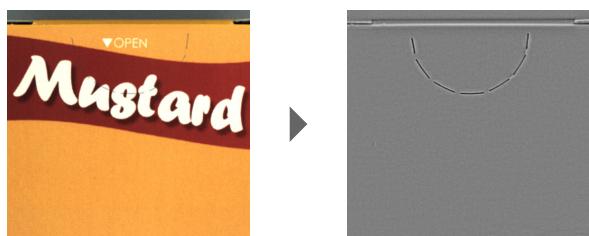
Stamping print inspection

It inspects the stamping print section with 3D surface by ignoring the print on the package.



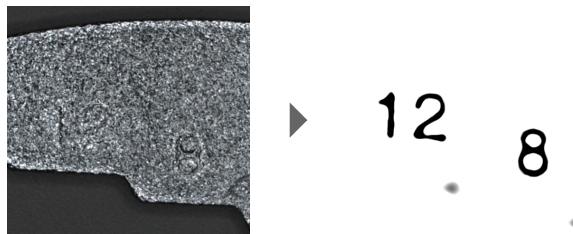
Inspection of existence of the perforation line for opening on the package

It inspects only the perforation line by ignoring patterns on the package.



Inspection of stamp on the metal casted surface

It emphasizes the stamp section with larger concavity and convexity on the random casted surface.



Print inspection on the film

It stabilizes the inspection by removing the halation that gives adverse effects to the inspection.



Capturing Images by Changing Light Emission Patterns (LumiTrax Specular Reflection Mode)

You can generate specular reflection, diffuse reflection, shape (irregularities), and other images by projecting striped images in the X and Y directions in four patterns each with an area light and changing the angle of light incidence for each pixel (this is called LumiTrax Specular Reflection Mode). This makes for easier detection of metallic glossy surfaces for which detection is often difficult as the appearance changes just by changing the object's position and angle. It also makes detection easier for defects, flaws, and dents that could not be detected without changing how light strikes the object during visual inspection.

Processing Flow

Conventional image processing

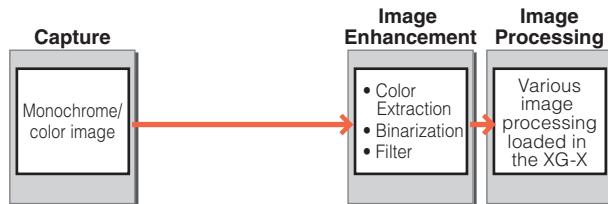
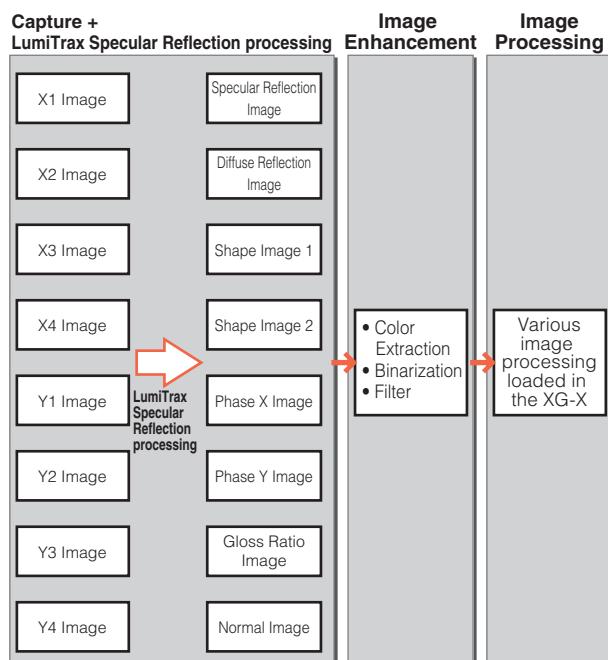


Image processing with LumiTrax Specular Reflection

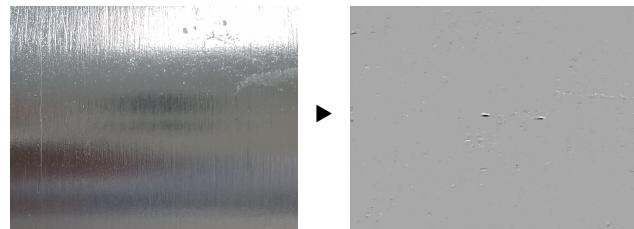


You can select the target images for processing for each Vision Tool unit.

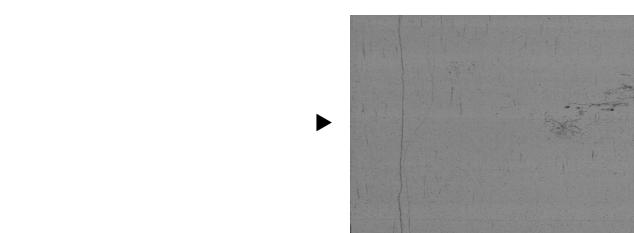
Example of LumiTrax Specular Reflection Processing

Inspecting the surface of a metallic cylinder

Surface irregularities, streaks, abrasions, and other defects on a bearing's lateral side are inspected.



Dents



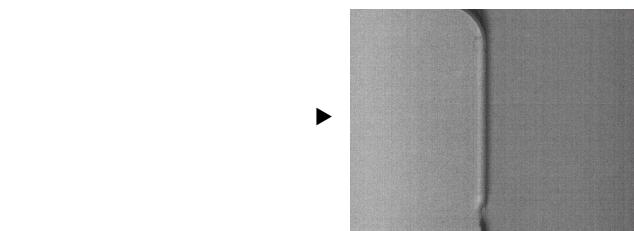
Streaks

Inspecting glass

Flaws on a glass surface and cracks on its ends are inspected.



Surface flaws



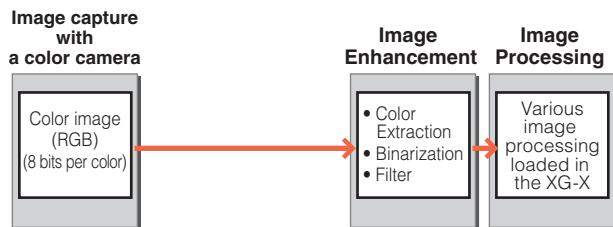
End face cracks

Capturing Images Using Multiple Light Colors (MultiSpectrum Mode)

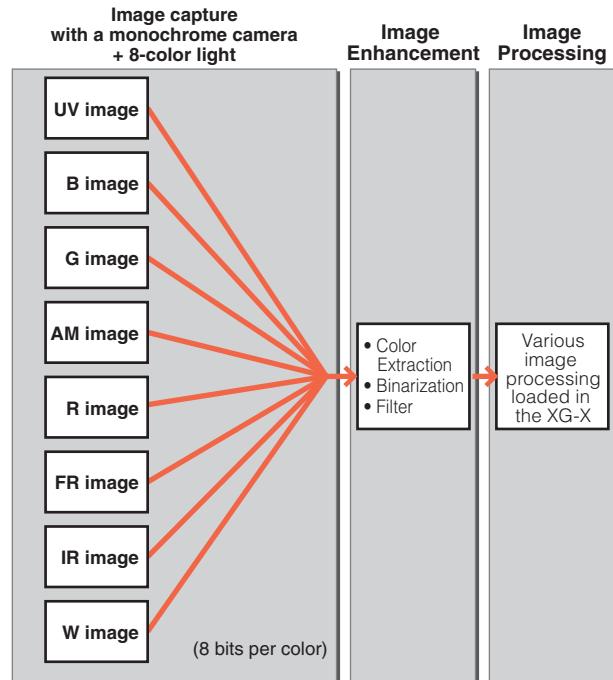
By capturing images with up to eight color lights and obtaining more detailed color information than a regular color camera, slight differences in color can be detected and the color range can be accurately specified (MultiSpectrum Mode). As a function to select and exclude multiple colors can also be used, stable color extraction is also possible.

Processing flow

Conventional color image processing



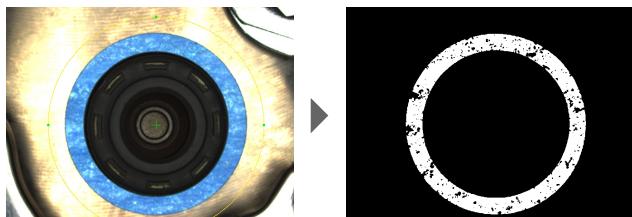
Color image processing with MultiSpectrum



Examples of Applications for MultiSpectrum Processing

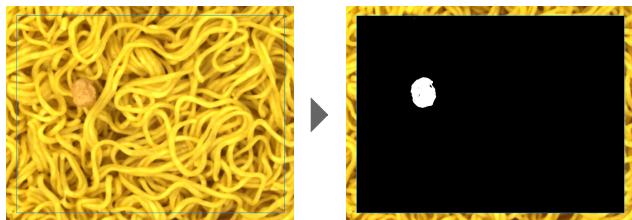
Gasket presence inspection

By using color information of up to eight colors, even parts, such as gaskets, which have a small color shade difference from their surroundings can also be clearly detected.



Detecting food contamination

By registering the colors that you do not want to detect as [Excluded Colors] separately from the [Extracted Colors] which you want to detect, stable inspections can be achieved even when the detection target colors and other colors (like the background) are similar.

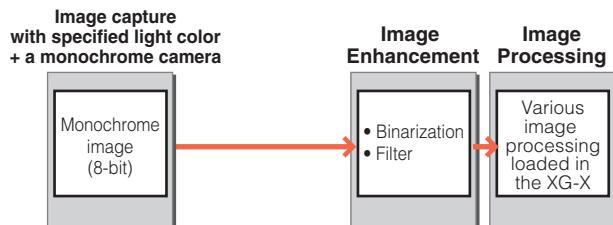


Capturing Images Using a Single Light Color with MultiSpectrum Light (Standard Lighting Mode)

By using MultiSpectrum light in Standard Lighting Mode, you can use the desired light color from among the eight light colors.

- **Visible Light (B/G/AM/R/W):** An image where the color part which is a complementary color of the selected light color is emphasized and where the similar-color color part is removed can be obtained.
- **Infrared Light (IR/FR):** By using the characteristic of infrared light where it is not easily scattered due to its higher transmittance than visible light, images such as one where only the black printed part is made to stand out from the work's pattern or where only the foreign substance in a liquid is emphasized can be obtained.
- **Ultraviolet Light (UV):** As UV light has a tendency to scatter, images that highlight minute defects that are hard to see with visible light can be obtained. You can also obtain images that used excitation light obtained by adding fluorescent material to the object or by painting the object with fluorescent coating and reflecting ultraviolet light off the object.

Processing flow



Example of Application for Standard Lighting

Switching light colors to suit the inspection items

By combining this mode with Multi-Capture, you can use different light colors for each inspection item.

1st capture

Turn on the red LED that clearly shows the pattern for position adjustment



2nd capture

Turn on the blue LED which is a similar color to cancel out the print pattern for blot inspection



LumiTrax Mode

Overview of Capture Modes

► LumiTrax Mode

LumiTrax Specular Reflection
Mode

MultiSpectrum Mode

Standard Lighting Mode
(MultiSpectrum light)

Switching to LumiTrax Mode

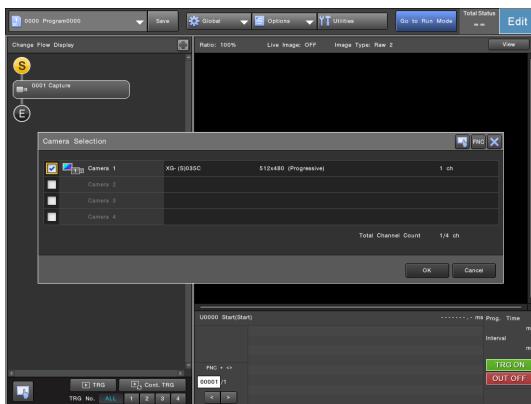
1 Prepare and connect a LumiTrax Mode-compatible camera (CA-HX*C/HX*M).

For more details, refer to the XG-X2000 Series Setup Manual.

Point Only the CA-DRW*X (connected to CA-DC50E) or CA-DRM*X/DWX10X (connected to CA-DC60E) lights can be used in LumiTrax Mode.

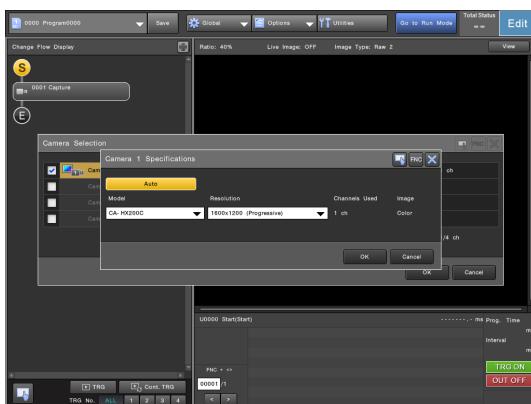
2 From the [Options] menu, select [Camera Settings] - [Camera Selection].

The [Camera Selection] menu appears.



3 Select the camera No. where the LumiTrax Mode-compatible camera is connected.

The [Camera* Specifications] screen appears.



4 Check that the camera model displayed in the [Model] field matches the connected LumiTrax Mode-compatible camera.

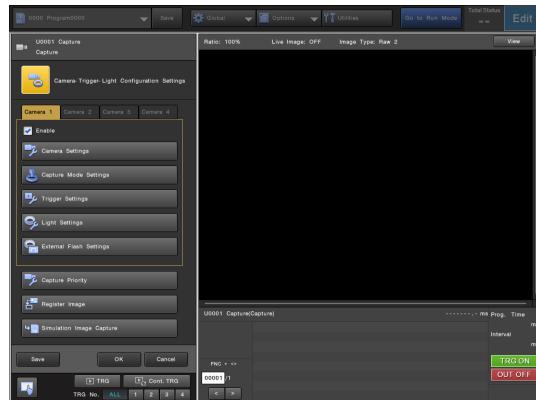
If a Different Camera is Displayed

Select [Auto] on the [Camera * Specifications] screen.

5 Select the capture resolution in the [Resolution] field.

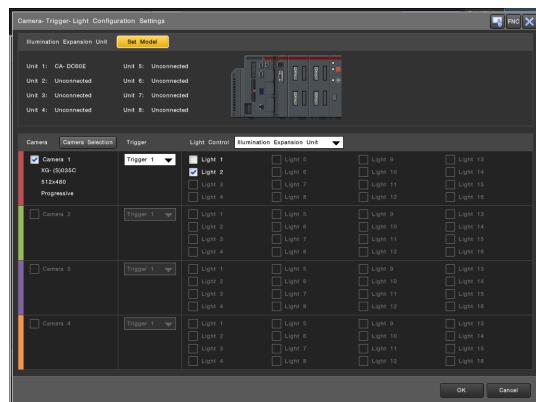
6 Select [OK].

7 Select the capture unit from the flowchart.



8 Select [Camera - Trigger - Light Configuration Settings].

The "Camera - Trigger - Light Configuration Settings" screen appears.



9 On the top of the screen, select [Set Model] for [Illumination Expansion Unit].

The "Illumination Expansion Unit Model Settings" screen appears.

10 Check that the connected illumination expansion unit is displayed.

If an illumination expansion unit is connected but [Unconnected] or a different model is displayed
Select the correct unit or select [Auto].

11 Select [OK].

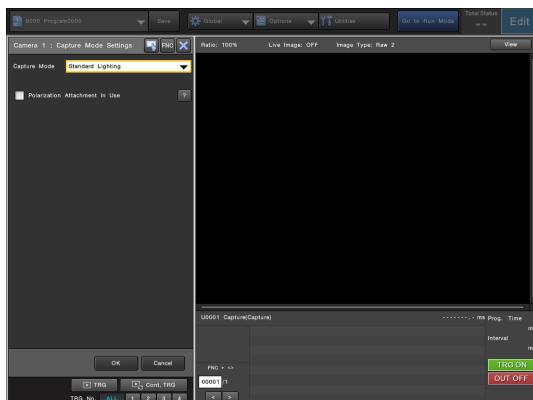
12 Select [OK].

13 Select the tab of the camera No. where the LumiTrax Mode-compatible camera is connected.

Switching to LumiTrax Mode

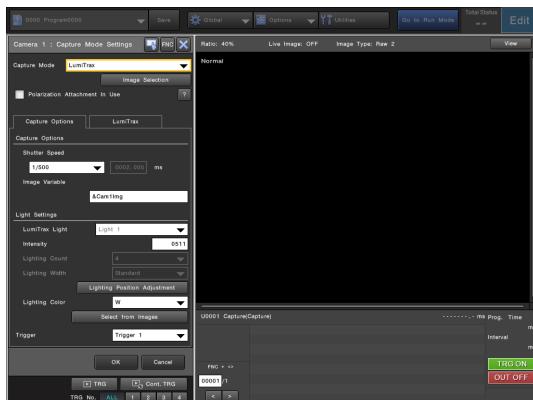
14 Select [Capture Mode Settings].

The "Capture Mode Settings" screen appears.



When the CA-DRM*PA is attached to the MultiSpectrum Light CA-DRM*X, selecting the [Polarization Attachment In Use] check box can suppress the lighting of the ultraviolet (UV) light, which may cause polarization filter deformation or deterioration.

15 In the [Capture Mode] field, select [LumiTrax].



16 Change the capture unit settings according to the measurement target.

See "Capture (LumiTrax Mode) (Area Camera Only)" (Page 7-11) for more details.

When Setting is Done

Add and configure other units that are required for measurement.

The operations and settings are the same as for measurements using area cameras.

For more details on the functions and restrictions that are specific to LumiTrax Mode-compatible cameras, see "Other Changes When LumiTrax Mode is Used" (Page 7-25).

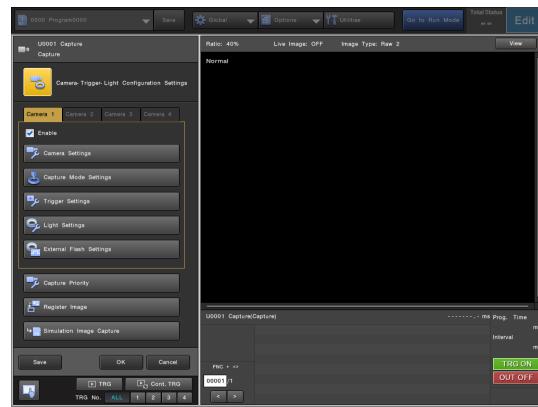
Capture (LumiTrax Mode) (Area Camera Only)

A capture unit is used for capturing images of the inspection/measurement target workpiece using a camera. When the CA-DC40E/DC50E/DC60E illumination expansion unit is connected, the settings (flashing/light intensity) can be controlled without wiring to the controller.

- This section provides information on the settings for when using LumiTrax Mode with LumiTrax Mode-compatible area cameras. When using other cameras, refer to the description below.
 - Area Camera: Page 2-25
 - 3D Camera: Page 8-14
 - LJ-V Series head: Page 8-22
 - Line Scan Camera: Page 8-175
- When using other capture modes, refer to the following descriptions:
 - LumiTrax Specular Reflection Mode (area camera): Page 7-32
 - LumiTrax Specular Reflection Mode (line scan camera): Page 7-44
 - MultiSpectrum Mode (area camera only): Page 7-62
 - Standard Lighting Mode Using MultiSpectrum Light: Page 7-86
- For special notes when using LumiTrax mode, see "Other Changes When LumiTrax Mode is Used" (Page 7-25).

Top Menu

The capture unit menu has the following options. Change the settings as required.



Camera - Trigger - Light Configuration Settings (Page 7-12)	The connected cameras and illumination expansion units, trigger input for each camera, and illumination control targets can be configured together.
Camera Settings (Page 7-13)	You can specify the conditions for image capture.
Capture Mode Settings (Page 7-15)	Change the LumiTrax mode settings.
Trigger Settings (Page 7-19)	Specify the settings for triggering the controller to take an image.
Light Settings (Page 7-20)	When an illumination expansion unit CA-DC40E/DC50E/DC60E (sold separately) is connected to the controller, the settings related to the light brightness and illumination are configured per light.
External Flash Settings (Page 7-22)	Set the illumination timing for controlling external light equipment using the external FLASH terminal.
Capture Priority (Page 7-22)	This option controls the conditions of the trigger input status for capture unit completion (transition to the next unit) with priority.
Register Image (Page 7-23)	Register images to use as the basis for measurements and setting.
Simulation Image Capture (Page 7-24)	Save the captured image to the SD card. The saved images can be referenced as simulation images in XG-X VisionEditor.

Image Capture Setup

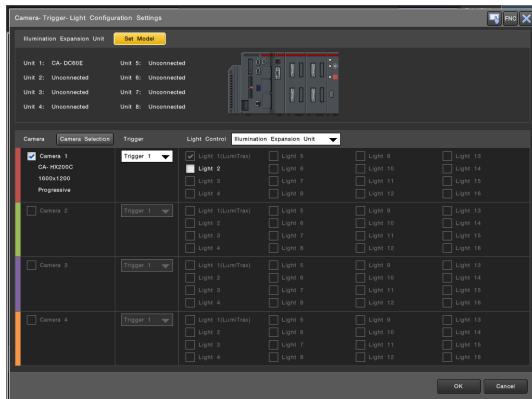
In the capture unit, images are captured by using the cameras, maximum of 4, connected to the controller. The image data is sent from the camera to the controller and stored in a specified image variable.



- If the cameras used in a capture unit are different from the cameras actually connected to the controller, a camera setting error will occur. No image capturing and subsequent image processing units will be processed. In such cases, set the camera model setting correctly or turn off the controller and connect the correct camera.
- The model and other information for the camera set in a capture unit can be viewed in the [Camera Selection] screen (Page 4-11).

Camera - Trigger - Light Configuration Settings

The connected cameras and illumination expansion units, trigger input for each camera, and illumination control targets can be configured together.



Illumination Expansion Unit

Displays the information of the illumination expansion unit connected to the controller. Select [Set Model] to specify the model of the connected illumination expansion unit for each light unit No.

Camera

Check the camera No. box of the camera to be used. Select [Camera Selection] to specify the model of the connected camera for each camera No. See "Specifying the Model of the Connected Camera (Camera Selection)" (Page 4-11) for more details.

Trigger

Select the trigger to be assigned to each camera.

Light Control

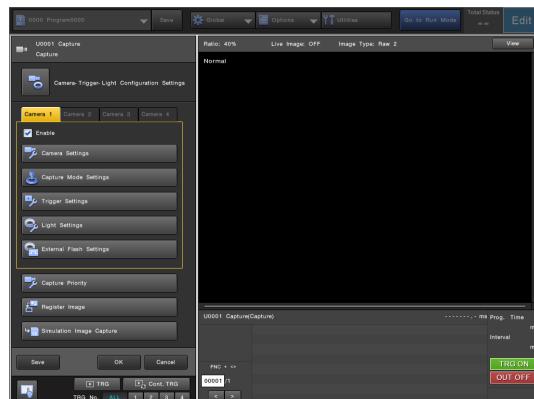
Specify the control method for the light assigned to each camera.

- Illumination Expansion Unit:** Check the light number of the illumination expansion unit to which you wish to assign an illumination control.
- External Flash:** Check the external terminal to which an illumination control will be assigned.

Point Only the CA-DRW*X (connected to CA-DC50E) or CA-DRM*X/DXW10X (connected to CA-DC60E) lights can be used in LumiTrax Mode.

Camera 1 to Camera 4

Select the tab of the camera for setting the capture options for.

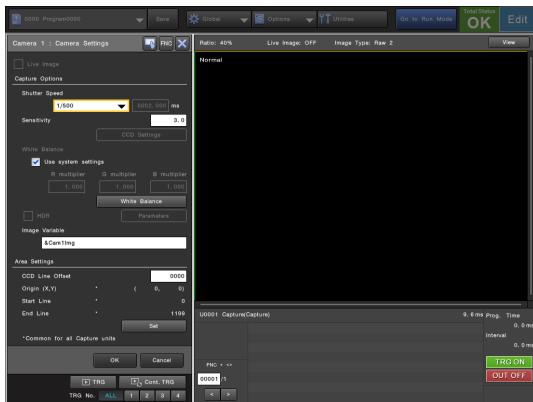


Enable

Check the box to enable the current setting target camera. Remove the check mark if a camera is connected to the controller but is not used.

Camera Settings

You can specify the conditions for image capture.



- The gain adjustment cannot be used if LumiTrax mode is enabled.
- If you change the capture options after the color extraction settings have been set, the color extraction result for the captured image may be different. Make sure to readjust the color extraction settings if the capture options are changed.

Live Image

Check this box to display the latest images through a continuous feed.



- [Live Image] is only available in Setup Mode.
- When the [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings] (Page 7-19), this cannot be changed.
- If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-19), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- [Live Image] is not available when LumiTrax Mode is enabled.

Capture Options

Shutter Speed

Select or enter the shutter speed for the camera specified in camera tab. Select the shutter speed according to the target movement speed and lighting conditions. When setting the shutter speed to match a fast line, prepare a light where the required lighting can be secured for producing the desired images.

The range for possible shutter speed adjustment is different for each camera.

- CA-HX048C/HX048M: 0.022 to 1000 (ms)
- CA-HX200C/HX200M/HX500C/HX500M: 0.010 to 100 (ms)

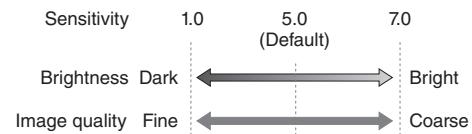
Sensitivity

The sensitivity of the camera can be adjusted. Typically, to adjust the brightness of an image, the lens aperture, lighting and shutter speed are the ones adjusted accordingly.

However, if none of these improve image brightness, such as in lines where the movement speed is fast, then change the camera sensitivity.



- If the camera sensitivity is increased, so will the overall brightness of the image. However, noise in the image will become more visible (and the image will appear coarser). When the camera sensitivity is decreased, the overall image darkens but the noise will be reduced (the image appears smoother).



- If the camera sensitivity is set higher than default, a vertical line may appear on the screen depending on the capture condition. This phenomenon is a feature of the controller and not an error. If this occurs, set the camera sensitivity lower and secure illuminance via an external auxiliary lighting etc.
- The range of sensitivity adjustment for each camera type is different.
 - CA-HX048C/HX048M: 1.0 to 7.0 (Default: 2)
 - CA-HX200C/HX200M/HX500C/HX500M: 1.0 to 7.0 (Default: 3)

Capture (LumiTrax Mode) (Area Camera Only)

White Balance

Adjustment of the white balance of the camera specified in camera tab. When a color camera is used, you can adjust the color balance to reproduce an exact white by correlating the illumination of the environment to a reference.

- **R Multiplier:** Specify the correction multiplier for the R component.
- **G Multiplier:** Specify the correction multiplier for the G component.
- **B Multiplier:** Specify the correction multiplier for the B component.



- This setting cannot be changed when the [Use system settings] option is checked.
- The color extraction result and other measurement results may change due to changes in the white balance setting. Be sure to verify the operation after changing the white balance setting.

HDR

HDR allows an image with a broad dynamic range to be created by capturing multiple images at different exposures.



HDR capture cannot be used when LumiTrax Mode is enabled.

Image Variable

Specify an image variable which will contain the image captured with the camera selected in camera tab.

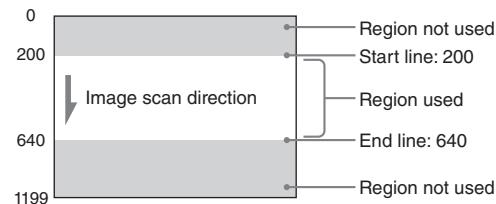


- Variables to be specified need to be added in advance on the [Variable Settings] screen (Page 4-4).
- Changing this setting will clear all image variables, archived data, output buffer, and target classification results.

Area Settings

The current CCD imaging region for the camera is displayed.

Example: When the CCD imaging region is set to “Start Line: 200, End Line:640”



CCD Line Offset

Set the offset for the start line in the CCD imaging region settings.

The range of setting values available are from 0 (Default) to (Maximum capture lines of the camera used - Specified end line).



- When the pixel CCD line offset is set, the line positions following the offset are shown in blue next to the [Start Line] and [End Line].
- When the offset value is changed, the processing time for the capture unit that will recently be executed is extended due to the changes being applied.

Set

Set the CCD imaging region.

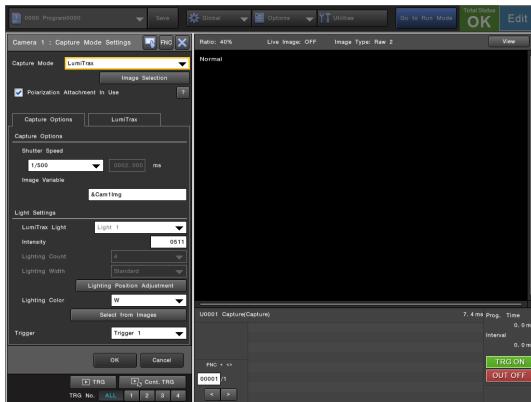
- **Origin X:** Specify the X coordinate of the origin (upper left) of the capture range.
- **Origin Y:** Specify the Y coordinate of the origin (upper left) of the capture range.
- **Start Line:** Specify the start line of the capture range.
- **End Line:** Specify the end line of the capture range.
- **Mirror / Rotate Image:** Select whether to perform mirror inversion or rotation of the capture image.
 - **OFF** (Default): Does not mirror the image horizontally.
 - **Horizontal:** Captures the image horizontally inverted.
 - **Vertical:** Captures the image vertically inverted.
 - **180° Rotate:** Rotates the image by 180° during image capture.



- While a CCD imaging region is being set, ordinary capture is performed even if HDR capture is enabled.
- Workpieces will not be processed if they do not lie between the start and end lines, even if they are in the process area.
- The area around the edge of the captured image may appear dark when a lens with a small maximum image size is used and the process area is at the edge part of the capture element.
- The CCD setting is common for all capture units.
- When setting the CCD imaging region, all image variables, archived data, and the output buffer are cleared.
- Once an image has been inverted/rotated, it cannot be reverted to the original image (normal orientation) in this unit.

Capture Mode Settings

Change the LumiTrax mode settings.



When using an image captured with LumiTrax Mode as a registered image, handling is different from standard captured images. See "Registration Numbers of Images Captured with LumiTrax Mode" (Page 7-26) for more details.

Capture Mode

To use LumiTrax Mode, select [LumiTrax].



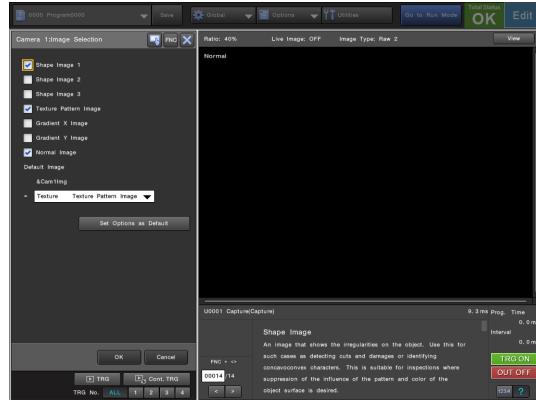
The LumiTrax mode cannot be set in the following conditions.

- When a line scan camera or an LJ-V Series sensor head is connected
- When a 3D camera is specified as another camera in the same capture unit
- When a different Capture Mode (with the exception of Standard Lighting Mode) or HDR is selected for another camera in the same capture unit
- When Specify Encoder is used in the trigger setting

Image Selection

Select the image you wish to use in LumiTrax mode.

- When selecting [Image Selection], the [Image Selection] screen appears. Put a check mark to the image type to be generated by LumiTrax mode.
- The image specified in [Default Image] is the image to be referred when the image variable extension is omitted.



See "Images that Can be Generated with LumiTrax Mode" (Page 7-25) for more details on the image types.

Set Options as Default

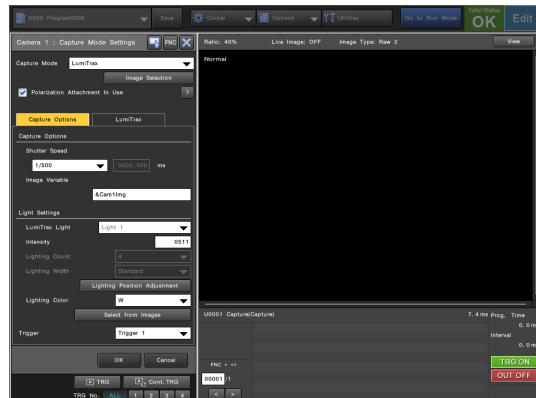
It saves the image select status and the default image select status to the System Settings. After this, the images selected by default in Image Selection and the initial value of Default Image when a program setting is newly created or a Capture unit is added will be the state that is saved in the System Settings.

Polarization Attachment In Use

When the CA-DRM*PA is attached to the MultiSpectrum Light CA-DRM*X, selecting the [Polarization Attachment In Use] check box can suppress the lighting of the ultraviolet (UV) light, which may cause polarization filter deformation or deterioration.

Capture Options

You can set the capturing conditions and image processing for when LumiTrax mode is used.



Capture (LumiTrax Mode) (Area Camera Only)

Shutter Speed

Select or enter the shutter speed for the camera specified in camera tab. Select the shutter speed according to the target movement speed and lighting conditions.

Point This setting is common with the [Shutter Speed] setting on the [Camera Settings] screen.

Image Variable

Specify an image variable which will contain the image captured with the camera selected in camera tab.

Point

- Variables to be specified need to be added in advance in the [Variable Settings] screen.
- Changing the setting clears all image variables, archived data, and target classification results.

Light Settings

- LumiTrax Light:** Selects the light to be used in LumiTrax mode. The light numbers correspond to the connection order of the illumination expansion units.

Point Only the CA-DRW*X (connected to CA-DC50E) or CA-DRM*X/DXW10X (connected to CA-DC60E) lights can be used in LumiTrax Mode.

- Intensity:** Specifies the brightness of the light in the range between 0 and 1023 (Default: 511).

Point

- If two lights, including a CA-DWX10X, are connected to the CA-DC50E, the CA-DWX10X light intensity, regardless of the settings, is limited to 320.
- If you are using the CA-DRM10X or CA-DRM20X in MultiSpectrum Mode or Standard Lighting Mode, the light intensity when one light is connected to one light controller (CA-DC60E) is limited to 700 and 511 when two lights are connected. There are no limits on the light intensity of the CA-DRM5X itself, but the limits above apply.
- If the CA-DWX10X is connected to the CA-DC60E and you use LumiTrax Mode, LumiTrax Specular Reflection Mode, or Standard Lighting Mode, the light intensity is limited to 700.

- Lighting Count:** Specifies the lighting count (Default: 4).

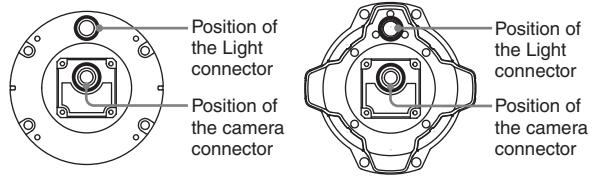
In the following inspections, setting this value to "8" will improve the stability of the inspection (only when using the CA-DRW*X light).

- Inspection of minute cuts
- Inspection of works that tend to have halation

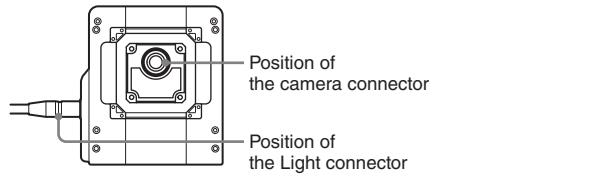
Point Setting "8" increases the number of images captured; therefore, the capturing time becomes longer (only when using the CA-DRW*X light).

- Lighting Width:** Specifies the width of light in one lighting. When halation occurs at the same position in several images, narrow down the lighting width (only when using the CA-DRW*X light).

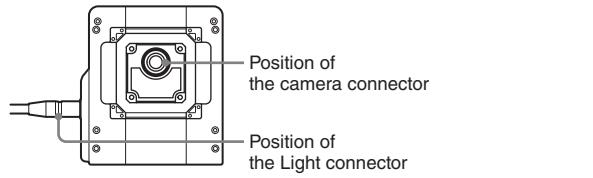
- Lighting Position Adjustment:** If the camera and the light connector positions are different from the following figure, adjustment is necessary. Adjust the lighting position of the light on the [Lighting Position Adjustment] screen.



for CA-DRW*X Series



for CA-DRM*X Series



for CA-DWX10X

Point The value set here is saved in the System Settings as the common setting value for all inspections.

- Lighting Color** (only when using the CA-DRM*X light): Specify the lighting color when using MultiSpectrum Light (Default: W). While [W] is normally used, you can also select a lighting color that is the same or similar to the workpiece color to eliminate unnecessary features on the workpiece surface or select a complementary lighting color to further highlight the features on the workpiece surface.

Trigger Setting

- Trigger:** Selects the trigger that will execute lighting. This setting is the same as [Trigger] on the [Trigger Settings] screen.

LumiTrax

You can specify the capturing conditions exclusive for LumiTrax mode.

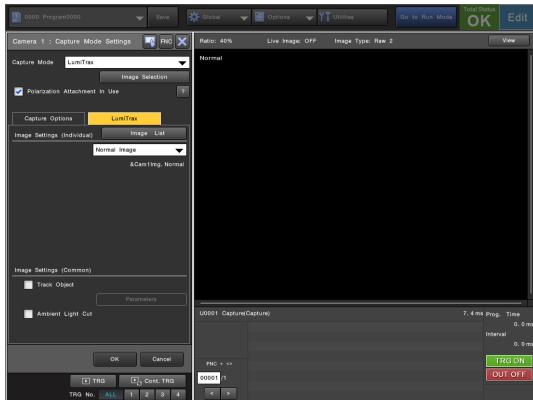


Image Settings (Individual)

You can specify the capturing conditions for each image type. See "Capture Modes Available with This Controller" (Page 7-3) for more details on the image types.

- Feature Size:** Specifies the size of the feature (cut, damage, character, etc.) to be emphasized ([Shape Image 1], [Shape Image 2], [Shape Image 3] only).
- Feature Size Margin:** Specifies the margin for the size of the feature to be emphasized ([Shape image 1], [Shape image 2], and [Shape image 3] only). When the value is decreased, only characteristics of a size that is approximate to [Feature Size] are emphasized. When the value is increased, characteristics with sizes not close to [Feature Size] are also emphasized.
- Contrast:** Adjusts the image contrast ([Shape image 1], [Shape image 2], [Shape image 3], [Texture Pattern Image] only).
- Level:** Adjusts the brightness of the entire image ([Shape image 1], [Shape image 2], [Shape image 3] only).
- Noise Cut:** Removes the minute noise elements from the background ([Shape image 1], [Shape image 2], [Shape image 3] only). This eliminates noise equal to or below the set tone.
- Halation Cut:** Specifies the level of halation removal ([Texture Pattern Image] only).

• **Options:** Sets the correction processing to be applied to the shape images and gradient images ([Shape Image 1], [Shape Image 2], [Shape Image 3], and [Gradient X Image], [Gradient Y Image] only). The correction process includes processes that are applied to images individually and processes that are applied commonly to the images.

- **Guided Filter:** Smoothens the image while keeping the features of the size specified in [Feature Size], such that the influence of the noise can be reduced. When the value is increased, the effect of the smoothening process increases (when the value is set to 0, it is disabled).
- **Texture Pattern Cut:** It removes effects of the patterns and the prints on the work surface. It is used when the print on the work surface stands out when inspecting for cuts and damages.
- **Halation Cut:** It specifies the level of halation removal.
- **Emphasis Direction:** It emphasizes the irregularities in the specified direction and suppresses the irregularities of the other direction. It is used when the change of the irregularities to be checked has directionality.
- **Degree:** Specifies the emphasis level for when using [Emphasis Direction].

Point The settings of [Halation Cut] and [Emphasis Direction] of the [Options] screen affect all shape images and gradient images.

Image Settings (Common)

- Track Object:** Check this option when tracking a moving workpiece and using LumiTrax mode. See "Applying LumiTrax Mode to a Moving Workpiece (Track Object)" (Page 7-18) for more details.

Point The number of images captured increases; therefore, the capturing time becomes longer.

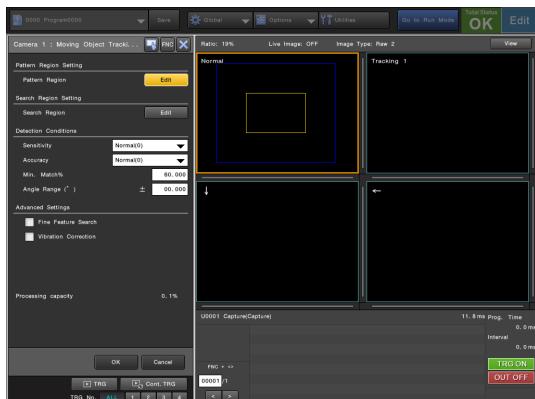
- Ambient Light Cut:** Check this option if you wish to suppress the effect on the measurement by ambient light other than the light for the measurement.

Point The number of images captured increases; therefore, the capturing time becomes longer.

Capture (LumiTrax Mode) (Area Camera Only)

Applying LumiTrax Mode to a Moving Workpiece (Track Object)

When using LumiTrax mode for a moving workpiece, check [Track Object] in the [LumiTrax] tab and then select [Parameters].



Specify the pattern for detecting the movement and change the settings for the pattern detection.

Pattern Region

Record the image of the model to search for as a [Pattern Region].

Search Region

Set a range (search region) in the image to search for the model recorded in the pattern region.

Sensitivity

Configure the search sensitivity. When detection is unstable, increase the level of sensitivity.

Accuracy

Configure the search accuracy. To measure with a high level of accuracy, set the search accuracy higher.

Min Match %

[Match%] is the value that indicates the percentage of similarity with the cut out pattern.

Check the variable range of the correlation value and set the numeral value lower than the variable range. The pattern with a correlation value that is lower than [Min. Match%] is excluded from the measurement candidates. Therefore, it is useful when prevention of erroneous detection is desired.

- When the value is lowered too much, the number of erroneous detection increases.
- When there is no pattern with a value that is higher than the Min. Match%, measurement is done considering it as there being no movement amount.

Angle Range (°)

When a pattern is tilted due to movement of the workpiece, specify the angle to be measured in the range between -90 and 90 degrees.

Fine Feature Search

Put a check mark when it is necessary to search with fine characteristic such as when searching on metal cast surface.



Point

The detection accuracy improves; however, processing time becomes longer.

Vibration Correction

Put a check mark when the work is vibrating or when the work moving speed changes during capturing.



Point

The number of images captured increases; therefore, the capturing time becomes longer.

Tracking a moving object in LumiTrax Mode

In addition to the partially lighted images that are necessary for LumiTrax processing, it additionally captures images that are used for calculation of the movement amount of the Object. LumiTrax processing is conducted based on the positional change of the pattern at the location specified in the image. With this function, LumiTrax Mode becomes usable even in the environment where the work moves on the screen during capturing.

1. Images captured when Track Object is disabled

It captures the normal image and the images used to generate the Shape Image, Texture Pattern Image, gradient X image and gradient Y image. LumiTrax processing cannot be conducted properly if the work does not stay still until the completion of capturing.



2. Images captured when Track Object is enabled

It is used when the work transfer speed is constant. In addition to the normal image and the images used to generate the Shape Image, Texture Pattern Image, gradient X image and gradient Y image, it captures the tracking image 1 for calculation of the movement amount. By comparing the patterns on these images, it estimates the movement amount at when each image is captured, and then conducts LumiTrax processing.



3. Images captured when Track Object is enabled (Vibration Correction applied)

It is used when the work transfer speed is not constant or for work that vibrates.

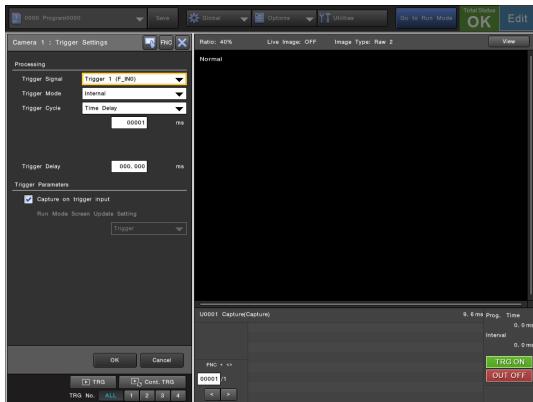
In addition to the images that are captured when Track Object is enabled, it additionally captures the tracking image 2. By comparing the normal image and tracking images 1 and 2, it detects and estimates the work vibration and speed change, and then conducts LumiTrax processing.



 To use Track Object, see "Tracking a moving object in LumiTrax Mode" (Page 7-18).

Trigger Settings

Specify the settings for triggering the controller to take an image.



Processing

Trigger Signal

Select the trigger signal to be used. The assignment of trigger signals and terminals are specified on the [Terminal Block & Parallel Port] screen (Page 6-11) in the [Global] menu.

Trigger Mode

Select the type of trigger to be used.

- **External** (Default): Captures images in response to trigger inputs from the handheld controller or trigger signals sent from an external device. The process is performed only once for each trigger input.
- **Internal**: Capture images in response to internally generated periodic trigger signals by specifying the interval time or encoder count.



If [Trigger Mode] is set to [Internal] and [Trigger Cycle] is set to [Time Delay], respectively, the trigger will constantly be generated while in Run mode (No triggers are generated in Setup mode). To temporarily stop the generation of internal trigger signals from an external device, use either of the following methods to prohibit trigger input. When internal trigger is disabled, the output of the result data up to that point continues.

- Terminal block input (EXT terminal)
- Communications command (TE,0 command).

For more details, see the XG-X2000 Series Communications Control Manual.

Trigger Cycle (Only When [Internal] is Selected)

- **Time Delay** (Default): Select to specify the trigger cycle based on time.
- **Specify Encoder**: Select to specify the trigger cycle using the encoder's pulse count.



[Specify Encoder] cannot be selected if LumiTrax Mode is enabled.

External Trigger Device (Only When [External] is Selected)

To use an external trigger, select and check the type of trigger to be used for image capture.

- **Terminal Block**: Trigger input through the external terminal assigned with %Trg1 through to 4
- **Handheld Controller/Mouse**: Trigger input provided by the No.3 (TRIGGER) button on the handheld controller or the TRG button on the screen.
- **RS-232C**: Trigger input through the RS-232C commands
- **Ethernet (TCP/IP)**: Trigger input through the Ethernet commands
- **PLC-Link**: Trigger input through RS-232C or Ethernet PLC-Link commands
- **CC-Link**: Trigger input through the CC-Link bit devices or commands
- **EtherNet/IP**: Trigger input through the EtherNet/IP cyclic communication, message communication, or commands
- **PROFINET**: Trigger input through the PROFINET cyclic communication, message communication, or commands
- **EtherCAT**: Trigger input through the EtherCAT cyclic communication, mailbox communication, or commands
- **PC Program**: Trigger input through the ActiveX control method



External triggers using the handheld controller/mouse are always available in Setup mode.

Trigger Delay

To set a time delay between the selected trigger input and capturing of an image, specify a trigger delay time (Trigger Delay).

The trigger delay can be set in the range between 0 and 999.999 ms for each camera.

Capture (LumiTrax Mode) (Area Camera Only)

Trigger Parameters

Capture on trigger input

Choose whether or not the capture unit will wait for a trigger signal to capture an image. When the check is removed, all cameras that are set will capture images according to the capture processing, regardless of their independent trigger signals.

This is the case when the image capture buffer (Page 4-12) is enabled and empty when the capture unit is processed. If there are any images in the buffer which satisfy the capture priority, the capture will be completed and the next unit will be executed regardless of this setting.

Run Mode Screen Update Setting

Select whether to update the camera images continuously in Run mode.

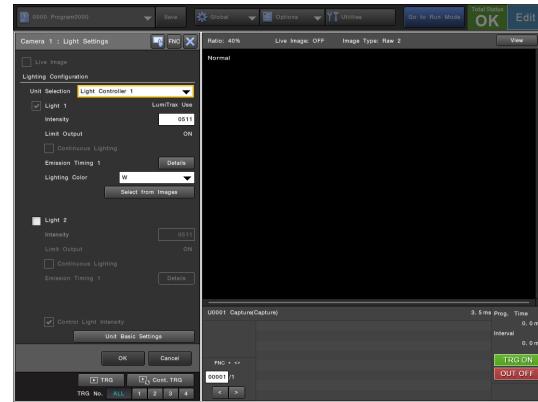
- Trigger:** Update the image only when a trigger input is received.
- Live Image:** Always displays the latest image while waiting for a trigger signal.

Point

- [Live Image] is only applied in Run mode.
- If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-19), this setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- Live Image is not available when LumiTrax (Page 7-8) or HDR capture (Page 7-14) is enabled.
- Even if [Live Image] is selected, the image is not updated continuously if [Live Image Feed] (Page 4-43) is not enabled in the camera Image Display screen part settings in Screen Editor (Page 4-25).

Light Settings

When an illumination expansion unit CA-DC40E/DC50E/DC60E (sold separately) is connected to the controller, the settings related to the light brightness and illumination are configured per light.



Live Image

Check this box to display the latest images through a continuous feed.

Point

- [Live Image] is only applied in Setup Mode.
- When the [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings] (Page 7-19), this cannot be changed.
- If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-19), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- [Live Image] is not available when LumiTrax Mode is enabled.

Lighting Configuration

Unit Selection

Choose the illumination expansion unit (light controller) to which the light you wish to enable emission is connected to.

Reference

- When multiple illumination expansion units are connected, they will be numbered 1 through 8, with 1 being the unit closest to the controller.
- If the connected illumination expansion unit and the model specified in [Illumination Expansion Unit] under [Camera - Trigger - Light Configuration Settings] are different, the currently selected light controller will be displayed in red.

Light*

Check the box of the light number you wish to enable emission.

Point

- Only the CA-DRW*X (connected to CA-DC50E) or CA-DRM*X/DXW10X (connected to CA-DC60E) lights can be used in LumiTrax Mode.
- The emission timing cannot be changed when continuous lighting is enabled.

Intensity

The brightness of each light can be set in the range of 0 to 1023 (Default: 511). Use this in conjunction with the shutter speed setting to correctly illuminate images.

Point

- The intensity can only be changed for lights that have been enabled in the [Light Configuration] screen (Page 6-9).
- The intensity of continuous lighting can be changed regardless of the camera selection. If a FLASH terminal output has been assigned to the light, the intensity can only be changed when the selected camera is the camera that is used with the FLASH terminal output.
- When the [Limit Output] is [ON], the upper limit is set to 511 (Even when 512 or a higher value is entered, the intensity remains at 511).
- When the [Limit Output] is [OFF] and the intensity is set to 512 or higher, be careful not to damage the light through excessive heat generation.
- If two lights, including a CA-DRW20X, are connected to the CA-DC50E, the CA-DRW20X light intensity, regardless of the settings, is limited to 320.
- If you are using the CA-DRM10X or CA-DRM20X in MultiSpectrum Mode or Standard Lighting Mode, the light intensity when one light is connected to one light controller (CA-DC60E) is limited to 700 and 511 when two lights are connected. There are no limits on the light intensity of the CA-DRM5X itself, but the limits above apply.
- If the CA-DXW10X is connected to the CA-DC60E and you use LumiTrax Mode, LumiTrax Specular Reflection Mode, or Standard Lighting Mode, the light intensity is limited to 700.

Limit Output

The status of the light output limit to prevent degradation of the LED light through overheating is displayed (Default: ON). To disable the light output limit, change the setting in [Unit Basic settings] or [Light Configuration] (Page 6-9) in the [Global] menu.

Continuous Lighting

Check this box to keep the light illuminated regardless of the FLASH terminal output.

Point

- Continuous lighting is unavailable for CA-DC50E.
- If two lights, including a CA-DRW20X, are connected to one light controller (CA-DC50E), the CA-DRW20X light intensity is limited to 320.
- If you are using the CA-DRM10X or CA-DRM20X in MultiSpectrum Mode or Standard Lighting Mode, the light intensity when one light is connected to one light controller (CA-DC60E) is limited to 700 and 511 when two lights are connected. There are no limits on the light intensity of the CA-DRM5X itself, but the limits above apply.

Emission Timing

The light emission timing controlled in linkage with the camera can be specified.

Select [Details] and select the illumination control timing from either emission timing 1 to 12 or external flash 1 to 4, and then specify the output on-delay and time. The light will illuminate in coordination with the assigned emission timing.

- Emission Timing 1 to 12:** Allows you to set the emission timing of each light controller each capture unit.
- External Flash 1 to 4:** Can be used in the same manner as the emission timing. However, the output on-delay and time settings are shared with the external flash terminals for controlling the external light.

Point

For CA-DC50E/DC60E, the output [On-Delay] and [Duration] are fixed values and cannot be changed.

Lighting Color (only when using the CA-DRM*X light):

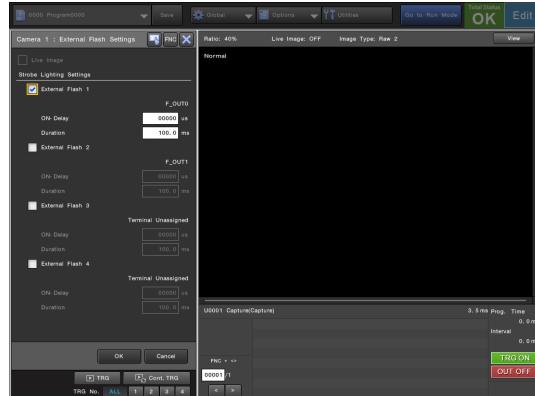
Specify the lighting color when using MultiSpectrum Light (Default: W). While [W] is normally used, you can also select a lighting color that is the same or similar to the workpiece color to eliminate unnecessary features on the workpiece surface or select a complementary lighting color to further highlight the features on the workpiece surface.

Unit Basic Settings

The basic common settings of the illumination expansion unit can be changed. The settings configured here are also reflected to [Light Configuration] in the [Global] menu (Page 6-9).

External Flash Settings

Specify the conditions for when using flash for image capture.



When the CA-DC40E/DC50E/DC60E (sold separately) illumination expansion unit is connected, the settings specified through the FLASH signals are also reflected to the illumination expansion unit.

Live Image

Check this box to display the latest images through a continuous feed.



- [Live Image] is only applied in Setup Mode.
- When the [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings] (Page 7-19), this cannot be changed.
- If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-19), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- [Live Image] is not available when LumiTrax Mode is enabled.

Strobe Lighting Settings

External FLASH*

Check the box for the subject FLASH* signal and specify the on-delay and duration.

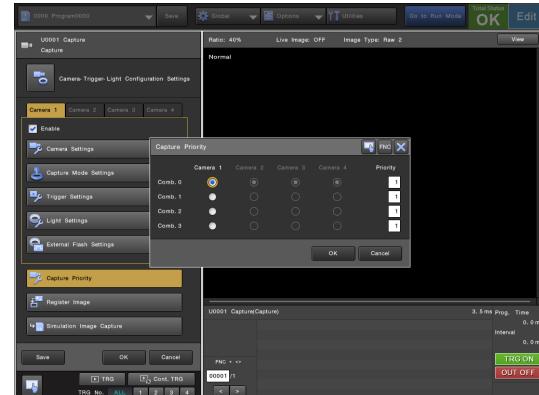
- **ON-Delay:** Set the Emission Timing 1-12 or External Flash signal 1-4 [ON-Delay] in the range from -50000 to 50000 (μ s) (If [Specify Encoder] is set for [Trigger Cycle], the range is -32767 to 32767 pulses.), with the image capture start time as 0 (Default: 0us = Same time as image capture start).
- **Duration:** Set the FLASH* signal output time in the range between 0.1 to 999.9 (ms).



The values for [ON-Delay] and [Duration] for the CA-DC50E/DC60E are fixed and cannot be changed.

Capture Priority

The [Capture Priority] screen appears, which controls the conditions of the trigger input status for capture unit completion (transition to the next unit) with priority. Normally, the capture unit is complete when the trigger inputs for all enabled cameras are received. It is possible to move to the next unit when the trigger input(s) of the specified camera(s) combination is received.



Comb. 0 to 3

Set up to four condition combinations to complete the capture unit. When all trigger inputs for the specified cameras are received, the process moves to the next unit.



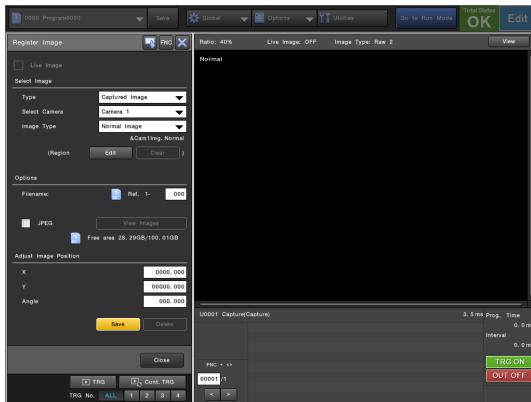
- Trigger input can only be specified for enabled cameras.
- The combination with which the unit was completed is stored as 0 to 3 in unit result data [Passing Status] (RSLT.STAT).

Priority

Specify the priority (from 1 to 4) for when more than one condition is met simultaneously. When the same priority is assigned, the condition met earliest is processed.

Register Image

Register images to use as the basis for measurements and setting.



Live Image

Check this box to display live images through a continuous feed.



- [Live Image] is only applied in Setup Mode.
- When the [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings] (Page 7-19), this cannot be changed.
- If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-19), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- [Live Image] is not available when LumiTrax Mode is enabled.

Select Image

Type

Select the image to be the registration source.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified in [Options].

Select Camera

Select the number of the camera used for registration.

Choose from Camera 1-4, and select only the camera number used for the capture unit being edited.

Image Type

When LumiTrax Mode is enabled, select the type of image to register from [Shape Image 1], [Shape Image 2], [Shape Image 3], [Texture Image], [Gradient X Image], [Gradient Y Image] and [Normal Image].

Region

To register only part of an image, select [Edit] then specify the region to register. To cancel the selected region, select [Clear].

Options

Filename

Specify the registered image number used for image registration in the form "(Camera No.)-(Specified No.)".



The saved file name is "ref (camera No.)(specified No.)" (for full screen image registration) or "ref (camera No.)(specified No.)_XXX_YYY" (for partial image registration).

JPEG

Check this box to save the image in JPEG format. When this box is not checked, the image will be saved in BMP format as either a 24-bit color bitmap image (color camera) or an 8-bit grayscale bitmap image (monochrome camera).



Using image compression may result in some image deterioration, thus measurement results from a compressed image may differ to those when using non compressed images.

View Images

You can check a list of registered images.

Adjust Image Position

Adjust the position of the image being captured.

X

Adjust the movement in the X (horizontal) direction between -8191.000 and 8191.000 pixels.

Y

Adjust the movement in the Y (vertical) direction between -16383.000 and 16383.000 pixels.

Angle

Adjust the position angle (rotation) around the center of the image between -999.999° and 999.999°.



Position adjustment may cause missing peripheries (black areas) due to image movement or jagged edges (jaggies) due to rotation in the registered image.

Save

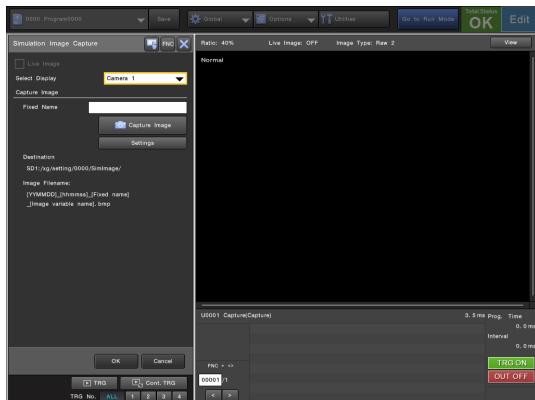
Save the displayed image as a registered image under the conditions specified on the [Register Image] screen.

Delete

When [Registered Image] is selected for [Type], you can delete the registered image specified in [Options].

Simulation Image Capture

The simulation image capture allows you to check the actual images captured by the camera based on the changed settings, or save the captured images to the SD card in the image format specified in the output settings. This is useful for quickly checking camera settings and saving images for simulation in XG-X VisionEditor.



Live Image

Check this box to display the latest images through a continuous feed.



- [Live Image] is only applied in Setup Mode.
- When the [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings] (Page 7-19), this cannot be changed.
- If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-19), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- [Live Image] is not available when LumiTrax Mode is enabled.

Select Display

Switch from 4-screen display to 1-screen display of the desired camera.

- **Camera 1:** Displays the image from Camera 1.
- **Camera 2:** Displays the image from Camera 2.
- **Camera 3:** Displays the image from Camera 3.
- **Camera 4:** Displays the image from Camera 4.
- **Camera 1 to 4:** Displays images from all the connected cameras.

Capture Image

Save the current camera image to the SD card in the save format specified in the output settings.

Fixed Name

Enter the fixed name if the file name contains a fixed name.

Capture Image

Save the image with the current settings.

Settings

The current save conditions can be checked in the list and changed as required.



- This function saves images from all cameras, regardless of the selected preview.
- When [Simulation Image Capture] is closed by selecting [OK], the update mode and VIEW bar settings will stay the same until power is turned off.

Save

The settings for all units are saved to the currently used program setting file in SD Card 1 or SD Card 2.



- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation.
As examples of items that can be made so they are not saved, there are the variables and the screen, such as a display pattern screen, display state changed in the current program setting.

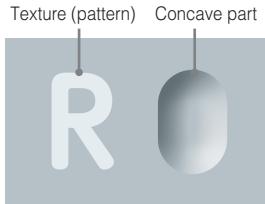
Other Changes When LumiTrax Mode is Used

Images that Can be Generated with LumiTrax Mode

With LumiTrax processing, you can generate images of the following types for use for the measurement.

Normal image

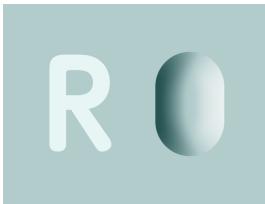
Images that are captured with all lights turned on.



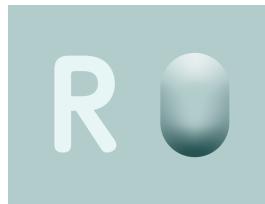
Partially lighted image

Images that are captured with lights partially turned on.

(Only the left light is on)



(Only the bottom light is on)



(Only the right light is on)



(Only the top light is on)



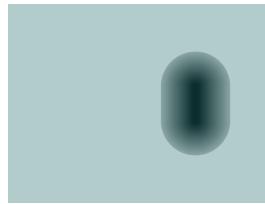
Texture pattern image

Images that show the patterns and colors on the work surface. It is used for detections of print failure and defects and for recognition of printed characters. It is suitable for inspections where the effects of halation should be suppressed.



Shape images (Shape Image 1 to 3)

Images that show the irregularities on the work. It is used for detections of cuts and damages and for recognition of concavoconvex characters. It is suitable for inspections where the influence of work surface patterns and colors should be suppressed. When there are several features with different sizes, it is possible to generate three types of shape images (shape image 1 to 3) by using different setting values and use the images for measurement, which is very convenient.



Gradient X image

Images that show the inclination in the X direction of each pixel. With respect to the image, the more the work is tilted to the left, the brighter the image becomes. Conversely, the more the work is tilted to the right, the darker the image becomes.

Gradient Y image

Images that show the inclination in the Y direction of each pixel. With respect to the image, the more the work is tilted upward, the brighter the image becomes. Conversely, the more the work is tilted downward, the darker the image becomes.

Registration Numbers of Images Captured with LumiTrax Mode

The registration image number [(Camera No.) - (Specified No.)] becomes as follows when registering images that are captured with LumiTrax Mode.

When the Image Variables that are Targets of Batch Registration are Specified

The following images are registered all at once in the 7 types of registered image number ranges below.

- Normal Image: 000 to 099
- Shape Image 1: 200 to 299
- Shape Image 2: 300 to 399
- Shape Image 3: 400 to 499
- Texture Pattern Image: 500 to 599
- Gradient X Image: 600 to 699
- Gradient Y Image: 700 to 799

See "Images that Can be Generated with LumiTrax Mode" (Page 7-25) for more details on the types of images.

Registration example:

When only the normal image, shape image 1, and texture pattern image are enabled as the image types to be acquired with LumiTrax Mode and when the images are registered to the registered image number 3, three images are registered as shown below.

- Normal Image: 003
- Shape Image 1: 203
- Texture Pattern Image: 503

When the Image Variables that are Not the Targets of Batch Registration are Specified

Only one image is registered to a range from 000 to 999 in the conventional way.

Handling of variables

When LumiTrax Mode is used, you can specify the image to use freely from the images that are captured with LumiTrax Mode for each of system image variable and user image variable.

- Shape1: Shape Image 1
- Shape2: Shape Image 2
- Shape3: Shape Image 3
- Texture: Texture Pattern Image
- GradientX: Gradient X Image
- GradientY: Gradient X Image
- Normal: Normal Image
- Tracking1: Tracking Image 1
- Tracking2: Tracking Image 2
- Upper: Partial Lighting Image(Upper)
- Right: Partial Lighting Image(Right)
- Lower: Partial Lighting Image(Lower)
- Left: Partial Lighting Image(Left)
- Ambient: Ambient Light Cut Image



When the image type is not specified, the image of the type specified as the default image is automatically used.

Image Output Unit

You can specify the contents of the output data.

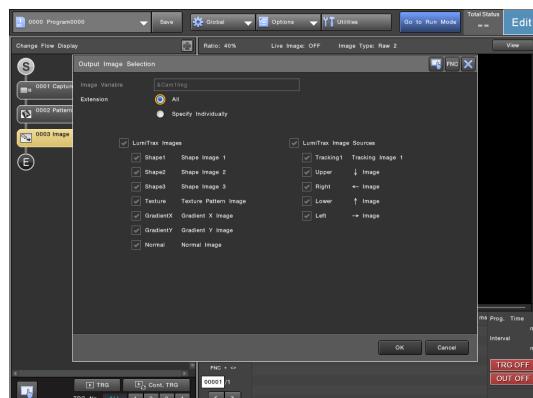
Image Setting

Image Variable

It specifies the image variable to be output.

When specifying an image array variable, specify the index to be output by a numeral value or a variable.

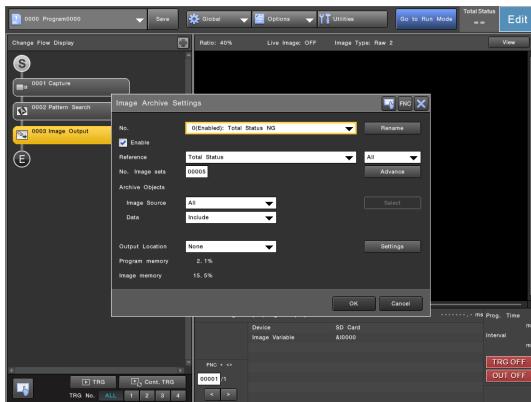
When LumiTrax Mode is used, you can specify and output any image from several generated images on the [Output Image Selection] screen displayed when [Settings] is selected.



[Settings] is operable only when the image variable that uses a camera with LumiTrax Mode selected is specified.

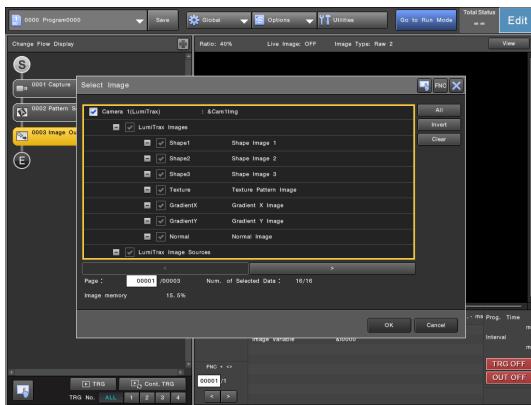
Image Archive Settings

In the state where flow editing is possible, open the [Image Archive Settings] screen by selecting [Utilities] at the upper section of the screen and then [Image Archive Settings]. On the screen, you can specify the detailed conditions for accumulating the images and result data, which were used for the inspections by the controller, to the image memory and resource memory in the controller as the archived data.



Archive Objects

- Image Source:** Select image variables that are subject of accumulation.
 - **All:** It sets all image variables in the program setting as subjects of accumulation (accumulates all images other than black images).
 - **Select:** Only selected image variables are subjects of accumulation (up to 256 image variables can be selected).



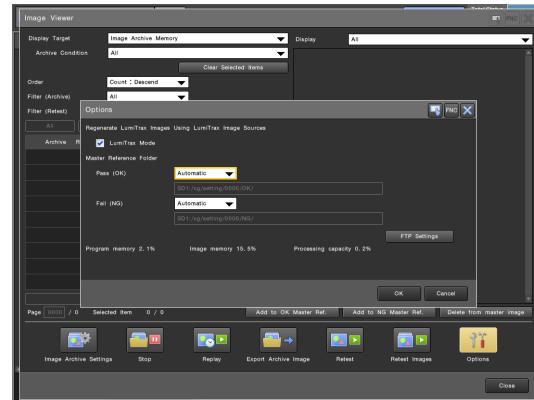
- Data:** It specifies whether or not the archive result data are accumulated (initial setting: Do not include).

Reference When LumiTrax Mode is used, you can specify any images from several generated images as subjects of archive accumulation.

Image Viewer

With flowchart editing enabled, from [Utilities] on the top of the screen, select [Image Viewer] to display the [Image Viewer] screen, and then select [Options] at the bottom of the screen.

By the [LumiTrax Mode] setting under [Regenerate LumiTrax Images Using LumiTrax Image Sources] on the [Options] screen, you can specify the method to generate the images that will be used during retesting which will be used in LumiTrax Mode.



Select this check box to adjust LumiTrax Mode settings during retesting. If you clear this check box, you will no longer need to archive generation source images in the image archive settings or other settings because images generated in LumiTrax Mode during image capture are used as is.

Communication Commands

BS Image Registration

Note when the LumiTrax Mode image is specified

All types of images that are selected as the image to be used with LumiTrax Mode are saved when executing the BS command.

Reference

- You can specify the types of images to be used on [Image Selection] of the capture unit (Page 7-15).
- See "Registration Numbers of Images Captured with LumiTrax Mode" (Page 7-26) for more details on registration image numbers used when registering images captured with LumiTrax Mode.

Point

- When an image variable without an extension such as [&Cam1Img] is specified while LumiTrax Mode is enabled, the image registration number becomes 000 to 099 regardless of the default image type.
- Even when 000 to 099 is specified in the BS command, the images that are actually stored to 000 to 099 are the normal images.
- For more details regarding the BS command, see the XG-X2000 Series Communications Control Manual.

UT Execution of Unit Test

Addition of an error code

When the unit specified as the subject of the unit test is a capture unit and the capture mode of any of the enabled cameras is not LumiTrax Mode or LumiTrax Specular Reflection Mode, the unit test cannot be executed and the error code 03 will be returned.

Execution of the unit test with regard to LumiTrax processing in the re-test mode

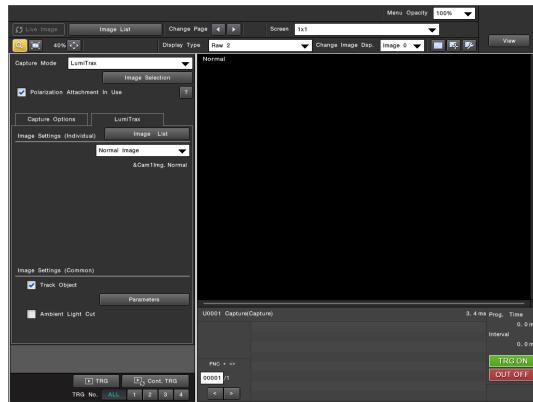
Whether or not LumiTrax processing is executed for the unit test depends on the [LumiTrax Processing] setting of the re-test setting.

Point

For more details regarding the UT command, see the XG-X2000 Series Communications Control Manual.

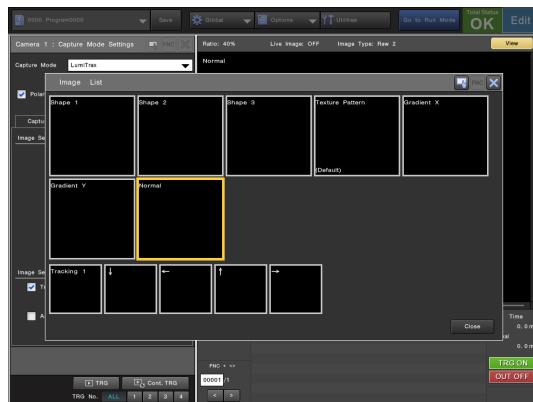
View bar

On the [Capture Mode Settings] screen for the capture unit, you can select [Image List] on the view toolbar to change the displayed LumiTrax Mode image (normal image, shape images 1-3, texture pattern image, gradient X image, and gradient Y image).



1 Select [Image List].

The [Image List] dialog will appear.



2 Select the LumiTrax Mode image that is to be displayed.

The dialog closes and the image switches to the one that is to be displayed.

LumiTrax Specular Reflection Mode

Overview of Capture Modes

LumiTrax Mode

► **LumiTrax Specular Reflection Mode**

MultiSpectrum Mode

Standard Lighting Mode
(MultiSpectrum light)

Switching to LumiTrax Specular Reflection Mode

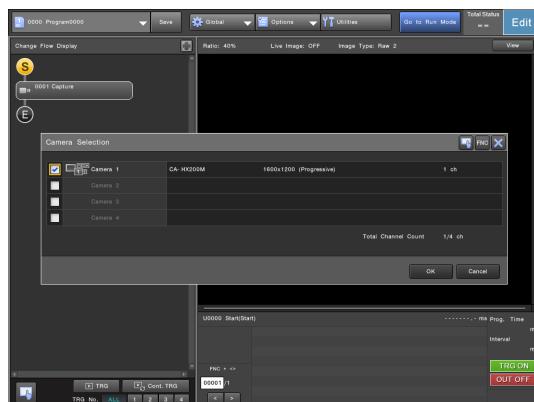
1 Prepare and connect a LumiTrax Specular Reflection Mode-compatible camera (CA-HX*M or CA-HL*MX).

For more details, refer to the XG-X2000 Series Setup Manual.

Point The lights that can be used in LumiTrax Specular Reflection Mode are CA-DWX10X (when using an area camera) or CA-DZW*X (when using a line camera or area camera) connected to CA-DC60E.

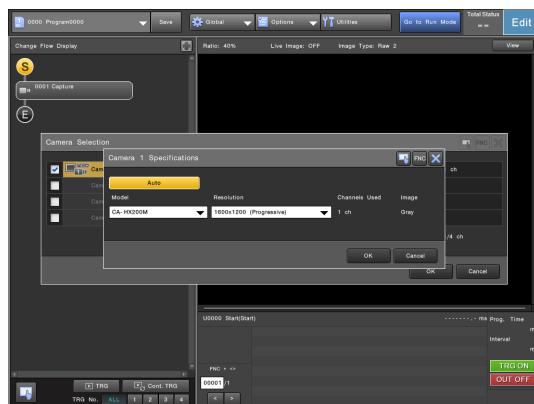
2 From the [Options] menu, select [Camera Settings] - [Camera Selection].

The [Camera Selection] menu appears.



3 Select the camera No. where the LumiTrax Specular Reflection Mode-compatible camera is connected.

The [Camera* Specifications] screen appears.



4 Check that the camera model displayed in the [Model] field matches the connected LumiTrax Specular Reflection Mode-compatible camera.

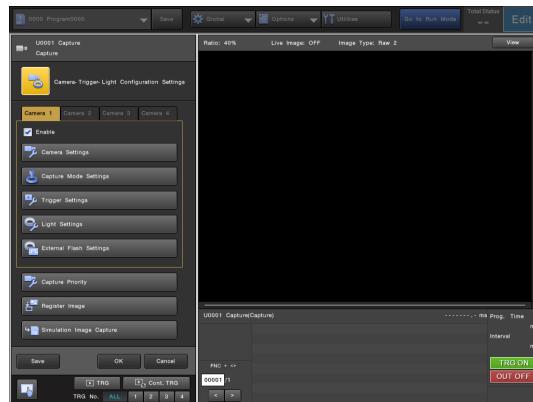
If a Different Camera is Displayed

Select [Auto] on the [Camera * Specifications] screen.

5 Select the capture resolution in the [Resolution] field.

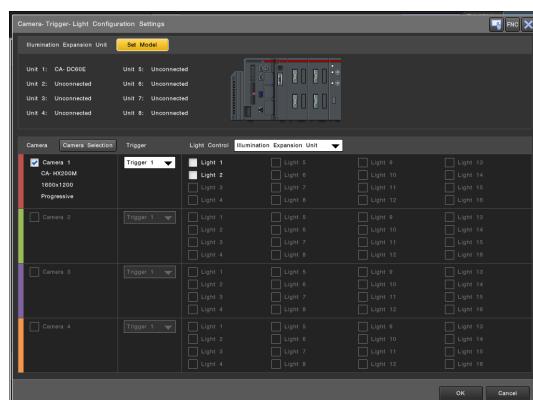
6 Select [OK].

7 Select the capture unit from the flowchart.



8 Select [Camera - Trigger - Light Configuration Settings].

The [Camera - Trigger - Light Configuration Settings] screen appears.



9 On the top of the screen, select [Set Model] for [Illumination Expansion Unit].

The [Illumination Expansion Unit Model Settings] screen appears.

10 Check that the connected illumination expansion unit is displayed.

If an illumination expansion unit is connected but [Unconnected] or a different model is displayed

Select the correct unit or select [Auto].

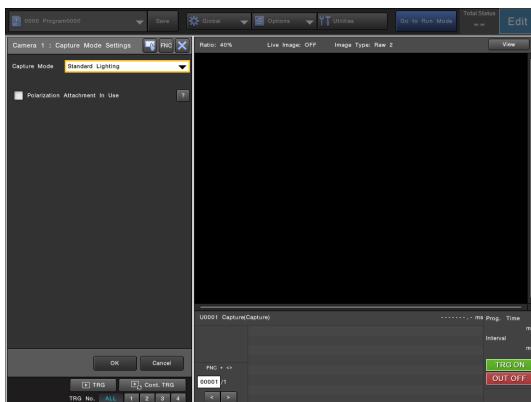
11 Select [OK].

12 Select [OK].

13 Select the tab of the camera No. where the LumiTrax Specular Reflection Mode-compatible camera is connected.

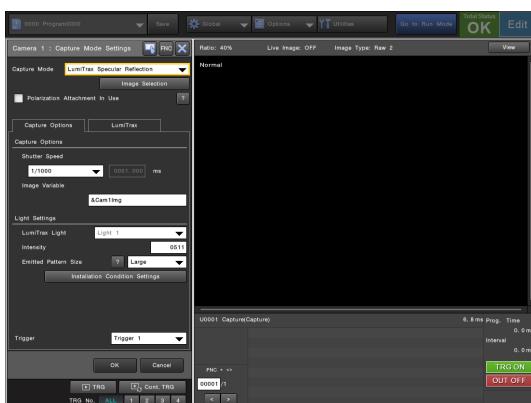
14 Select [Capture Mode Settings].

The [Capture Mode Settings] screen appears.



When the CA-DRM*PA is attached to the MultiSpectrum Light CA-DRM*X, selecting the [Polarization Attachment In Use] check box can suppress the lighting of the ultraviolet (UV) light, which may cause polarization filter deformation or deterioration.

15 In the [Capture Mode] field, select [LumiTrax Specular Reflection].



16 Change the capture unit settings according to the measurement target.

See "Capture (LumiTrax Specular Reflection Mode) (When Using an Area Camera)" (Page 7-32) or "Capture (LumiTrax Specular Reflection Mode) (When Using a Line Scan Camera)" (Page 7-44) for more details.

When Setting is Done

Add and configure other units that are required for measurement.

The operations and settings are the same as for measurements using area cameras.

For more details on the functions and restrictions that are specific to LumiTrax Specular Reflection Mode-compatible cameras, see "Other Changes When LumiTrax Specular Reflection Mode is Used" (Page 7-54).

Capture (LumiTrax Specular Reflection Mode) (When Using an Area Camera)

A capture unit is used for capturing images of the inspection/measurement target workpiece using a camera. When the CA-DC40E/DC50E/DC60E illumination expansion unit is connected, the settings (flashing/light intensity) can be controlled without wiring to the controller.

- This section provides information on the settings for when using LumiTrax Specular Reflection Mode with LumiTrax Specular Reflection Mode-compatible area cameras. When using other cameras, refer to the description below.
 - Area Camera: Page 2-25
 - 3D Camera: Page 8-14
 - LJ-V Series head: Page 8-22
 - Line Scan Camera: Page 8-175
- When using other capture modes, refer to the following descriptions:
 - LumiTrax Mode (area camera only): Page 7-11
 - LumiTrax Specular Reflection Mode (line scan camera): Page 7-44
 - MultiSpectrum Mode (area camera only): Page 7-62
 - Standard Lighting Mode Using MultiSpectrum Light: Page 7-86
- For special notes when using LumiTrax Specular Reflection Mode, see "Other Changes When LumiTrax Specular Reflection Mode is Used" (Page 7-54)

Image Capture Setup

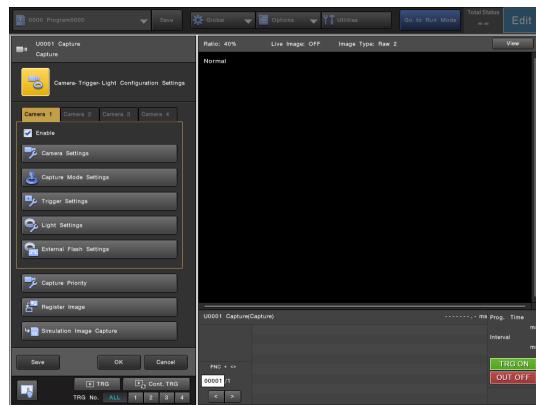
In the capture unit, images are captured by using the cameras, maximum of 4, connected to the controller. The image data is sent from the camera to the controller and stored in a specified image variable.



- If the cameras used in a capture unit are different from the cameras actually connected to the controller, a camera setting error will occur. No image capturing and subsequent image processing units will be processed. In such cases, set the camera model setting correctly or turn off the controller and connect the correct camera.
- The model and other information for the camera set in a capture unit can be viewed in the [Camera Selection] screen (Page 4-11).

Top Menu

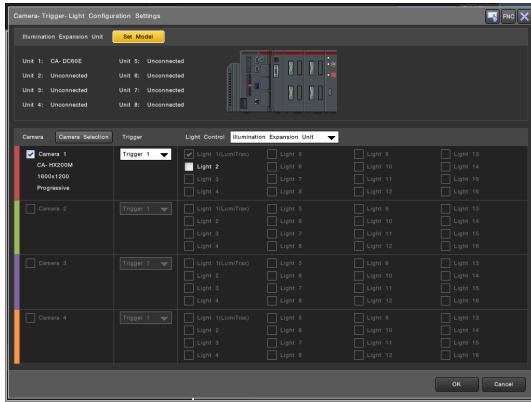
The capture unit menu has the following options. Change the settings as required.



Camera - Trigger - Light Configuration Settings (Page 7-33)	The connected cameras and illumination expansion units, trigger input for each camera, and illumination control targets can be configured together.
Camera Settings (Page 7-34)	You can specify the conditions for image capture.
Capture Mode Settings (Page 7-35)	Change the LumiTrax Specular Reflection Mode settings.
Trigger Settings (Page 7-38)	Specify the settings for triggering the controller to take an image.
Light Settings (Page 7-39)	When an illumination expansion unit CA-DC40E/DC50E/DC60E (sold separately) is connected to the controller, the settings related to the light brightness and illumination are configured per light.
External Flash Settings (Page 7-41)	Set the illumination timing for controlling external light equipment using the external FLASH terminal.
Capture Priority (Page 7-41)	This option controls the conditions of the trigger input status for capture unit completion (transition to the next unit) with priority.
Register Image (Page 7-42)	Register images to use as the basis for measurements and setting.
Simulation Image Capture (Page 7-43)	Save the captured image to the SD card. The saved images can be referenced as simulation images in XG-X VisionEditor.

Camera - Trigger - Light Configuration Settings

The connected cameras and illumination expansion units, trigger input for each camera, and illumination control targets can be configured together.



Illumination Expansion Unit

Displays the information of the illumination expansion unit connected to the controller. Select [Set Model] to specify the model of the connected illumination expansion unit for each light unit No.

Camera

Check the camera No. box of the camera to be used. Select [Camera Selection] to specify the model of the connected camera for each camera No. See "Specifying the Model of the Connected Camera (Camera Selection)" (Page 4-11) for more details.

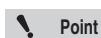
Trigger

Select the trigger to be assigned to each camera.

Light Control

Specify the control method for the light assigned to each camera.

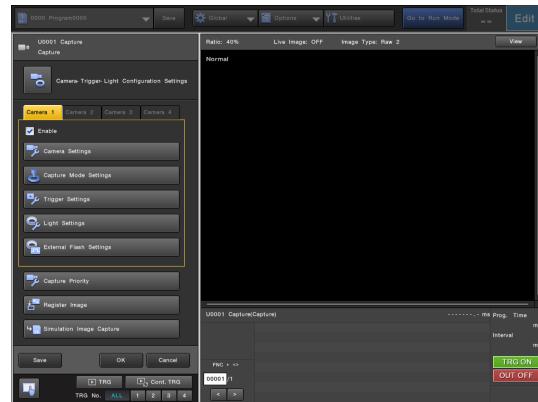
- Illumination Expansion Unit:** Check the light number of the illumination expansion unit to which you wish to assign an illumination control.
- External Flash:** Check the external terminal to which an illumination control will be assigned.



The lights that can be used in LumiTrax Specular Reflection Mode when using an area camera are CA-DXW10X or CA-DZW*X (connected to CA-DC60E) only.

Camera 1 to Camera 4

Select the tab of the camera for setting the capture options for.



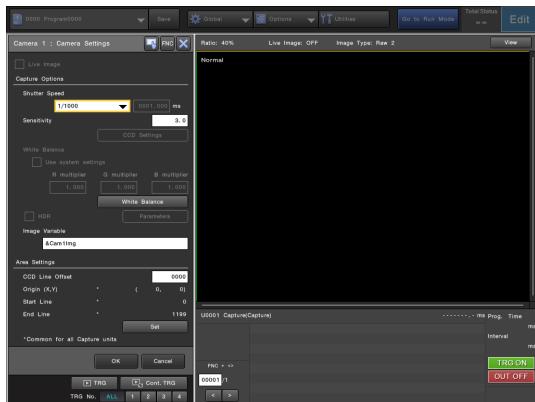
Enable

Check the box to enable the current setting target camera. Remove the check mark if a camera is connected to the controller but is not used.

Capture (LumiTrax Specular Reflection Mode) (When Using an Area Camera)

Camera Settings

You can specify the conditions for image capture.



- Point** The gain adjustment cannot be used if LumiTrax Specular Reflection Mode is enabled.

Live Image

Check this box to display the latest images through a continuous feed.

- Point**
- [Live Image] is only available in Setup Mode.
 - When the [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings] (Page 7-19), this cannot be changed.
 - If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-19), this check box is always unchecked and the setting cannot be changed.
 - When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
 - In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
 - [Live Image] is not available when LumiTrax Specular Reflection Mode is enabled.

Capture Options

Shutter Speed

Select or enter the shutter speed for the camera specified with the camera tab. Select the shutter speed according to the target movement speed and lighting conditions. When setting the shutter speed to match a fast line, prepare a light where the required lighting can be secured for producing the desired images.

The range for possible shutter speed adjustment is different for each camera.

- CA-HX048M: 0.022 to 1000 (ms)
- CA-HX200M/HX500M: 0.010 to 100 (ms)

Sensitivity

The sensitivity of the camera can be adjusted. Typically, to adjust the brightness of an image, the lens aperture, lighting and shutter speed are the ones adjusted accordingly.

However, if none of these improve image brightness, such as in lines where the movement speed is fast, then change the camera sensitivity.



- If the camera sensitivity is increased, so will the overall brightness of the image. However, noise in the image will become more visible (and the image will appear coarser). When the camera sensitivity is decreased, the overall image darkens but the noise will be reduced (the image appears smoother).



- If the camera sensitivity is set higher than default, a vertical line may appear on the screen depending on the capture condition. This phenomenon is a feature of the controller and not an error. If this occurs, set the camera sensitivity lower and secure illuminance via an external auxiliary lighting etc.
- The range of sensitivity adjustment for each camera type is different.
 - CA-HX048M: 1.0 to 7.0 (Default: 2)
 - CA-HX200M/HX500M: 1.0 to 7.0 (Default: 3)

HDR

HDR allows an image with a broad dynamic range to be created by capturing multiple images at different exposures. Check this option when using HDR capture. The use of HDR capture can provide an image which is suitable for processing even when there is uneven glare, mixed bright and dark spots, or other issues with the inspection target.



- HDR capture cannot be used when LumiTrax Specular Reflection Mode is enabled.

Image Variable

Specify an image variable which will contain the image captured with the camera selected in the camera tab.

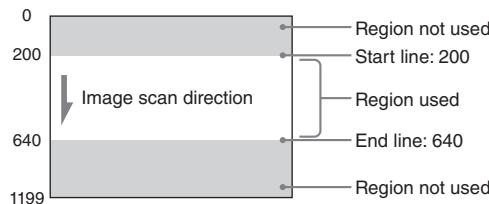


- Variables to be specified need to be added in advance on the [Variable Settings] screen (Page 4-4).
- Changing this setting will clear all image variables, archived data, output buffer, and target classification results.

Area Settings

The current CCD imaging region for the camera is displayed.

Example: When the CCD imaging region is set to “Start Line: 200, End Line:640”



CCD Line Offset

Set the offset for the start line in the CCD imaging region settings. The range of setting values available are from 0 (Default) to (Maximum capture lines of the camera used - Specified end line).



- When the CCD line offset is set, the line positions following the offset are shown in blue next to the [Start Line] and [End Line].
- When the offset value is changed, the processing time for the capture unit that will recently be executed is extended due to the changes being applied.

Set

Set the CCD imaging region.

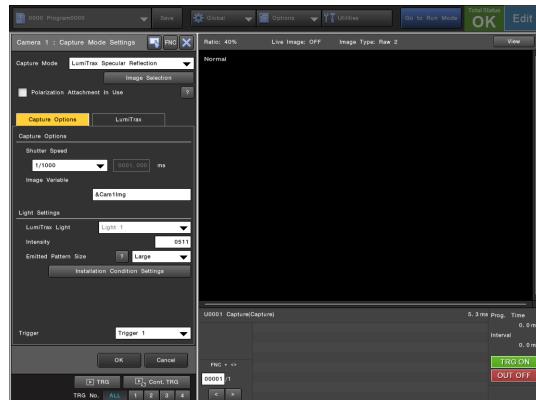
- Origin X:** Specify the X coordinate of the origin (upper left) of the capture range.
- Origin Y:** Specify the Y coordinate of the origin (upper left) of the capture range.
- Start Line:** Specify the start line of the capture range.
- End Line:** Specify the end line of the capture range.
- Mirror / Rotate Image:** Select whether to perform mirror inversion or rotation of the capture image.
 - OFF** (Default): Does not mirror the image horizontally.
 - Horizontal:** Captures the image horizontally inverted.
 - Vertical:** Captures the image vertically inverted.
 - 180° Rotate:** Rotates the image by 180° during image capture.



- Workpieces will not be processed if they do not lie between the start and end lines, even if they are in the process area.
- The area around the edge of the captured image may appear dark when a lens with a small maximum image size is used and the process area is at the edge part of the capture element.
- These settings are common for all capture units.
- When setting the CCD imaging region, all image variables, archived data, and the output buffer are cleared.
- Once an image has been inverted/rotated, it cannot be reverted to the original image (normal orientation) in this unit.

Capture Mode Settings

Change the LumiTrax Specular Reflection Mode settings.



When using an image captured with LumiTrax Specular Reflection Mode as a registered image, handling is different from standard captured images. See "Registration Numbers of Images Captured with LumiTrax Specular Reflection Mode" (Page 7-55) for more details.

Capture Mode

To use LumiTrax Specular Reflection Mode, select [LumiTrax Specular Reflection].



The LumiTrax Specular Reflection Mode cannot be set in the following conditions.

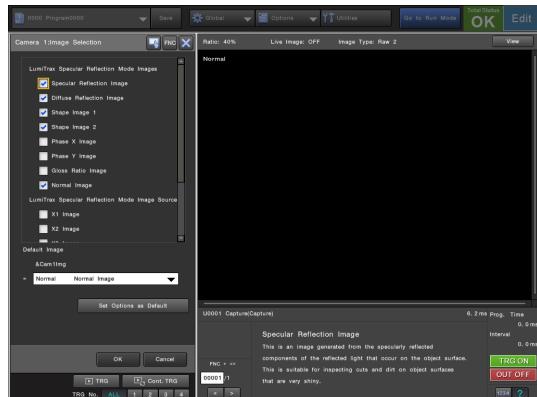
- When a line scan camera or an LJ-V Series sensor head is connected
- When a 3D camera is specified as another camera in the same capture unit
- When a different Capture Mode (with the exception of Standard Lighting Mode), LumiTrax Specular Reflection Mode (line scan camera) or HDR is selected for another camera in the same capture unit
- When Specify Encoder is used in the trigger setting

Capture (LumiTrax Specular Reflection Mode) (When Using an Area Camera)

Image Selection

Select the image you wish to use in LumiTrax Specular Reflection Mode.

- When selecting [Image Selection], the [Image Selection] screen appears. Put a check mark to the image type to be generated by LumiTrax Specular Reflection Mode.
- The image specified in [Default Image] is the image to be referred when the image variable extension is omitted.



See "Images that Can be Generated with LumiTrax Specular Reflection Mode" (Page 7-54) for more details on the image types.

Set Options as Default

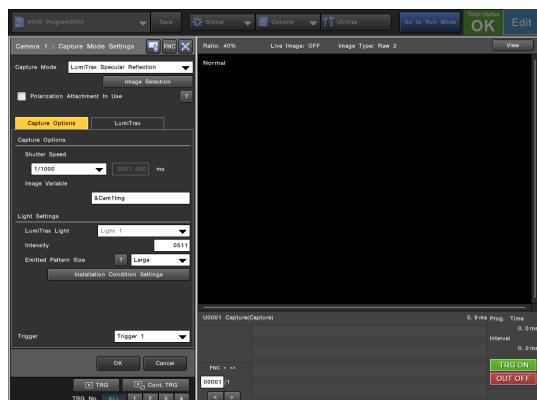
It saves the image select status and the default image select status to the System Settings. After this, the images selected by default in Image Selection and the initial value of Default Image when a program setting is newly created or a Capture unit is added will be the state that is saved in the System Settings.

Polarization Attachment In Use

When the CA-DRM*PA is attached to the MultiSpectrum Light CA-DRM*X, selecting the [Polarization Attachment In Use] check box can suppress the lighting of the ultraviolet (UV) light, which may cause polarization filter deformation or deterioration.

Capture Options

You can set the capturing conditions and image processing for when LumiTrax Specular Reflection Mode is used.



Shutter Speed

Select or enter the shutter speed for the camera specified with the camera tab. Select the shutter speed according to the target movement speed and lighting conditions.

Point This setting is common with the [Shutter Speed] setting on the [Camera Settings] screen.

Image Variable

Specify an image variable which will contain the image captured with the camera selected in the camera tab.

Point

- Variables to be specified need to be added in advance in the [Variable Settings] screen.
- Changing the setting clears all image variables, archived data, and target classification results.

Light Settings

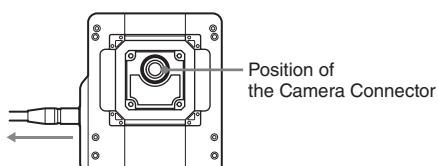
- LumiTrax Light:** Selects the light to be used in LumiTrax Specular Reflection Mode. The light numbers correspond to the connection order of the illumination expansion units.

Point The lights that can be used in LumiTrax Specular Reflection Mode when using an area camera are CA-DWX10X or CA-DZW*X (connected to CA-DC60E) only.

- Intensity:** Specifies the brightness of the light in the range between 0 and 1023 (Default: 511).

Point If the CA-DWX10X or CA-DZW30X/DZW50X is connected to CA-DC60E and you use LumiTrax Specular Reflection Mode or Standard Lighting Mode, the light intensity is limited to 700. However, with regard to the CA-DZW50X, if the ambient temperature exceeds 35 °C, the actual light intensity that can be used is up to 511 and if the intensity is set to a value higher than that, a warning message may be displayed.

- Emitted Pattern Size:** Selects the size for the emitted pattern (default setting: Large).
- Installation Condition Settings:** Sets the light cable direction as seen from the camera and light setup in accordance with the actual installation state in order to use LumiTrax Specular Reflection Mode. Normally, setup the camera and light so that the direction of the lighting cable is on the left side of the camera as shown in the figure below.



- Trigger:** Selects the trigger signal to be used. This setting is the same as [Trigger Signal] on the [Trigger Settings] screen.

LumiTrax

You can specify the capturing conditions exclusive for LumiTrax Specular Reflection Mode.

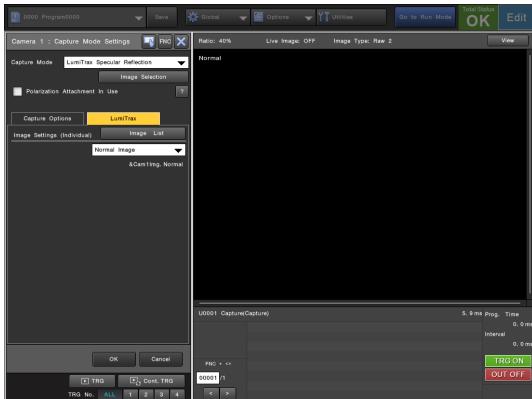


Image Settings (Individual)

You can specify the capturing conditions for each image type. See "Images that Can be Generated with LumiTrax Specular Reflection Mode" (Page 7-54) for more details on the image types.

- **Gain:** Adjusts the gain for the generated images ([Specular Reflection Image], [Diffuse Reflection Image], and [Gloss Ratio Image] only).
- **Gain Optimization Using Captured Image:** Adjusts the gain for optimal image processing based on captured images ([Specular Reflection Image] and [Diffuse Reflection Image] only).
- **Feature Size:** Specifies the size of the feature (cut, damage, character, etc.) to be emphasized ([Shape Image 1], [Shape Image 2] only).
- **Feature Size Margin:** Specifies the margin for the size of the feature to be emphasized ([Shape image 1], [Shape image 2] only). When the value is decreased, only features of a size that is approximate to [Feature Size] are emphasized. When the value is increased, features with sizes not close to [Feature Size] are also emphasized.
- **Contrast:** Adjusts the image contrast ([Shape image 1], [Shape image 2] only).
- **Level:** Adjusts the brightness of the entire image ([Shape image 1], [Shape image 2], [Gloss Ratio Image] only).
- **Noise Cut:** Removes the minute noise elements from the background ([Shape image 1], [Shape image 2] only). This eliminates noise equal to or below the set tone.
- **Absolute Value Mode:** Enable this mode to turn concave/convex parts on the image white and all other background black ([Shape Image 1], [Shape Image 2] only).

• **Options:** Sets the correction processing to be applied to the shape images, specular reflection image and diffuse reflection image. The correction process includes processes that are applied to images individually and processes that are applied commonly to the images.

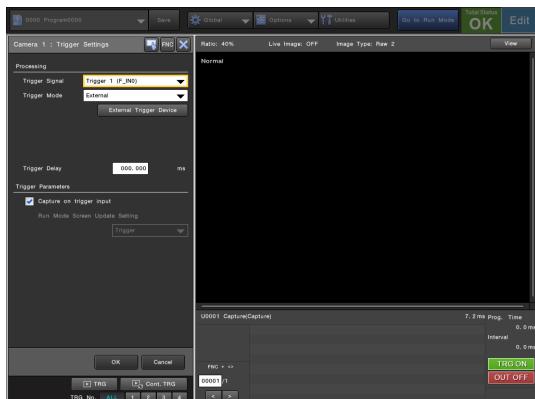
- **Emphasis Direction:** It emphasizes the irregularities in the specified direction and suppresses the irregularities of the other direction. It is used when the change of the irregularities to be checked has directionality.
- **Degree:** Specifies the emphasis level for when using [Emphasis Direction] ([Specular Reflection Image], [Diffuse Reflection Image],[Shape Image 1], [Shape Image 2] only).



You can set the [Emphasis Direction] settings on the [Options] screen for Shape Image 1 and Shape Image 2, specular reflection images, and diffuse reflection images.

Trigger Settings

Specify the settings for triggering the controller to take an image.



Processing

Trigger Signal

Select the trigger signal to be used. The assignment of trigger signals and terminals are specified on the [Terminal Block & Parallel Port] screen (Page 6-11) in the [Global] menu.

Trigger Mode

Select the type of trigger to be used.

- External** (Default): Captures images in response to trigger inputs from the handheld controller or trigger signals sent from an external device. The process is performed only once for each trigger input.
- Internal**: Capture images in response to internally generated periodic trigger signals by specifying the interval time or encoder count.



If [Trigger Mode] is set to [Internal] and [Trigger Cycle] is set to [Time Delay], respectively, the trigger will constantly be generated while in Run mode (No triggers are generated in Setup mode). To temporarily stop the generation of internal trigger signals from an external device, use either of the following methods to prohibit trigger input. When internal trigger is disabled, the output of the result data up to that point continues.

- Terminal block input (EXT terminal)
- Communications command (TE,0 command).

For more details, see the XG-X2000 Series Communications Control Manual.

Trigger Cycle (Only When [Internal] is Selected)

- Time Delay** (Default): Select to specify the trigger cycle based on time.
- Specify Encoder**: Select to specify the trigger cycle using the encoder's pulse count.



[Specify Encoder] cannot be selected if LumiTrax Specular Reflection Mode is enabled.

External Trigger Device (Only When [External] is Selected)

To use an external trigger, select and check the type of trigger to be used for image capture.

- **Terminal Block**: Trigger input through the external terminal assigned with %Trg1 through to 4
- **Handheld Controller/Mouse**: Trigger input provided by the No.3 (TRIGGER) button on the handheld controller or the TRG button on the screen.
- **RS-232C**: Trigger input through the RS-232C commands
- **Ethernet (TCP/IP)**: Trigger input through the Ethernet commands
- **PLC-Link**: Trigger input through RS-232C or Ethernet PLC-Link commands
- **CC-Link**: Trigger input through the CC-Link bit devices or commands
- **EtherNet/IP**: Trigger input through the EtherNet/IP cyclic communication, message communication, or commands
- **PROFINET**: Trigger input through the PROFINET cyclic communication, message communication, or commands
- **EtherCAT**: Trigger input through the EtherCAT cyclic communication, mailbox communication, or commands
- **PC Program**: Trigger input through the ActiveX control method



External triggers using the handheld controller/mouse are always available in Setup mode.

Trigger Delay

To set a fixed time delay between the selected trigger input and capturing of an image, specify a trigger delay time (Trigger Delay).

The trigger delay can be set in the range between 0 and 999.999 ms for each camera.

Trigger Parameters

Capture on trigger input

Choose whether or not the capture unit will wait for a trigger signal to capture an image. When the check is removed, all cameras that are set will capture images according to the capture processing, regardless of their independent trigger signals.

This is the case when the image capture buffer (Page 4-12) is enabled and empty when the capture unit is processed. If there are any images in the buffer which satisfy the capture priority, the capture will be completed and the next unit will be executed regardless of this setting.

Run Mode Screen Update Setting

Select whether to update the camera images continuously in Run mode.

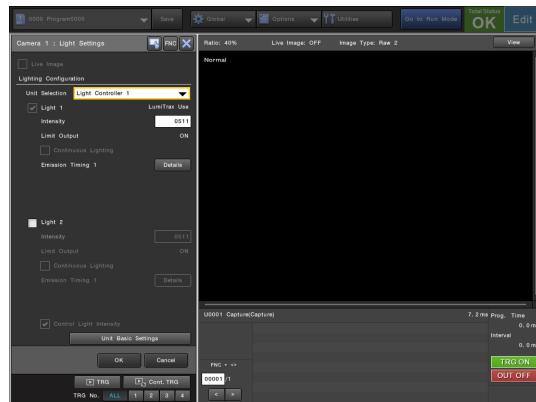
- Trigger:** Update the image only when a trigger input is received.
- Live Image:** Always displays the latest image while waiting for a trigger signal.



- [Live Image] is only applied in Run mode.
- If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-38), this setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- Live Image is not available when LumiTrax Specular Reflection Mode (Page 7-35) or HDR capture (Page 7-34) is enabled.
- Even if [Live Image] is selected, the image is not updated continuously if [Live Image Feed] (Page 4-43) is not enabled in the camera Image Display screen part settings in Screen Editor (Page 4-25).

Light Settings

When an illumination expansion unit CA-DC40E/DC50E/DC60E (sold separately) is connected to the controller, the settings related to the light brightness and illumination are configured per light.



Live Image

Check this box to display the latest images through a continuous feed.



- [Live Image] is only applied in Setup Mode.
- When the [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings] (Page 7-38), this cannot be changed.
- If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-38), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- [Live Image] is not available when LumiTrax Specular Reflection Mode is enabled.

Lighting Configuration

Unit Selection

Choose the illumination expansion unit (light controller) to which the light you wish to enable emission is connected to.



- When multiple illumination expansion units are connected, they will be numbered 1 through 8, with 1 being the unit closest to the controller.
- If the connected illumination expansion unit and the model specified in [Illumination Expansion Unit] under [Camera - Trigger - Light Configuration Settings] are different, the currently selected light controller will be displayed in red.

Light*

Check the box of the light number you wish to enable emission.



- The lights that can be used in LumiTrax Specular Reflection Mode when using an area camera are CA-DXW10X or CA-DZW*X (connected to CA-DC60E) only.
- The emission timing cannot be changed when continuous lighting is enabled.

Intensity

The brightness of each light can be set in the range of 0 to 1023 (Default: 511). Use this in conjunction with the shutter speed setting to correctly illuminate images.



- The intensity can only be changed for lights that have been enabled in the [Lighting Configuration] screen (Page 6-9).
- The intensity of continuous lighting can be changed regardless of the camera selection. If a FLASH terminal output has been assigned to the light, the intensity can only be changed when the selected camera is the camera that is used with the FLASH terminal output.
- When the [Limit Output] is [ON], the upper limit is set to 511 (Even when 512 or a higher value is entered, the intensity remains at 511).
- When the [Limit Output] is [OFF] and the intensity is set to 512 or higher, be careful not to damage the light through excessive heat generation.
- If the CA-DXW10X or CA-DZW30X/DZW50X is connected to CA-DC60E and you use LumiTrax Specular Reflection Mode or Standard Lighting Mode, the light intensity is limited to 700. However, with regard to the CA-DZW50X, if the ambient temperature exceeds 35 °C, the actual light intensity that can be used is up to 511 and if the intensity is set to a value higher than that, a warning message may be displayed.

Limit Output

The status of the light output limit to prevent degradation of the LED light through overheating is displayed (Default: ON). To disable the light output limit, change the setting in [Unit Basic Settings] or [Lighting Configuration] (Page 6-9) in the [Global] menu.

Continuous Lighting

Check this box to keep the light illuminated regardless of the FLASH terminal output.

Emission Timing

The light emission timing controlled in linkage with the camera can be specified.

Select [Details] and select the illumination control timing from either emission timing 1 to 12 or external flash 1 to 4, and then specify the output on-delay and time. The light will illuminate in coordination with the assigned emission timing.

- Emission Timing 1 to 12:** Allows you to set the emission timing of each light controller by capture unit.
- External Flash 1 to 4:** Can be used in the same manner as the emission timing. However, the output on-delay and time settings are shared with the external flash terminals for controlling the external light.



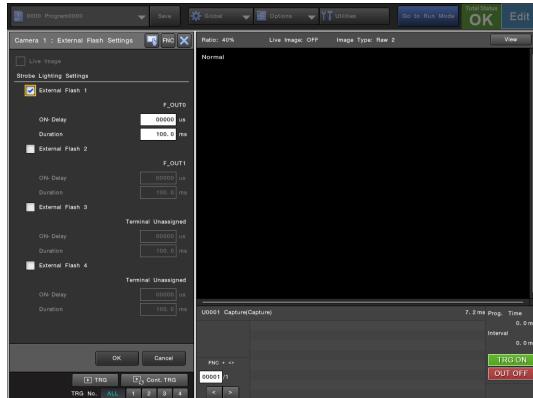
For CA-DC50E/DC60E, the output [ON-Delay] and [Duration] are fixed values and cannot be changed.

Unit Basic Settings

The basic common settings of the illumination expansion unit can be changed. The settings configured here are also reflected to [Lighting Configuration] in the [Global] menu (Page 6-9).

External Flash Settings

Specify the conditions for when using flash for image capture.



When the external flash is selected as the emission timing for the illumination expansion unit CA-DC40E/DC50E/DC60E (sold separately), the output ON-delay and duration specified in the External Flash Settings are also reflected to the illumination expansion unit.

Live Image

Check this box to display the latest images through a continuous feed.



- [Live Image] is only applied in Setup Mode.
- When the [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings] (Page 7-38), this check box cannot be changed.
- If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-38), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- [Live Image] is not available when LumiTrax Specular Reflection Mode is enabled.

Strobe Lighting Settings

External FLASH*

Check the box for the subject FLASH* signal and specify the on-delay and duration.

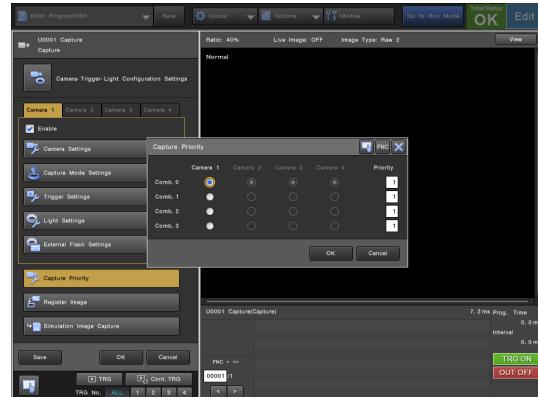
- **ON-Delay:** Set the Emission Timing 1-12 or External Flash signal 1-4 [ON-Delay] in the range from -50000 to 50000 (μs), with the image capture start time as 0 (Default: 0μs = Same time as image capture start).
- **Duration:** Set the FLASH* signal output time in the range between 0.1 to 999.9 (ms).



The values for [ON-Delay] and [Duration] for the CA-DC50E/DC60E are fixed and cannot be changed.

Capture Priority

The [Capture Priority] screen appears, which controls the conditions of the trigger input status for capture unit completion (transition to the next unit) with priority. Normally, the capture unit is complete when the trigger inputs for all enabled cameras are received. It is possible to move to the next unit when the trigger input(s) of the specified camera(s) combination is received.



Comb. 0 to 3

Set up to four condition combinations to complete the capture unit. When all trigger inputs for the specified cameras are received, the process moves to the next unit.



- Trigger input can only be specified for enabled cameras.
- The combination with which the unit was completed is stored as 0 to 3 in unit result data [Passing Status] (RSLT.STAT).

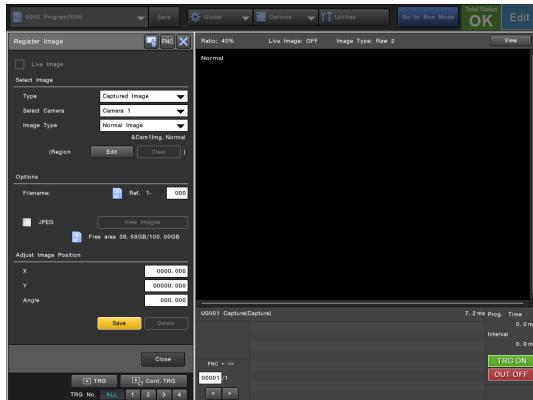
Priority

Specify the priority (from 1 to 4) for when more than one condition is met simultaneously. When the same priority is assigned, the condition met earliest is processed.

Capture (LumiTrax Specular Reflection Mode) (When Using an Area Camera)

Register Image

Register images to use as the basis for measurements and setting.



Live Image

Check this box to display live images through a continuous feed.

- Point**
- [Live Image] is only applied in Setup Mode.
 - When the [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings] (Page 7-38), this cannot be changed.
 - If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-38), this check box is always unchecked and the setting cannot be changed.
 - When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
 - In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
 - [Live Image] is not available when LumiTrax Specular Reflection Mode is enabled.

Select Image

Type

Select the image to be the registration source.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified in [Options].

Select Camera

Select the number of the camera used for registration.

Among Camera 1 to 4, only the camera number used for the capture unit being edited can be selected.

Image Type

When LumiTrax Specular Reflection Mode is enabled, select the type of image to register from [Specular Reflection Image], [Diffuse Reflection Image], [Shape Image 1], [Shape Image 2], [Phase X Image], [Phase Y Image], [Gloss Ratio Image] and [Normal Image].

Region

To register only part of an image, select [Edit] then specify the region to register. To cancel the selected region, select [Clear].

Options

Filename

Specify the registered image number used for image registration in the form "(Camera No.)-(Specified No.)".

Reference The saved file name is "ref (camera No.)(specified No.)" (for full screen image registration) or "ref (camera No.)(specified No.)_XXX_YYY" (for partial image registration).

JPEG

Check this box to save the image in JPEG format. When this box is not checked, the image will be saved in BMP format as either a 24-bit color bitmap image (color camera) or an 8-bit grayscale bitmap image (monochrome camera).

Point Using image compression may result in some image deterioration, thus measurement results from a compressed image may differ to those when using non-compressed images.

View Images

You can check a list of registered images.

Adjust Image Position

Adjust the position of the image being captured.

X

Adjust the movement in the X (horizontal) direction between -8191.000 and 8191.000 pixels.

Y

Adjust the movement in the Y (vertical) direction between -16383.000 and 16383.000 pixels.

Angle

Adjust the position angle (rotation) around the center of the image between -999.999° and 999.999°.

Point Position adjustment may cause missing peripheries (black areas) due to image movement or jagged edges (jaggies) due to rotation in the registered image.

Save

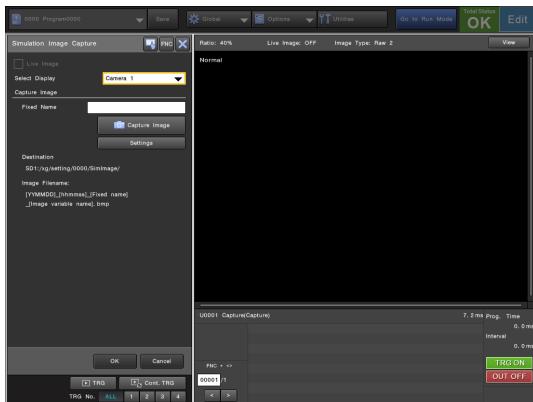
Save the displayed image as a registered image under the conditions specified on the [Register Image] screen.

Delete

When [Registered Image] is selected for [Type], you can delete the registered image specified in [Options].

Simulation Image Capture

The simulation image capture allows you to check the actual images captured by the camera based on the changed settings, or save the captured images to the SD card in the image format specified in the output settings. This is useful for quickly checking camera settings and saving images for simulation in XG-X VisionEditor.



Live Image

Check this box to display the latest images through a continuous feed.



- [Live Image] is only applied in Setup Mode.
- When the [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings] (Page 7-38), this cannot be changed.
- If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-38), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- [Live Image] is not available when LumiTrax Specular Reflection Mode is enabled.

Select Display

Switch from 4-screen display to 1-screen display of the desired camera.

- **Camera 1:** Displays the image from Camera 1.
- **Camera 2:** Displays the image from Camera 2.
- **Camera 3:** Displays the image from Camera 3.
- **Camera 4:** Displays the image from Camera 4.
- **Camera 1 to 4:** Displays images from all the connected cameras.

Capture Image

Save the current camera image to the SD card in the save format specified in the output settings.

Fixed Name

Enter the fixed name if the file name contains a fixed name.

Capture Image

Save the image with the current settings.

Settings

The current save conditions can be checked in the list and changed as required.



- This function saves images from all cameras, regardless of the selected preview.
- When [Simulation Image Capture] is closed by selecting [OK], the update mode and VIEW bar settings will stay the same until power is turned off.

Save

The settings for all units are saved to the currently used program setting file in SD Card 1 or SD Card 2.



- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. As examples of items that can be made so they are not saved, there are the variables and the screen, such as a display pattern screen, display state changed in the current program setting.

Capture (LumiTrax Specular Reflection Mode) (When Using a Line Scan Camera)

A capture unit is used for capturing images of the inspection/measurement target workpiece using a camera. When the CA-DC40E/DC50E/DC60E illumination expansion unit is connected, the settings (flashing/light intensity) can be controlled without wiring to the controller.

- For more details on preparations to install a line scan camera, see "Preparing a Line Scan Camera" (Page 8-170).
- This section provides information on the settings for when using LumiTrax Specular Reflection Mode with LumiTrax Specular Reflection Mode-compatible line scan cameras. When using other cameras, refer to the description below.
 - Area Camera: Page 2-25
 - 3D Camera: Page 8-14
 - LJ-V Series head: Page 8-22
 - Line Scan Camera: Page 8-175
- When using other capture modes, refer to the following descriptions:
 - LumiTrax Mode (area camera only): Page 7-11
 - LumiTrax Specular Reflection Mode (area camera): Page 7-32
 - MultiSpectrum Mode (area camera only): Page 7-62
 - Standard Lighting Mode Using MultiSpectrum Light: Page 7-86
- For special notes when using LumiTrax Specular Reflection Mode, see "Other Changes When LumiTrax Specular Reflection Mode is Used" (Page 7-54)

Image Capture Setup

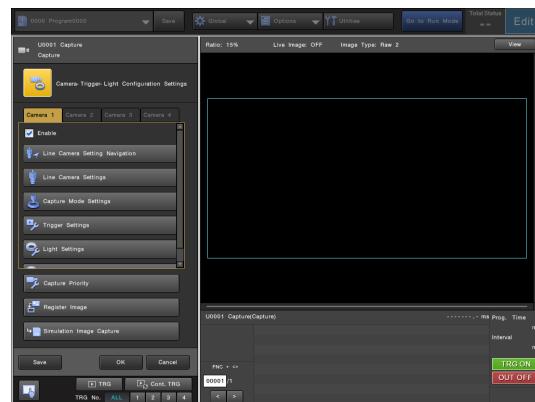
In the capture unit, images are captured by using the cameras, maximum of 4, connected to the controller. The image data is sent from the camera to the controller and stored in a specified image variable.



- If the cameras used in a capture unit are different from the cameras actually connected to the controller, a camera setting error will occur. No image capturing and subsequent image processing units will be processed. In such cases, set the camera model setting correctly or turn off the controller and connect the correct camera.
- The model and other information for the camera set in a capture unit can be viewed in the [Camera Selection] screen (Page 4-11).

Top Menu

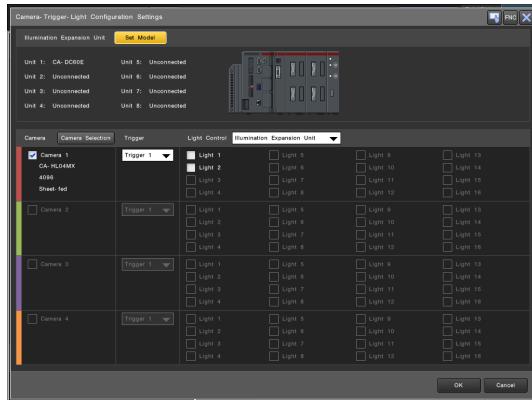
The capture unit menu has the following options. Change the settings as required.



Camera - Trigger - Light Configuration Settings (Page 7-45)	The connected cameras and illumination expansion units, trigger input for each camera, and illumination control targets can be configured together.
Line Camera Setting Navigation (Page 7-45)	Adjust the camera and light.
Line Camera Settings (Page 7-46)	You can specify the conditions for image capture.
Capture Mode Settings (Page 7-48)	Change the LumiTrax Specular Reflection Mode settings.
Trigger Settings (Page 7-51)	Specify the settings for triggering the controller to take an image.
Light Settings (Page 7-52)	When an illumination expansion unit CA-DC40E/DC50E/DC60E (sold separately) is connected to the controller, the settings related to the light brightness and illumination are configured per light.
External Flash Settings (Page 7-52)	Set the illumination timing for controlling external light equipment using the external FLASH terminal.
Capture Priority (Page 7-53)	This option controls the conditions of the trigger input status for capture unit completion (transition to the next unit) with priority.
Register Image (Page 7-53)	Register images to use as the basis for measurements and setting.
Simulation Image Capture (Page 7-53)	Save the captured image to the SD card. The saved images can be referenced as simulation images in XG-X VisionEditor.

Camera - Trigger - Light Configuration Settings

The connected cameras and illumination expansion units, trigger input for each camera, and illumination control targets can be configured together.



Illumination Expansion Unit

Displays the information of the illumination expansion unit connected to the controller. Select [Set Model] to specify the model of the connected illumination expansion unit for each light unit No.

Camera

Check the camera No. box of the camera to be used. Select [Camera Selection] to specify the model of the connected camera for each camera No. See "Specifying the Model of the Connected Camera (Camera Selection)" (Page 4-11) for more details.

Trigger

Select the trigger to be assigned to each camera.

Light Control

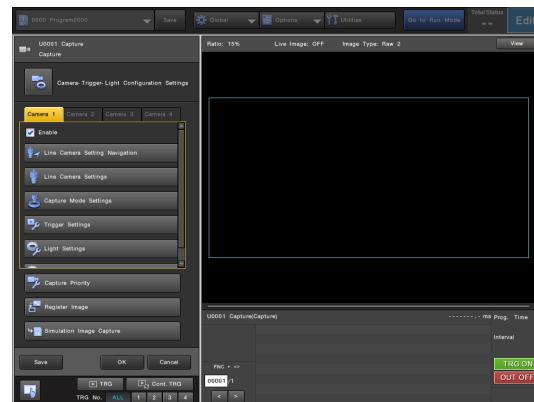
Specify the control method for the light assigned to each camera.

- Illumination Expansion Unit:** Check the light number of the illumination expansion unit to which you wish to assign an illumination control.
- External Flash:** Check the external terminal to which an illumination control will be assigned.

Point The illumination expansion unit and external FLASH terminal can be selected simultaneously.

Camera 1 to Camera 4

Select the tab of the camera for setting the capture options for.

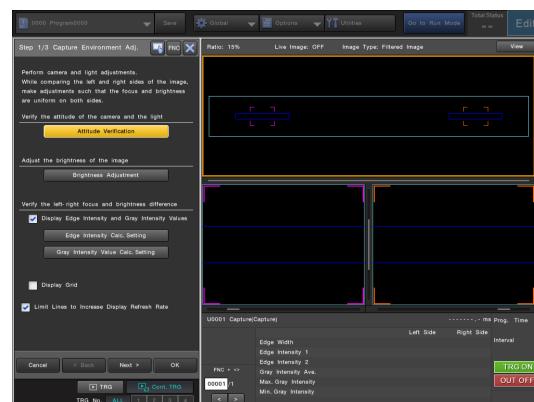


Enable

Check the box to enable the current setting target camera. Remove the check mark if a camera is connected to the controller but is not used.

Line Camera Setting Navigation

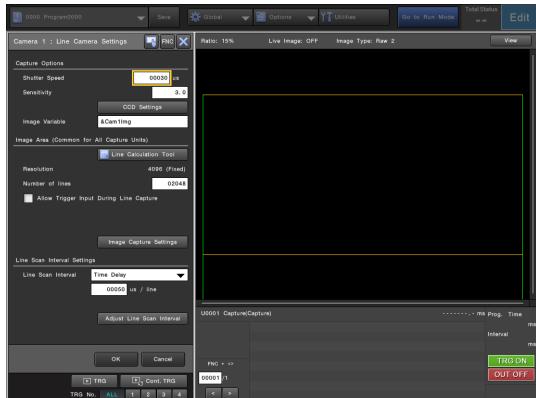
Change the capture options in accordance with the onscreen instructions so that the workpiece can be correctly captured.



For more details, refer to "Preparation 2: Changing the Settings to Capture the Workpiece Correctly (Line Camera Setting Navigation)" (Page 8-171).

Line Camera Settings

You can specify the conditions for image capture.



The image quality can also be adjusted by camera sensitivity adjustment of the captured image. This functionality is useful when needing to optimize an image's brightness and adjust for black / white saturation.

Capture Options

Shutter Speed

Select or enter the shutter speed for the camera specified with the camera tab (2 to 20000 µs, Default Setting: 30). When setting the shutter speed to match a fast line, prepare a light where the required lighting can be secured for producing the desired images.

Sensitivity

The sensitivity of the camera can be adjusted (1.0 to 7.0, Default Setting: 3). Typically, to adjust the brightness of an image, the lens aperture, lighting and shutter speed are the ones adjusted accordingly. However, if none of these improve image brightness, such as in lines where the movement speed is fast, then change the camera sensitivity.



If the camera sensitivity is increased, so will the overall brightness of the image. However, noise in the image will become more visible (and the image will appear coarser). When the camera sensitivity is decreased, the overall image darkens but the noise will be reduced (the image appears smoother).



Image Variable

Specify an image variable which will contain the image captured with the camera selected in the camera tab.



- Variables to be specified need to be added in advance in the [Variable Settings] (Page 4-4) screen.
- Changing the setting clears all image variables, archived data, and target classification results.

Image Area (Common for All Capture Units)

The settings vary depending on the image capture method.

Fixed Capture Settings

- Line Calculation Tool:** If you select [Single Target] for [Capture Target] and then input the full size in millimeters for [Y Direction Length], the number of lines in the vertical direction required for capture will be displayed. Select [Reflect to Capture Parameters] to apply the displayed number of lines to the capture settings.



You must correctly set the Y direction scaling coefficient first before executing this setting.

- Resolution:** Displays the number of horizontal direction lines, and operation mode (Fixed).
- Number of lines:** Specifies the number of lines to capture in the vertical direction.

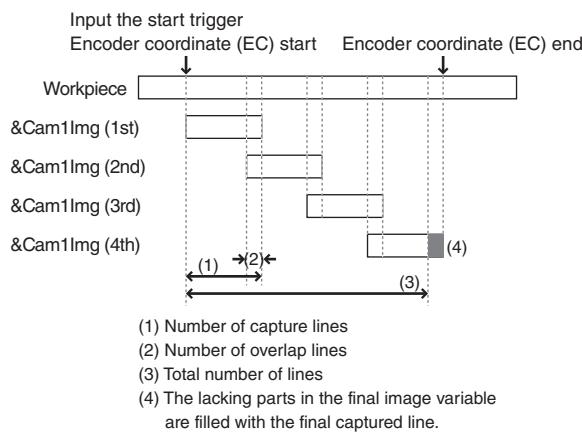
Continuous Capture Settings

- Line Calculation Tool:** If you select [Continuous Target] for [Capture Target] and then input the full size in millimeters for [Area of Each Capture] and [Overlap Length], the number of lines in the vertical direction and the number of overlap lines required for capture will be displayed. Select [Reflect to Capture Parameters] to apply the displayed numbers of lines to the capture settings.



You must correctly set the Y direction scaling coefficient first before executing this setting.

- Resolution:** Displays the number of horizontal direction lines, and operation mode (Continuous).
- Number of lines:** Specifies the number of lines to capture in the vertical direction.
- Overlapping lines:** Specify the number of lines that will be overlapped from the image variable of the previous capture when storing in the image variable.
- Total number of lines:** Specify the number of lines (999999 lines maximum) to stop capturing at when capturing by continuous capture when the image is big and cannot be fully captured with the single frame capture. When this setting is enabled and the total number of lines is specified, the system operates as follows:



- The encoder coordinates start counting up when a start trigger is input.
- When the capture for the total number of lines is complete, the counting up of the encoder coordinates will stop and start waiting for the next start trigger (The encoder coordinates will be reset to 0 when the next start trigger is input).
- Missing parts of the final image variable will be filled using the final captured line.

Point

- The area around the edge of the captured image may appear dark when a lens with a small maximum image size is used and the processing region is set at the edge portion of the CCD.
- These settings are common for all capture units.
- When setting the image area, all image variables, archived data, and the output buffer are cleared.
- When continuously capturing images, if the image processing time is longer than the capture cycle, the image capture buffer may become overloaded, during which captured images are discarded without inspection. Adjust the settings, such as decreasing the processing time or the number of overlap lines, or slowing down the line trigger cycle, so that the image capture buffer does not become overloaded.
- When an overflow of the image capture buffer occurs, "Trigger Pass occurred" is displayed at the bottom right of the screen. The occurrence can also be detected by monitoring %Cam1Status to %Cam4Status.
- If %Ext is input after the start trigger input, the operation follows the [End capture by EXT signal] setting.

Mirror / Rotate Image

Select whether to perform mirror inversion or rotation of the image for the camera selected in the camera tab.

- **OFF** (Default): Does not mirror the image horizontally.
- **Horizontal**: Captures the image horizontally inverted.
- **Vertical**: Captures the image vertically inverted.
- **180° Rotate**: Rotates the image by 180° during image capture.

Point

When continuous capture is performed using a line scan camera, vertical inversion and 180 degrees rotation cannot be selected.

Line Scan Interval Settings

Line Scan Interval

Specify the line scan interval.

- When [Time Delay] is selected: Specify the line scan interval in time (24 to 30000 µs per line).
- When [Specify Encoder] is enabled: Specify an encoder count (1 to 99999999) for the line scan interval.

Use Dedicated Encoder (Only When [Specify Encoder] is selected)

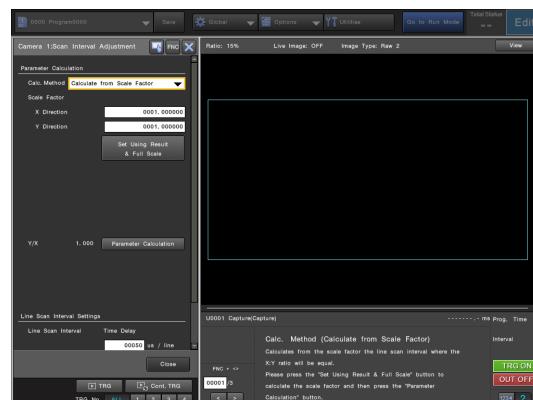
Check this option when using the CA-EN100U encoder unit (sold separately). A desired pulse count per rotation can be specified by connecting the controller with CA-EN100U. This is useful as it eliminates the need for a pulley, etc. for adjusting signals from the encoder.

Adjust Line Scan Interval

Adjust the line scan interval to match the X/Y resolutions.



If the X/Y resolutions are different, the generated image may be stretched or shrunk in the Y direction. In such a case, correct measurement is not possible because the length and shape will change according to the rotation angle of the measurement target.



- **Calc. Method:** Select the calculation method for the setting values related to the line scan interval. For more details on the adjustment procedure and setting values for each calculation method, see "Notes on Adjusting the Line Scan Interval" (Page 8-186).

- **Pulse Count Per 1 Revolution** (only when [Use Dedicated Encoder] is specified): Specifies the pulse count per rotation for the dedicated encoder.

Line Scan Interval:

- When [Time Delay] is selected: Specify the interval per line in time.
- When [Specify Encoder] is selected: Specify the encoder input count per line.

Capture (LumiTrax Specular Reflection Mode) (When Using a Line Scan Camera)

- Sampling Mode (Only When [Specify Encoder] is Selected)**
 - **x1** (Default): Pulse count increases by 1 on the rising edge of phase A of the encoder.
 - **x2**: Pulse count increases by 1 on both the rising and falling edge of phase A of the encoder.
 - **x4**: Pulse count increases by 1 on both the rising and falling edges of phase A and phase B of the encoder.
- Details (Only when [Specify Encoder] is selected)**
 - Encoder Direction:**
 - OFF** (Default): The pulse count goes up for rotation in both the clockwise and counterclockwise directions.
 - CW**: The pulse count always goes up only for rotation in the clockwise direction.
 - CW and CCW**: The pulse count goes up for rotation in the clockwise direction. If there is a pulse count for the counter-clockwise direction, that amount goes down before counting again.
 - Reverse Detection:**
 - OFF** (Default): The pulse count goes up for rotation in the clockwise direction.
 - ON**: The pulse count goes up for rotation in the counter-clockwise direction.
 - Z-Phase Function :**
 - None** (Default): Encoder Z phase input is not used.
 - Trigger**: Used as trigger input.
 - Reset Pulse Count**: Used to reset the encoder count.
 - Reset Pulse Count and Trigger**: Used to reset the encoder count and as trigger input.
 - External Trigger**:
 - Trigger**: Used as trigger input.
 - Reset Pulse Count and Trigger**: Used to reset the encoder count and as trigger input.
 - Detect Timeout**: Specify the duration before a timeout error occurs when an encoder count stops (units: ms).

Check Encoder Connection (When [Specify Encoder] is selected)

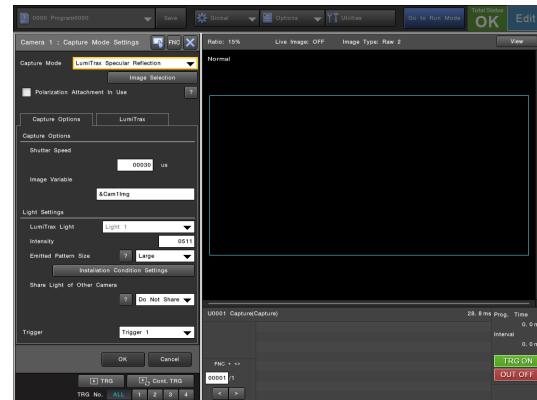
The [Check Encoder Connection] screen is displayed.



The encoder terminal to be used will vary depending on the model of the camera input unit and the selected trigger signal. The position of the encoder terminal to use with the current program setting can be checked on the [Check Encoder Connection] screen.

Capture Mode Settings

Change the LumiTrax Specular Reflection Mode settings.



When using an image captured with LumiTrax Specular Reflection Mode as a registered image, handling is different from standard captured images. See "Registration Numbers of Images Captured with LumiTrax Specular Reflection Mode" (Page 7-55) for more details.

Capture Mode

To use LumiTrax Specular Reflection Mode, select [LumiTrax Specular Reflection].



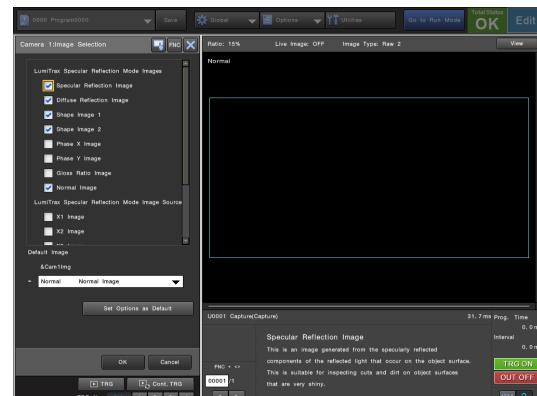
The LumiTrax Specular Reflection Mode cannot be set in the following conditions.

- When a different Capture Mode (with the exception of Standard Lighting Mode), LumiTrax Specular Reflection Mode (area camera) or HDR is selected for another camera in the same capture unit

Image Selection

Select the image you wish to use in LumiTrax Specular Reflection Mode.

- When selecting [Image Selection], the [Image Selection] screen appears. Put a check mark to the image type to be generated by LumiTrax Specular Reflection Mode.
- The image specified in [Default Image] is the image to be referred when the image variable extension is omitted.



See "Images that Can be Generated with LumiTrax Specular Reflection Mode" (Page 7-54) for more details on the image types.

Set Options as Default

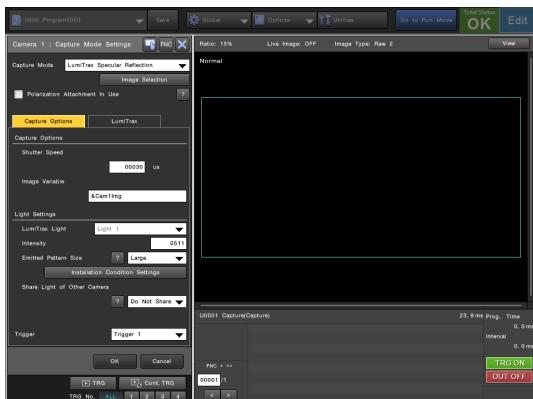
It saves the image select status and the default image select status to the System Settings. After this, the images selected by default in Image Selection and the initial value of Default Image when a program setting is newly created or a Capture unit is added will be the state that is saved in the System Settings.

Polarization Attachment In Use

When the CA-DRM*PA is attached to the MultiSpectrum Light CA-DRM*X, selecting the [Polarization Attachment In Use] check box can suppress the lighting of the ultraviolet (UV) light, which may cause polarization filter deformation or deterioration.

Capture Options

You can set the capturing conditions and image processing for when LumiTrax Specular Reflection Mode is used.



Shutter Speed

Select or enter the shutter speed for the camera specified with the camera tab. Select the shutter speed according to the target movement speed and lighting conditions.

Point This setting is common with the [Shutter Speed] setting on the [Line Camera Settings] screen.

Image Variable

Specify an image variable which will contain the image captured with the camera selected in the camera tab.

Point

- Variables to be specified need to be added in advance in the [Variable Settings] screen.
- Changing the setting clears all image variables, archived data, and target classification results.

Light Settings

- LumiTrax Light:** Selects the light to be used in LumiTrax Specular Reflection Mode. The light numbers correspond to the connection order of the illumination expansion units.



The light that can be used in LumiTrax Specular Reflection Mode when using a line scan camera is CA-DZW*X (connected to CA-DC60E) only.

- Intensity:** Specifies the brightness of the light in the range between 0 and 1023 (Default: 511).

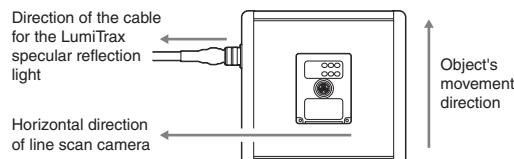


If the CA-DZW30X/DZW50X is connected to CA-DC60E and you use LumiTrax Specular Reflection Mode or Standard Lighting Mode, the light intensity is limited to 700. However, with regard to the CA-DZW50X, if the ambient temperature exceeds 35 °C, the actual light intensity that can be used is up to 511 and if the intensity is set to a value higher than that, a warning message may be displayed.

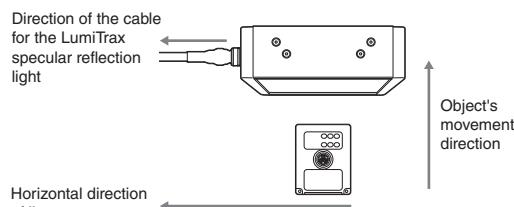
- Emitted Pattern Size:** Selects the size for the emitted pattern (default setting: Large).

- Installation Condition Settings:** Sets the light setup, and object movement direction and light cable direction as seen from the camera in accordance with the actual installation state in order to use LumiTrax Specular Reflection Mode. Normally, setup the line scan camera and light so that the direction of the lighting cable is on the left side relative to the object's movement direction as shown in the figure below.

To setup a transmitted light



To setup a reflected light



- Share Light of Other Camera:** To share the same light of another line scan camera, select [Camera*]. The capture settings for the camera currently being set will always be applied to the capture settings for the cameras that are specified to be sharing the same light.

- Trigger:** Selects the trigger signal to be used. This setting is the same as [Trigger Signal] on the [Trigger Settings] screen.

LumiTrax

You can specify the capturing conditions exclusive for LumiTrax Specular Reflection Mode.

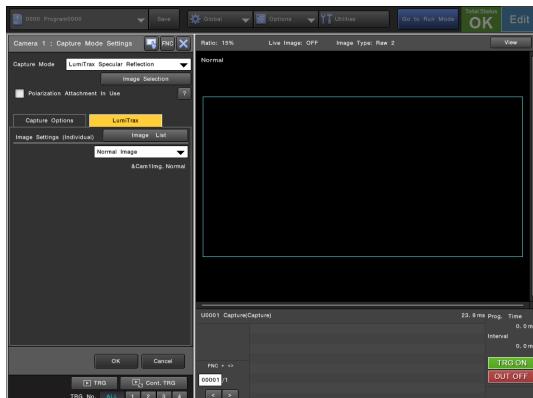


Image Settings (Individual)

You can specify the capturing conditions for each image type. See "Images that Can be Generated with LumiTrax Specular Reflection Mode" (Page 7-54) for more details on the image types.

- **Gain:** Adjusts the gain for the generated images ([Specular Reflection Image], [Diffuse Reflection Image], and [Gloss Ratio Image] only).
- **Gain Optimization Using Captured Image:** Adjusts the gain for optimal image processing based on captured images ([Specular Reflection Image] and [Diffuse Reflection Image] only).
- **Feature Size:** Specifies the size of the feature (cut, damage, character, etc.) to be emphasized ([Shape Image 1], [Shape Image 2] only).
- **Feature Size Margin:** Specifies the margin for the size of the feature to be emphasized ([Shape image 1], [Shape image 2] only). When the value is decreased, only features of a size that is approximate to [Feature Size] are emphasized. When the value is increased, features with sizes not close to [Feature Size] are also emphasized.
- **Contrast:** Adjusts the image contrast ([Shape image 1], [Shape image 2] only).
- **Level:** Adjusts the brightness of the entire image ([Shape image 1], [Shape image 2], [Gloss Ratio Image] only).
- **Noise Cut:** Removes the minute noise elements from the background ([Shape image 1], [Shape image 2] only). This eliminates noise equal to or below the set tone.
- **Absolute Value Mode:** Enable this mode to turn concave/convex parts on the image white and all other background black ([Shape Image 1], [Shape Image 2] only).

• **Options:** Sets the correction processing to be applied to the shape images, specular reflection image and diffuse reflection image. The correction process includes processes that are applied to images individually and processes that are applied commonly to the images.

- **Emphasis Direction:** It emphasizes the irregularities in the specified direction and suppresses the irregularities of the other direction. It is used when the change of the irregularities to be checked has directionality.
- **Degree:** Specifies the emphasis level for when using [Emphasis Direction] ([Shape Image 1], [Shape Image 2], and [Specular Reflection Image], [Diffuse Reflection Image] only).

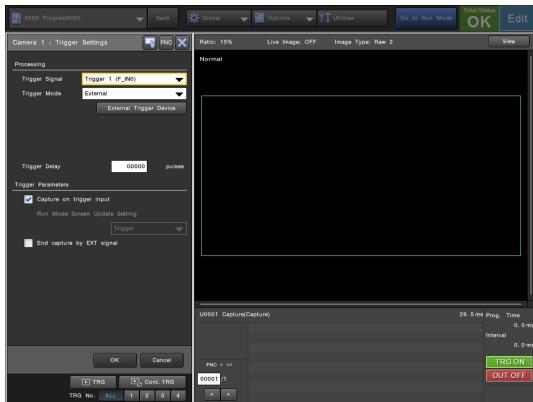


Point

You can set the [Emphasis Direction] settings on the [Options] screen for Shape Image 1 and Shape Image 2, specular reflection images, and diffuse reflection images.

Trigger Settings

Specify the settings for triggering the controller to take an image.



Processing

Trigger Signal

Select the trigger signal to be used. The assignment of trigger signals and terminals are specified on the [Terminal Block & Parallel Port] screen (Page 6-11) in the [Global] menu.

Trigger Mode

Select the type of trigger to be used.

- External** (Default): Captures images in response to trigger inputs from the handheld controller or trigger signals sent from an external device. The process is performed only once for each trigger input.
- Internal**: Capture images in response to internally generated periodic trigger signals by specifying the interval time or encoder count.



If [Trigger Mode] is set to [Internal] and [Trigger Cycle] is set to [Time Delay], respectively, the trigger will constantly be generated while in Run mode (No triggers are generated in Setup mode). To temporarily stop the generation of internal trigger signals from an external device, use either of the following methods to prohibit trigger input. When internal trigger is disabled, the output of the result data up to that point continues.

- Terminal block input (EXT terminal)
- Communications command (TE,0 command).

For more details, see the XG-X2000 Series Communications Control Manual.

Trigger Cycle (Only When [Internal] is Selected)

- Time Delay** (Default): Select to specify the trigger cycle or line scan interval based on time.
- Specify Encoder**: Select to specify the trigger cycle or line scan interval using the encoder count.

External Trigger Device (Only When [External] is Selected)

To use an external trigger, select and check the type of trigger to be used for image capture.

- **Terminal Block**: Trigger input through the external terminal assigned with %Trg1 through to 4
- **Handheld Controller/Mouse**: Trigger input provided by the No.3 (TRIGGER) button on the handheld controller or the TRG button on the screen.
- **RS-232C**: Trigger input through the RS-232C commands
- **Ethernet (TCP/IP)**: Trigger input through the Ethernet commands
- **PLC-Link**: Trigger input through RS-232C or Ethernet PLC-Link commands
- **CC-Link**: Trigger input through the CC-Link bit devices or commands
- **EtherNet/IP**: Trigger input through the EtherNet/IP cyclic communication, message communication, or commands
- **PROFINET**: Trigger input through the PROFINET cyclic communication, message communication, or commands
- **EtherCAT**: Trigger input through the EtherCAT cyclic communication, mailbox communication, or commands
- **PC Program**: Trigger input through the ActiveX control method



External triggers using the handheld controller/mouse are always available in Setup mode.

Trigger Delay

To set a fixed time delay between the selected trigger input and capturing of an image, specify a trigger delay time (Trigger Delay).

- The trigger delay can be set in the range between 0 and 999.999 ms for each camera.
- When [Trigger Cycle] or [Line Scan Interval] is set to [Specify Encoder], specify the encoder count (0 to 65535, Default: 0).

Capture (LumiTrax Specular Reflection Mode) (When Using a Line Scan Camera)

Trigger Parameters

Capture on trigger input

Choose whether or not the capture unit will wait for a trigger signal to capture an image. When the check is removed, all cameras that are set will capture images according to the capture processing, regardless of their independent trigger signals.

This is the case when the image capture buffer (Page 4-12) is enabled and empty when the capture unit is processed. If there are any images in the buffer which satisfy the capture priority, the capture will be completed and the next unit will be executed regardless of this setting.

Run Mode Screen Update Setting

Select whether to update the camera images continuously in Run mode.

- Trigger:** Update the image only when a trigger input is received.
- Live Image:** Always displays the latest image while waiting for a trigger signal.



- If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-51), this setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- [Live Image] is not available when a line scan camera is used.

End Capture by EXT Signal

If enabled, the capture process can be terminated via EXT signal input.



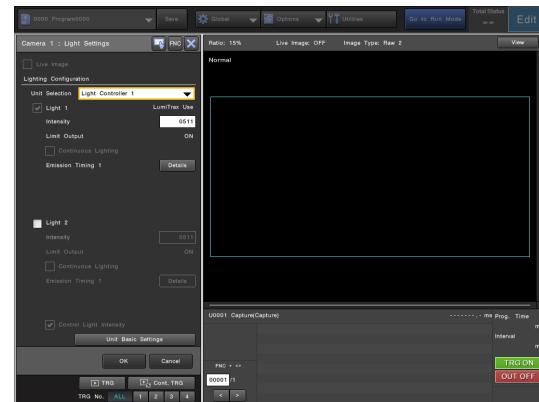
- The missing (non-captured) line parts will be filled using the data of the final captured line.

Light Settings

When an illumination expansion unit CA-DC40E/DC50E/DC60E (sold separately) is connected to the controller, the settings related to the light brightness and illumination are configured per light.



- If the PWM mode is used while using a line scan camera, the brightness may fluctuate between lines. Make sure to use the DC mode.



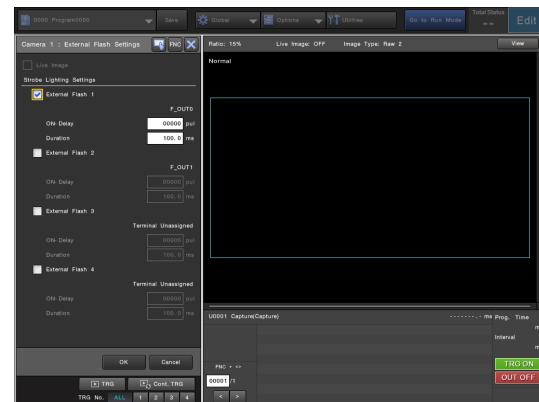
The settings are the same as for area cameras. See "Light Settings" (Page 2-32) for more details.



- If the CA-DZW30X/DZW50X is connected to CA-DC60E and you use LumiTrax Specular Reflection Mode or Standard Lighting Mode, the light intensity is limited to 700. However, with regard to the CA-DZW50X, if the ambient temperature exceeds 35 °C, the actual light intensity that can be used is up to 511 and if the intensity is set to a value higher than that, a warning message may be displayed.

External Flash Settings

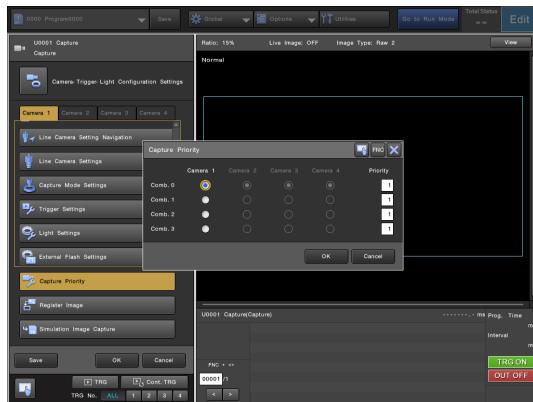
Specify the conditions for when using flash for image capture.



The settings are the same as for area cameras. See "External Flash Settings" (Page 2-33) for more details.

Capture Priority

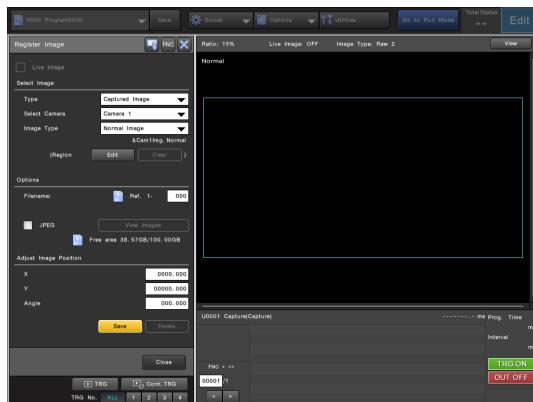
The [Capture Priority] screen appears, which controls the conditions of the trigger input status for capture unit completion (transition to the next unit) with priority. Normally, the capture unit is complete when the trigger inputs for all enabled cameras are received. It is possible to move to the next unit when the trigger input(s) of the specified camera(s) combination is received.



The settings are the same as for area cameras. See "Capture Priority" (Page 2-34) for more details.

Register Image

Register images to use as the basis for measurements and setting.



The settings are the same as for area cameras. See "Register Image" (Page 2-34) for more details.

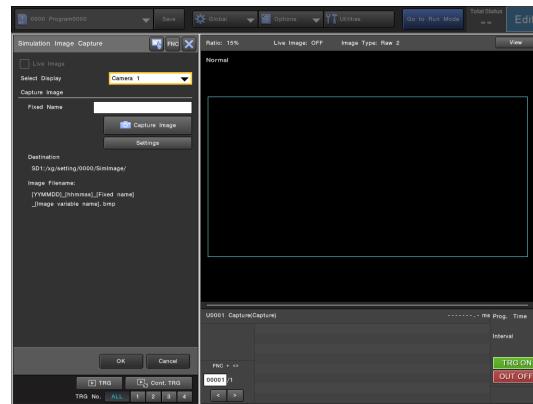
Live Image

Check this box to display the latest images through a continuous feed.

Point [Live Image] is only applied in Setup Mode.

Simulation Image Capture

The simulation image capture allows you to check the actual images captured by the camera based on the changed settings, or save the captured images to the SD card in the image format specified in the output settings. This is useful for quickly checking camera settings and saving images for simulation in XG-X VisionEditor.



The settings are the same as for area cameras. See "Simulation Image Capture" (Page 2-35) for more details.

Save

The settings for all units are saved to the currently used program setting file in SD Card 1 or SD Card 2.

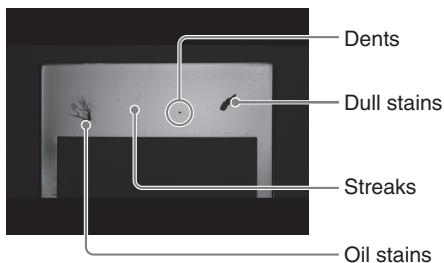
- Point**
- If the device is turned off before any settings are saved, all of those changes will be deleted.
 - Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
 - Items specified not to be saved are excluded from the saving operation. As examples of items that can be made so they are not saved, there are the variables and the screen, such as a display pattern screen, display state changed in the current program setting.

Other Changes When LumiTrax Specular Reflection Mode is Used

Images that Can be Generated with LumiTrax Specular Reflection Mode

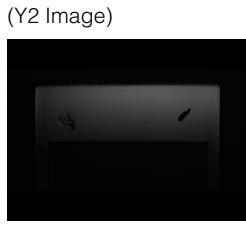
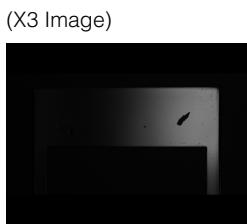
With LumiTrax Specular Reflection Mode processing, you can generate images of the following types for use for the measurement.

Actual Image of an Object



Images X1 to 4 and Y1 to 4

These are the actual captured images for which the striped pattern is moved four times in the X and Y directions.



Normal Image

This is an average of all the captured images that can be used to see the entire image and for position adjustment.



Specular Reflection Image

This image compares the striped pattern images and only the specularly reflected components are extracted. It can be used for inspecting streaks and abrasions on glossy surfaces.



Diffuse Reflection Image

This image compares the normal image and the specular reflection image, and the diffusely reflected components are extracted. It can be used for inspecting foreign matter and stains.



Gloss Ratio Image

This image compares the specular reflection image and the diffuse reflection image, and parts that have changes in glossiness are extracted. It can be used for inspecting defects on dull surfaces or cylindric surfaces and other such inspections.



Shape Image

This is an image where changes having concavities and convexities are extracted from the stripe shifts on the striped pattern images. It is used to inspect dents and shallow concavities and convexities.



Registration Numbers of Images Captured with LumiTrax Specular Reflection Mode

The registration image number [(Camera No.) - (Specified No.)] becomes as follows when registering images that are captured with LumiTrax Specular Reflection Mode.

When the Image Variables that are Targets of Batch Registration are Specified

The following images are registered all at once in the 8 types of registered image number ranges below.

- Normal Image: 000 - 099
- Specular Reflection Image: 200 - 299
- Diffuse Reflection Image: 300 - 399
- Shape Image 1: 400 - 499
- Shape Image 2: 500 - 599
- Phase X Image: 600 - 699
- Phase Y Image: 700 - 799
- Gloss Ratio Image: 800 - 899

See "Images that Can be Generated with LumiTrax Specular Reflection Mode" (Page 7-54) for more details on the types of images.

Registration example:

When only the normal image, specular reflection image, diffuse reflection image, and shape image 1 are enabled as the image types to be acquired with LumiTrax Specular Reflection Mode and when the images are registered to the registered image number 3, four images are registered as shown below.

- Normal Image: 003
- Specular Reflection Image: 203
- Diffuse Reflection Image: 303
- Shape Image 1: 403

When the Image Variables that are Not the Targets of Batch Registration are Specified

Only one image is registered to a range from 000 to 999 in the conventional way.

Handling of variables

When LumiTrax Specular Reflection Mode is used, you can specify the image to use freely from the images that are captured with LumiTrax Specular Reflection Mode for each of system image variable and user image variable.

- SpecularRF: Specular Reflection Image
- DiffuseRF: Diffuse Reflection Image
- Shape1: Shape Image 1
- Shape2: Shape Image 2
- PhaseX: Phase X Image
- PhaseY: Phase Y Image
- GlossRatio: Gloss Ratio Image
- Normal: Normal Image
- X1: X1 Image
- X2: X2 Image
- X3: X3 Image
- X4: X4 Image
- Y1: Y1 Image
- Y2: Y2 Image
- Y3: Y3 Image
- Y4: Y4 Image



When the image type is not specified, the image of the type specified as the default image is automatically used.

Image Output Unit

You can specify the contents of the output data.

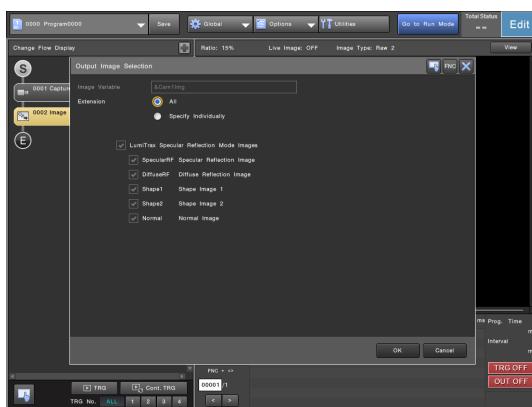
Image Setting

Image Variable

It specifies the image variable to be output.

When specifying an image array variable, specify the index to be output by a numeral value or a variable.

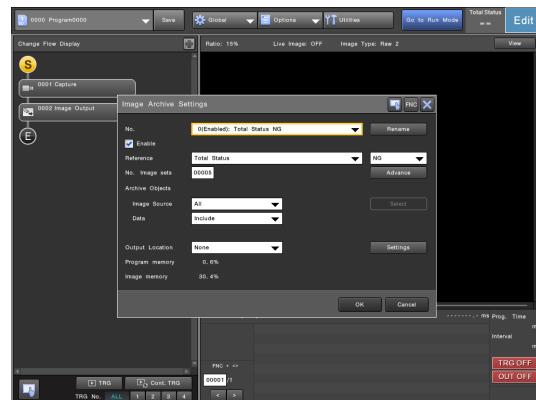
When LumiTrax Specular Reflection Mode is used, you can specify and output any image from several generated images on the [Output Image Selection] screen displayed when [Settings] is selected.



[Settings] is operable only when the image variable that uses a camera with LumiTrax Specular Reflection Mode selected is specified.

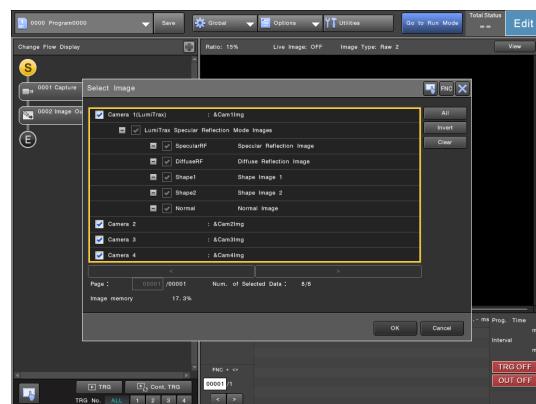
Image Archive Settings

In the state where flow editing is possible, open the [Image Archive Settings] screen by selecting [Utilities] at the upper section of the screen and then [Image Archive Settings]. On the screen, you can specify the detailed conditions for accumulating the images and result data, which were used for the inspections by the controller, to the image memory and program memory in the controller as the archived data.



Archive Objects

- Image Source:** Select image variables that are subject of accumulation.
 - **All:** It sets all image variables in the program setting as subjects of accumulation (accumulates all images other than black images).
 - **Select:** Only selected image variables are subjects of accumulation (up to 256 image variables can be selected).



- Data:** It specifies whether or not the archive result data are accumulated (initial setting: Do not include).

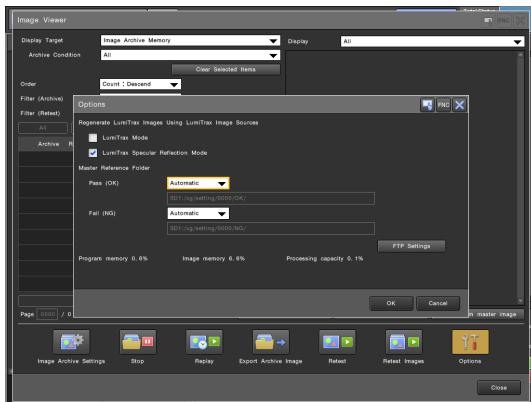


When LumiTrax Specular Reflection Mode is used, you can specify any images from several generated images as subjects of archive accumulation.

Image Viewer

With flowchart editing enabled, from [Utilities] on the top of the screen, select [Image Viewer] to display the [Image Viewer] screen, and then select [Options] at the bottom of the screen.

By the [LumiTrax Specular Reflection Mode] setting under [Regenerate LumiTrax Images Using LumiTrax Image Sources] on the [Options] screen, you can specify the method to generate the images that will be used during retesting which will be used in LumiTrax Specular Reflection Mode.



Select this check box to adjust LumiTrax Specular Reflection Mode settings during retesting. If you clear this check box, you will no longer need to archive generation source images in the image archive settings or other settings because images generated in LumiTrax Specular Reflection Mode during image capture are used as is.

Communication Commands

BS Image Registration

Note when the LumiTrax Specular Reflection Mode image is specified

All types of images that are selected as the image to be used with LumiTrax Specular Reflection Mode are saved when executing the BS command.



Reference

- You can specify the types of images to be used on [Image Selection] of the capture unit (Page 7-36, Page 7-48).
- See "Registration Numbers of Images Captured with LumiTrax Specular Reflection Mode" (Page 7-55) for more details on registration image numbers used when registering images captured with LumiTrax Specular Reflection Mode.



Point

- When an image variable without an extension such as [&Cam1Img] is specified while LumiTrax Specular Reflection Mode is enabled, the image registration number becomes 000 to 099 regardless of the default image type.
- Even when 000 to 099 is specified in the BS command, the images that are actually stored to 000 to 099 are the normal images.
- For more details regarding the BS command, see the XG-X2000 Series Communications Control Manual.

CL Change of line numbers

When using LumiTrax Specular Reflection Mode with a line scan camera, the upper limit of lines is limited as follows:

- When using the CA-HL08MX with 8192 selected for Resolution: The upper limit of lines is 8,192 and the upper limit of overlapping lines is 4,096.
- In all other cases: The upper limit of lines is 16,384 and the upper limit of overlapping lines is 8,192.

UT Execution of Unit Test

Addition of an error code

When the unit specified as the subject of the unit test is a capture unit and the capture mode of any of the enabled cameras is not LumiTrax Mode or LumiTrax Specular Reflection Mode, the unit test cannot be executed and the error code 03 will be returned.

Execution of the unit test with regard to LumiTrax Specular Reflection Mode processing in the re-test mode

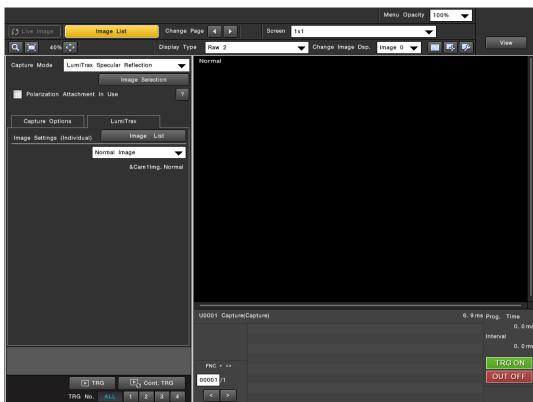
Whether or not LumiTrax Specular Reflection Mode processing is executed for the unit test depends on the [LumiTrax Specular Reflection Mode] setting of the re-test setting.



For more details regarding the UT command, see the XG-X2000 Series Communications Control Manual.

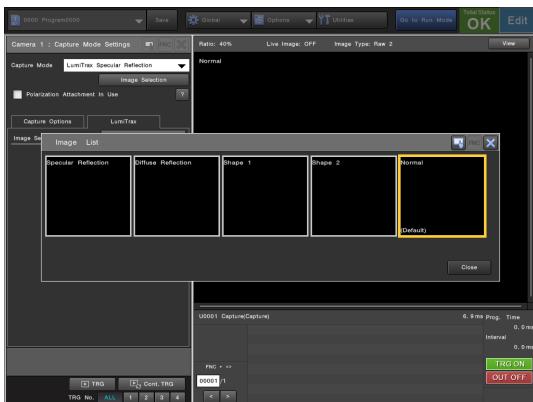
View bar

On the [Capture Mode Settings] screen for the capture unit, you can select [Image List] on the view toolbar to change the displayed LumiTrax Specular Reflection Mode image (Specular Reflection Image, Diffuse Reflection Image, Shape Image 1, Shape Image 2, Phase X Image, Phase Y Image, Gloss Ratio Image, Normal Image, X1 image - X4 image, and Y1 image - Y4 image).



1 Select [Image List].

The [Image List] dialog will appear.



2 Select the LumiTrax Specular Reflection Mode image that is to be displayed.

The dialog closes and the image switches to the one that is to be displayed.

MultiSpectrum Mode

Overview of Capture Modes

LumiTrax Mode

LumiTrax Specular Reflection
Mode

► **MultiSpectrum Mode**

Standard Lighting Mode
(MultiSpectrum light)

Switching to MultiSpectrum Mode

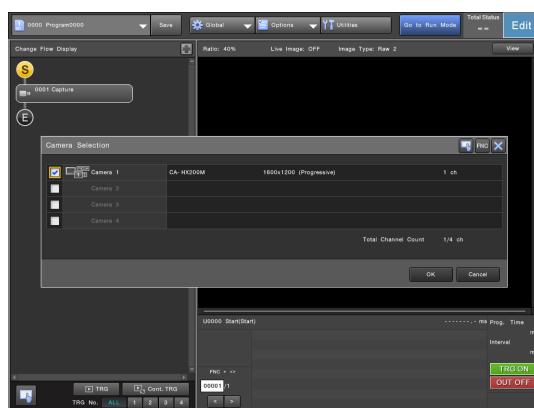
1 Prepare and connect a MultiSpectrum Mode-compatible camera (CA-HX*M).

For more details, refer to the XG-X2000 Series Setup Manual.

Point Only the CA-DRM*X (connected to CA-DC60E) lights can be used in MultiSpectrum Mode.

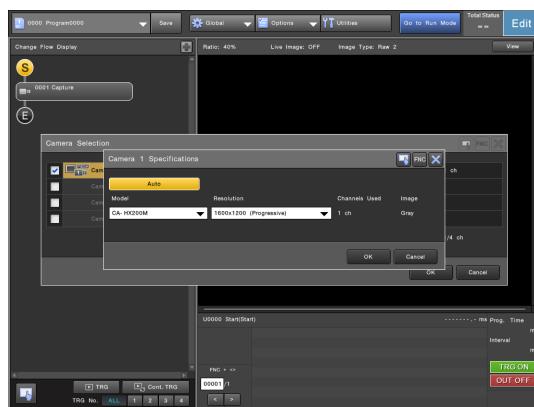
2 From the [Options] menu, select [Camera Settings] - [Camera Selection].

The [Camera Selection] menu appears.



3 Select the camera No. where the MultiSpectrum Mode-compatible camera is connected.

The [Camera* Specifications] screen appears.



4 Check that the camera model displayed in the [Model] field matches the connected MultiSpectrum Mode-compatible camera.

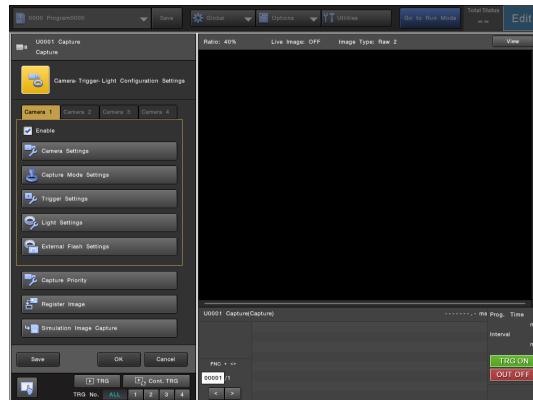
If a Different Camera is Displayed

Select [Auto] on the [Camera * Specifications] screen.

5 Select the capture resolution in the [Resolution] field.

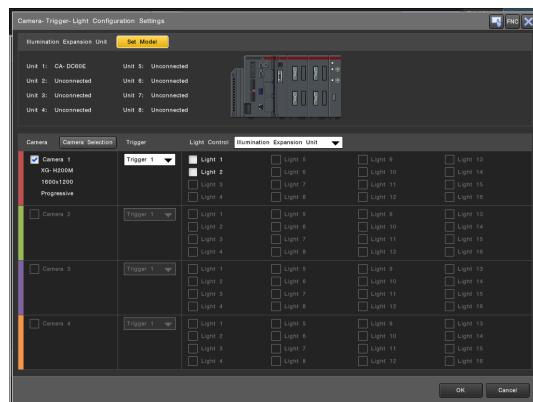
6 Select [OK].

7 Select the capture unit from the flowchart.



8 Select [Camera - Trigger - Light Configuration Settings].

The "Camera - Trigger - Light Configuration Settings" screen appears.



9 On the top of the screen, select [Set Model] for [Illumination Expansion Unit].

The "Illumination Expansion Unit Model Settings" screen appears.

10 Check that the connected illumination expansion unit is displayed.

If an illumination expansion unit is connected but [Unconnected] or a different model is displayed
Select the correct unit or select [Auto].

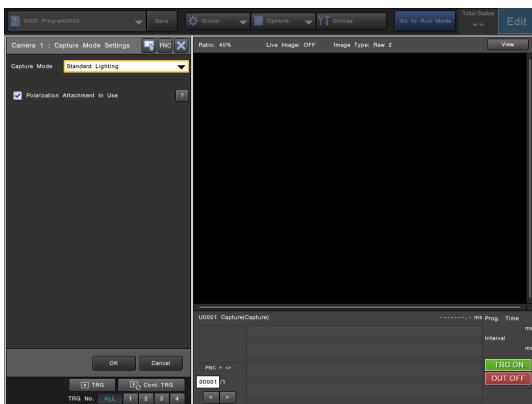
11 Select [OK].

12 Select [OK].

13 Select the tab of the camera No. where the MultiSpectrum Mode-compatible camera is connected.

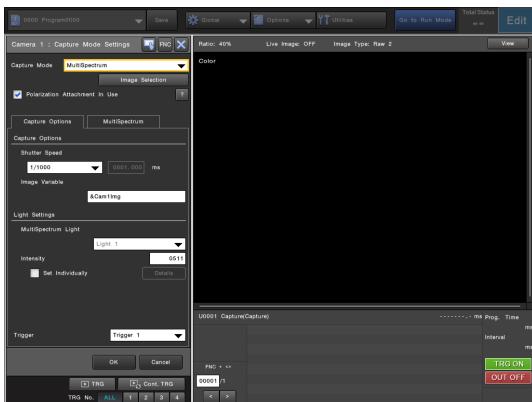
14 Select [Capture Mode Settings].

The "Capture Mode Settings" screen appears.



Point When the CA-DRM*PA is attached to the MultiSpectrum Light CA-DRM*X, selecting the [Polarization Attachment In Use] check box can suppress the lighting of the ultraviolet (UV) light, which may cause polarization filter deformation or deterioration.

15 In the [Capture Mode] field, select [MultiSpectrum].



16 Change the capture unit settings according to the measurement target.

See "Capture (MultiSpectrum Mode) (Area Camera Only)" (Page 7-62) for more details.

When Setting is Done

Add and configure other units that are required for measurement.

The operations and settings are the same as for measurements using area cameras.

For more details on the functions and restrictions that are specific to MultiSpectrum Mode-compatible cameras, see "Other Changes When MultiSpectrum Mode is Used" (Page 7-75).

Capture (MultiSpectrum Mode) (Area Camera Only)

A capture unit is used for capturing images of the inspection/measurement target workpiece using a camera. When the CA-DC40E/DC50E/DC60E illumination expansion unit is connected, the settings (flashing/light intensity) can be controlled without wiring to the controller.

- This section provides information on the settings for when using MultiSpectrum Mode with MultiSpectrum Mode-compatible area cameras. When using other cameras, refer to the description below.
 - Area Camera: Page 2-25
 - 3D Camera: Page 8-14
 - LJ-V Series head: Page 8-22
 - Line Scan Camera: Page 8-175
- When using other capture modes, refer to the following descriptions:
 - LumiTrax Mode (Area Camera Only): Page 7-11
 - LumiTrax Specular Reflection Mode (area camera): Page 7-32
 - LumiTrax Specular Reflection Mode (line scan camera): Page 7-44
 - Standard Lighting Mode Using MultiSpectrum Light: Page 7-86
- For special notes when using MultiSpectrum Mode, see "Other Changes When MultiSpectrum Mode is Used" (Page 7-75)

Image Capture Setup

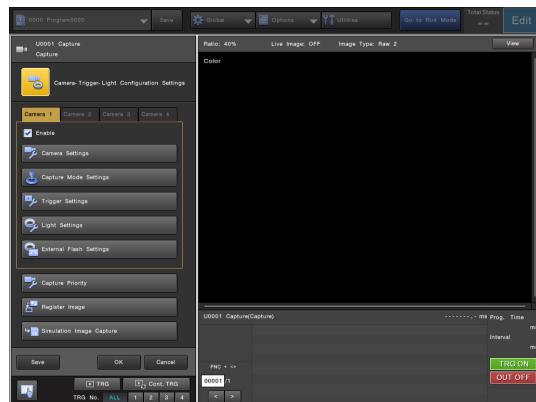
In the capture unit, images are captured by using the cameras, maximum of 4, connected to the controller. The image data is sent from the camera to the controller and stored in a specified image variable.

Point

- If the cameras used in a capture unit are different from the cameras actually connected to the controller, a camera setting error will occur. No image capturing and subsequent image processing units will be processed. In such cases, set the camera model setting correctly or turn off the controller and connect the correct camera.
- The model and other information for the camera set in a capture unit can be viewed in the [Camera Selection] screen (Page 4-11).

Top Menu

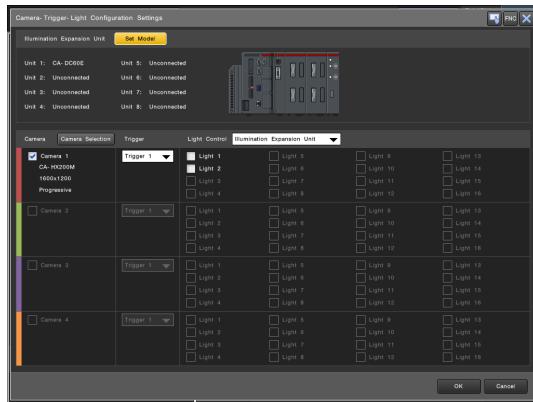
The capture unit menu has the following options. Change the settings as required.



Camera - Trigger - Light Configuration Settings (Page 7-63)	The connected cameras and illumination expansion units, trigger input for each camera, and illumination control targets can be configured together.
Camera Settings (Page 7-64)	You can specify the conditions for image capture.
Capture Mode Settings (Page 7-65)	Change the MultiSpectrum Mode settings.
Trigger Settings (Page 7-69)	Specify the settings for triggering the controller to take an image.
Light Settings (Page 7-70)	When an illumination expansion unit CA-DC40E/DC50E/DC60E (sold separately) is connected to the controller, the settings related to the light brightness and illumination are configured per light.
External Flash Settings (Page 7-72)	Set the illumination timing for controlling external light equipment using the external FLASH terminal.
Capture Priority (Page 7-72)	This option controls the conditions of the trigger input status for capture unit completion (transition to the next unit) with priority.
Register Image (Page 7-73)	Register images to use as the basis for measurements and setting.
Simulation Image Capture (Page 7-74)	Save the captured image to the SD card. The saved images can be referenced as simulation images in XG-X VisionEditor.

Camera - Trigger - Light Configuration Settings

The connected cameras and illumination expansion units, trigger input for each camera, and illumination control targets can be configured together.



Illumination Expansion Unit

Displays the information of the illumination expansion unit connected to the controller. Select [Set Model] to specify the model of the connected illumination expansion unit for each light unit No.

Camera

Check the camera No. box of the camera to be used. Select [Camera Selection] to specify the model of the connected camera for each camera No. See "Specifying the Model of the Connected Camera (Camera Selection)" (Page 4-11) for more details.

Trigger

Select the trigger to be assigned to each camera.

Light Control

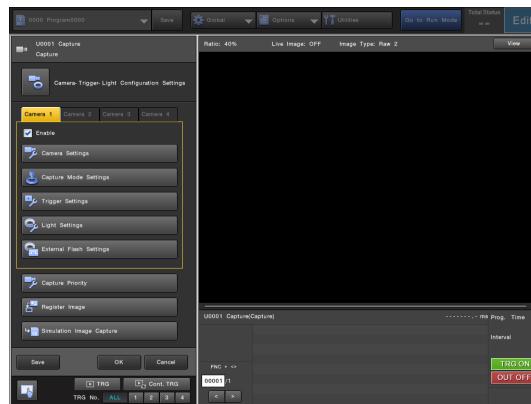
Specify the control method for the light assigned to each camera.

- Illumination Expansion Unit:** Check the light number of the illumination expansion unit to which you wish to assign an illumination control.
- External Flash:** Check the external terminal to which an illumination control will be assigned.

 **Point** Only the CA-DRM*X (connected to CA-DC60E) lights can be used in MultiSpectrum Mode.

Camera 1 to Camera 4

Select the tab of the camera for setting the capture options for.



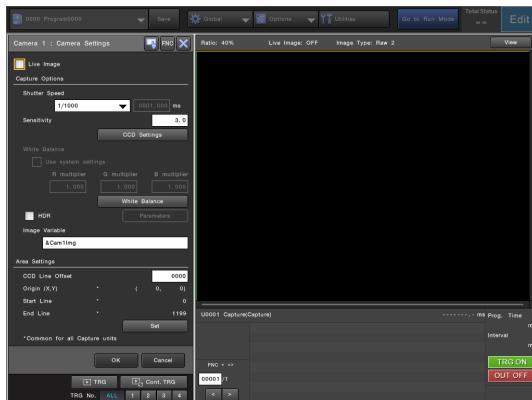
Enable

Check the box to enable the current setting target camera. Remove the check mark if a camera is connected to the controller but is not used.

Capture (MultiSpectrum Mode) (Area Camera Only)

Camera Settings

You can specify the conditions for image capture.



- The gain adjustment cannot be used if MultiSpectrum Mode is enabled.
- If you change the capture options after the color extraction settings have been set, the color extraction result for the captured image may be different. Make sure to readjust the color extraction settings if the capture options are changed.

Live Image

Check this box to display the latest images through a continuous feed.



- [Live Image] is only available in Setup Mode.
- When the [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings] (Page 7-19), this cannot be changed.
- If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-19), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- [Live Image] is not available when MultiSpectrum Mode is enabled.

Capture Options

Shutter Speed

Select or enter the shutter speed for the camera specified in camera tab. Select the shutter speed according to the target movement speed and lighting conditions. When setting the shutter speed to match a fast line, prepare a light where the required lighting can be secured for producing the desired images.

The range for possible shutter speed adjustment is different for each camera.

- CA-HX048M: 0.022 to 1000 (ms)
- CA-HX200M/HX500M: 0.010 to 100 (ms)

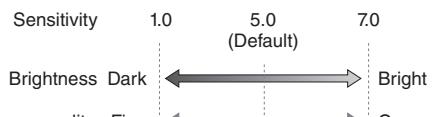
Sensitivity

The sensitivity of the camera can be adjusted. Typically, to adjust the brightness of an image, the lens aperture, lighting and shutter speed are the ones adjusted accordingly.

However, if none of these improve image brightness, such as in lines where the movement speed is fast, then change the camera sensitivity.



- If the camera sensitivity is increased, so will the overall brightness of the image. However, noise in the image will become more visible (and the image will appear coarser). When the camera sensitivity is decreased, the overall image darkens but the noise will be reduced (the image appears smoother).



- If the camera sensitivity is set higher than default, a vertical line may appear on the screen depending on the capture condition. This phenomenon is a feature of the controller and not an error. If this occurs, set the camera sensitivity lower and secure illuminance via an external auxiliary lighting etc.
- The range of sensitivity adjustment for each camera type is different.
 - CA-HX048M: 1.0 to 7.0 (Default: 2)
 - CA-HX200M/HX500M: 1.0 to 7.0 (Default: 3)

HDR

HDR allows an image with a broad dynamic range to be created by capturing multiple images at different exposures.



HDR capture cannot be used when MultiSpectrum Mode is enabled.

Image Variable

Specify an image variable which will contain the image captured with the camera selected in camera tab.

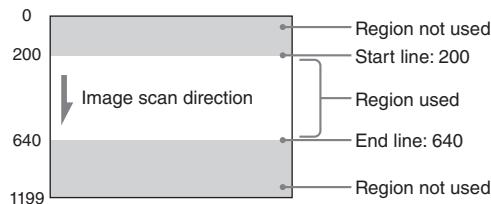


- Variables to be specified need to be added in advance on the [Variable Settings] screen (Page 4-4).
- Changing this setting will clear all image variables, archived data, output buffer, and target classification results.

Area Settings

The current CCD imaging region for the camera is displayed.

Example: When the CCD imaging region is set to “Start Line: 200, End Line:640”



CCD Line Offset

Set the offset for the start line in the CCD imaging region settings.

The range of setting values available are from 0 (Default) to (Maximum capture lines of the camera used - Specified end line).



- When the CCD line offset is set, the line positions following the offset are shown in blue next to the [Start Line] and [End Line].
- When the offset value is changed, the processing time for the capture unit that will recently be executed is extended due to the changes being applied.

Set

Set the CCD imaging region.

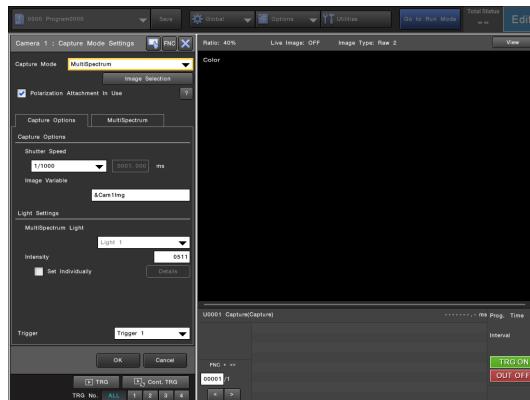
- Origin X:** Specify the X coordinate of the origin (upper left) of the capture range.
- Origin Y:** Specify the Y coordinate of the origin (upper left) of the capture range.
- Start Line:** Specify the start line of the capture range.
- End Line:** Specify the end line of the capture range.
- Mirror / Rotate Image:** Select whether to perform mirror inversion or rotation of the capture image.
 - OFF** (Default): Does not mirror the image horizontally.
 - Horizontal**: Captures the image horizontally inverted.
 - Vertical**: Captures the image vertically inverted.
 - 180° Rotate**: Rotates the image by 180° during image capture.



- While a CCD imaging region is being set, ordinary capture is performed even if HDR capture is enabled.
- Workpieces will not be processed if they do not lie between the start and end lines, even if they are in the process area.
- The area around the edge of the captured image may appear dark when a lens with a small maximum image size is used and the process area is at the edge part of the capture element.
- The CCD setting is common for all capture units.
- When setting the CCD imaging region, all image variables, archived data, and the output buffer are cleared.
- Once an image has been inverted/rotated, it cannot be reverted to the original image (normal orientation) in this unit.

Capture Mode Settings

Change the MultiSpectrum Mode settings.



When using an image captured with MultiSpectrum Mode as a registered image, handling is different from standard captured images. See "Registration Numbers of Images Captured with MultiSpectrum Mode" (Page 7-76) for more details.

Capture Mode

To use MultiSpectrum Mode, select [MultiSpectrum].



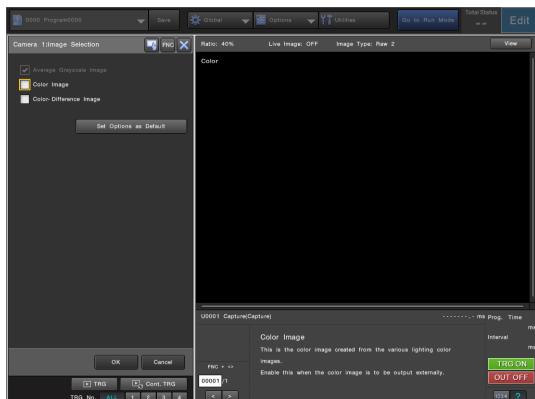
MultiSpectrum Mode cannot be set in the following conditions.

- When a line scan camera or an LJ-V Series sensor head is connected
- When a 3D camera is specified as another camera in the same capture unit
- When a different Capture Mode (with the exception of Standard Lighting Mode) or HDR is selected for another camera in the same capture unit
- When Specify Encoder used in the trigger setting

Capture (MultiSpectrum Mode) (Area Camera Only)

Image Selection

When selecting [Image Selection], the [Image Selection] screen appears. Put a check mark to the image type to be generated by MultiSpectrum mode.



See "Images that can be generated in MultiSpectrum Mode" (Page 7-75) for more details on the image types.

Set Options as Default

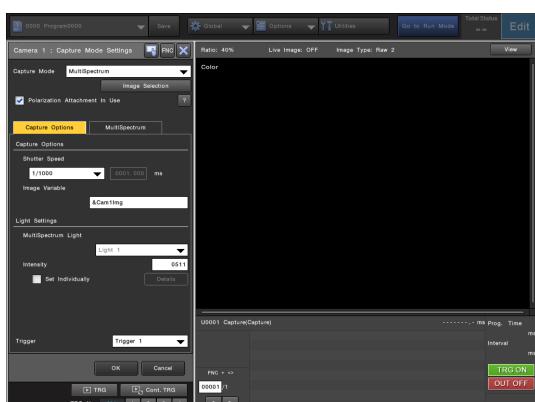
Saves the image selection state to the System Settings. After this, the images selected by default in Image Selection when a program setting is newly created or a Capture unit is added will be the state that is saved in the System Settings.

Polarization Attachment In Use

When the CA-DRM*PA is attached to the MultiSpectrum Light CA-DRM*X, selecting the [Polarization Attachment In Use] check box can suppress the lighting of the ultraviolet (UV) light, which may cause polarization filter deformation or deterioration.

Capture Options

You can set the capturing conditions and image processing for when MultiSpectrum Mode is used.



Shutter Speed

Select or enter the shutter speed for the camera specified in camera tab. Select the shutter speed according to the target movement speed and lighting conditions.

Point This setting is common with the [Shutter Speed] setting on the [Camera Settings] screen.

Image Variable

Specify an image variable which will contain the image captured with the camera selected in camera tab.



- Variables to be specified need to be added in advance in the [Variable Settings] screen.
- Changing the setting clears all image variables, archived data, and target classification results.

Light Settings

- MultiSpectrum Light:** Selects the light to be used in MultiSpectrum Mode. The light numbers correspond to the connection order of the illumination expansion units.



Only the CA-DRM*X (connected to CA-DC60E) lights can be used in MultiSpectrum Mode.

- Intensity:** Specifies the brightness of the light in the range between 0 and 1023 (Default: 511). To correctly differentiate colors, you need to adjust the lighting to an appropriate brightness so there are no saturated or dark areas.



If you are using the CA-DRM10X or CA-DRM20X in MultiSpectrum Mode or Standard Lighting Mode, the light intensity when one light is connected to one light controller (CA-DC60E) is limited to 700 and 511 when two lights are connected. There are no limits on the light intensity of the CA-DRM5X itself, but the limits above apply.

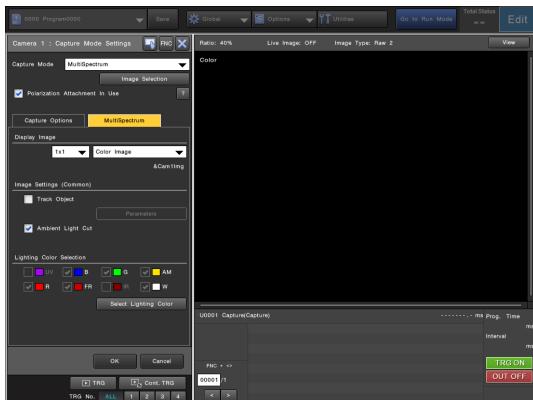
- Set Individually:** To specify the intensity for each light individually, select this check box and select [Details].
 - Intensity:** You can specify the intensity value for each light. You can also select [Auto-Adjust] to automatically set the light intensity for each color so that saturation does not occur.
 - Brightness Adjustment:** You can specify the light intensity individually for each color.
 - Batch Shift:** Shifts the intensity for all colors at once. You can adjust the light brightness while retaining the balance for each color.
 - Shutter Speed:** Select or enter the shutter speed for the specified camera.

Trigger Setting

- Trigger:** Selects the trigger that will execute lighting. This setting is the same as [Trigger] on the [Trigger Settings] screen.

MultiSpectrum

You can specify the capturing conditions exclusive for MultiSpectrum Mode.



Display Image

Select the type of image to be displayed.

Image Settings (Common)

- Track Object:** Select this check box to track a moving workpiece when using MultiSpectrum. For more details, refer to "Applying MultiSpectrum Mode to a Moving Workpiece (Track Object)" (Page 7-67).

Point The number of images captured increases; therefore, the capturing time becomes longer.

- Ambient Light Cut:** Select this check box if you want to suppress the impact on the measurement from ambient light other than the light for the measurement.

Point The number of images captured increases; therefore, the capturing time becomes longer.

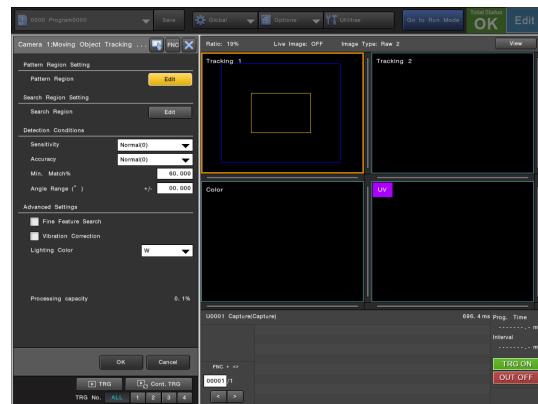
Lighting Color Selection

You can limit the lighting colors to reduce capture time. Select [Select Lighting Color] and select the check box for the color that you want to use while checking the images that you obtain with each color.

You can also select [Recommended Selection] to follow the on-screen instructions and delete unnecessary light colors.

Applying MultiSpectrum Mode to a Moving Workpiece (Track Object)

When using MultiSpectrum Mode for a moving workpiece, check [Track Object] in the [MultiSpectrum] tab and then select [Parameters].



Specify the pattern for detecting the movement and change the settings for the pattern detection.

Pattern Region

Record the image of the model to search for as a [Pattern Region].

Search Region

Set a range (search region) in the image to search for the model recorded in the pattern region.

Sensitivity

Configure the search sensitivity. When detection is unstable, increase the level of sensitivity.

Accuracy

Configure the search accuracy. To measure with a high level of accuracy, set the search accuracy higher.

Min Match %

[Match%] is the value that indicates the percentage of similarity with the cut out pattern.

Check the variable range of the correlation value and set the numeral value lower than the variable range. The pattern with a correlation value that is lower than [Min. Match%] is excluded from the measurement candidates. Therefore, it is useful when prevention of erroneous detection is desired.

- Point**
- When the value is lowered too much, the number of erroneous detection increases.
 - When there is no pattern with a value that is higher than the Min. Match%, measurement is done considering it as there being no movement amount.

Angle Range (°)

When a pattern is tilted due to movement of the workpiece, specify the angle to be measured in the range between -90 and 90 degrees.

Fine Feature Search

Put a check mark when it is necessary to search with fine characteristic such as when searching on metal cast surface.

- Point** The detection accuracy improves; however, processing time becomes longer.

Capture (MultiSpectrum Mode) (Area Camera Only)

Vibration Correction

Put a check mark when the work is vibrating or when the work moving speed changes during capturing.



The number of images captured increases; therefore, the capturing time becomes longer.

Lighting Color

Specify the lighting color which is to be used when tracking a moving object (default value: W). Normally W is used, but if the Track Object is not stable, the stability of the Track Object might be able to be improved by specifying a lighting color that is the same as or that is complementary to the workpiece.

Tracking a moving object in MultiSpectrum Mode

In addition to the lighting color images that are necessary for MultiSpectrum processing, it additionally captures images that are used for calculation of the movement amount of the object. MultiSpectrum processing is conducted based on the positional change of the pattern at the location specified in the image. With this function, MultiSpectrum becomes usable even in the environment where the object moves on the screen during capture.

1. Images captured when Track Object is disabled:

Captures images in each light color. MultiSpectrum processing cannot be conducted properly if the object does not stay still until the completion of capturing.



2. Images captured when Track Object is enabled:

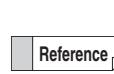
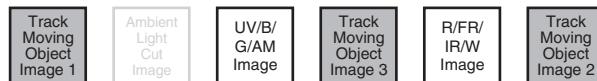
This setting is used when the object transfer speed is constant. In addition to the images in each light color, Tracking Image 1 and Tracking Image 2 are captured in order to calculate the movement amount (you can specify the light color to be used in capturing the tracking images). By comparing the patterns on these images, it estimates the movement amount at when each image is captured, and then conducts MultiSpectrum processing.



3. Images captured when Track Object is enabled (Vibration Correction applied):

This setting is used when the object transfer speed is not constant or for objects that vibrate.

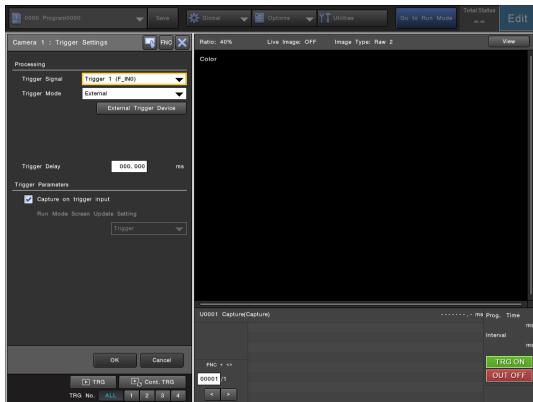
In addition to the two types of images that are captured when Track Object is enabled, it also captures Tracking Image 3 (you can specify the light color to be used in capturing the tracking image). By comparing Tracking Images 1 to 3, object vibrations and speed changes can be detected and estimated, and MultiSpectrum processing is performed.



When Ambient Light Cut is enabled, an image with the lights off (Ambient Light Cut image) is captured immediately after Tracking 1.

Trigger Settings

Specify the settings for triggering the controller to take an image.



Processing

Trigger Signal

Select the trigger signal to be used. The assignment of trigger signals and terminals are specified on the [Terminal Block & Parallel Port] screen (Page 6-11) in the [Global] menu.

Trigger Mode

Select the type of trigger to be used.

- **External** (Default): Captures images in response to trigger inputs from the handheld controller or trigger signals sent from an external device. The process is performed only once for each trigger input.
- **Internal**: Capture images in response to internally generated periodic trigger signals by specifying the interval time or encoder count.



If [Trigger Mode] is set to [Internal] and [Trigger Cycle] is set to [Time Delay], respectively, the trigger will constantly be generated while in Run mode (No triggers are generated in Setup mode). To temporarily stop the generation of internal trigger signals from an external device, use either of the following methods to prohibit trigger input. When internal trigger is disabled, the output of the result data up to that point continues.

- Terminal block input (EXT terminal)
- Communications command (TE,0 command).

For more details, see the XG-X2000 Series Communications Control Manual.

Trigger Cycle (Only When [Internal] is Selected)

- **Time Delay** (Default): Select to specify the trigger cycle based on time.
- **Specify Encoder**: Select to specify the trigger cycle using the encoder's pulse count.



[Specify Encoder] cannot be selected if MultiSpectrum Mode is enabled.

External Trigger Device (Only When [External] is Selected)

To use an external trigger, select and check the type of trigger to be used for image capture.

- **Terminal Block**: Trigger input through the external terminal assigned with %Trg1 through to 4
- **Handheld Controller/Mouse**: Trigger input provided by the No.3 (TRIGGER) button on the handheld controller or the TRG button on the screen.
- **RS-232C**: Trigger input through the RS-232C commands
- **Ethernet (TCP/IP)**: Trigger input through the Ethernet commands
- **PLC-Link**: Trigger input through RS-232C or Ethernet PLC-Link commands
- **CC-Link**: Trigger input through the CC-Link bit devices or commands
- **EtherNet/IP**: Trigger input through the EtherNet/IP cyclic communication, message communication, or commands
- **PROFINET**: Trigger input through the PROFINET cyclic communication, message communication, or commands
- **EtherCAT**: Trigger input through the EtherCAT cyclic communication, mailbox communication, or commands
- **PC Program**: Trigger input through the ActiveX control method



External triggers using the handheld controller/mouse are always available in Setup mode.

Trigger Delay

To set a time delay between the selected trigger input and capturing of an image, specify a trigger delay time (Trigger Delay).

The trigger delay can be set in the range between 0 and 999.999 ms for each camera.

Trigger Parameters

Capture on trigger input

Choose whether or not the capture unit will wait for a trigger signal to capture an image. When the check is removed, all cameras that are set will capture images according to the capture processing, regardless of their independent trigger signals.

This is the case when the image capture buffer (Page 4-12) is enabled and empty when the capture unit is processed. If there are any images in the buffer which satisfy the capture priority, the capture will be completed and the next unit will be executed regardless of this setting.

Run Mode Screen Update Setting

Select whether to update the camera images continuously in Run mode.

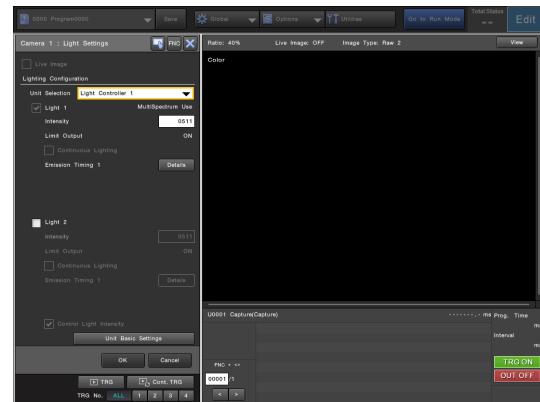
- Trigger:** Update the image only when a trigger input is received.
- Live Image:** Always displays the latest image while waiting for a trigger signal.

Point

- [Live Image] is only applied in Run mode.
- If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-69), this setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- Live Image is not available when MultiSpectrum Mode (Page 7-65) or HDR capture (Page 7-64) is enabled.
- Even if [Live Image] is selected, the image is not updated continuously if [Live Image Feed] (Page 4-43) is not enabled in the camera Image Display screen part settings in Screen Editor (Page 4-25).

Light Settings

When an illumination expansion unit CA-DC40E/DC50E/DC60E (sold separately) is connected to the controller, the settings related to the light brightness and illumination are configured per light.



Live Image

Check this box to display the latest images through a continuous feed.

Point

- [Live Image] is only applied in Setup Mode.
- When the [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings] (Page 7-19), this cannot be changed.
- If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-19), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- [Live Image] is not available when MultiSpectrum Mode is enabled.

Lighting Configuration

Unit Selection

Choose the illumination expansion unit (light controller) to which the light you wish to enable emission is connected to.

Reference

- When multiple illumination expansion units are connected, they will be numbered 1 through 8, with 1 being the unit closest to the controller.
- If the connected illumination expansion unit and the model specified in [Illumination Expansion Unit] under [Camera - Trigger - Light Configuration Settings] are different, the currently selected light controller will be displayed in red.

Light*

Check the box of the light number you wish to enable emission.

Point

- Only the CA-DRM*X (connected to CA-DC60E) lights can be used in MultiSpectrum Mode.
- The emission timing cannot be changed when continuous lighting is enabled.

Intensity

The brightness of each light can be set in the range of 0 to 1023 (Default: 511). Use this in conjunction with the shutter speed setting to correctly illuminate images.

Point

- The intensity can only be changed for lights that have been enabled in the [Light Configuration] screen (Page 6-9).
- The intensity of continuous lighting can be changed regardless of the camera selection. If a FLASH terminal output has been assigned to the light, the intensity can only be changed when the selected camera is the camera that is used with the FLASH terminal output.
- When the [Limit Output] is [ON], the upper limit is set to 511 (Even when 512 or a higher value is entered, the intensity remains at 511).
- When the [Limit Output] is [OFF] and the intensity is set to 512 or higher, be careful not to damage the light through excessive heat generation.
- If you are using the CA-DRM10X or CA-DRM20X in MultiSpectrum Mode or Standard Lighting Mode, the light intensity when one light is connected to one light controller (CA-DC60E) is limited to 700 and 511 when two lights are connected. There are no limits on the light intensity of the CA-DRM5X itself, but the limits above apply.

Limit Output

The status of the light output limit to prevent degradation of the LED light through overheating is displayed (Default: ON). To disable the light output limit, change the setting in [Unit Basic settings] or [Light Configuration] (Page 6-9) in the [Global] menu.

Continuous Lighting

Check this box to keep the light illuminated regardless of the FLASH terminal output.

Point

- Continuous lighting is unavailable for CA-DC50E.
Continuous lighting is also unavailable for CA-DRM*X if [Limit Output] is set to [OFF].

Emission Timing

The light emission timing controlled in linkage with the camera can be specified.

Select [Details] and select the illumination control timing from either emission timing 1 to 12 or external flash 1 to 4, and then specify the output on-delay and time. The light will illuminate in coordination with the assigned emission timing.

- Emission Timing 1 to 12:** Allows you to set the emission timing of each light controller each capture unit.
- External Flash 1 to 4:** Can be used in the same manner as the emission timing. However, the output on-delay and time settings are shared with the external flash terminals for controlling the external light.

Point

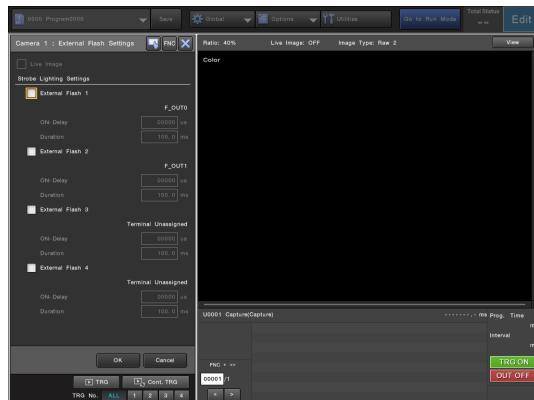
- For CA-DC50E/DC60E, the output [On-Delay] and [Duration] are fixed values and cannot be changed.

Unit Basic Settings

The basic common settings of the illumination expansion unit can be changed. The settings configured here are also reflected to [Light Configuration] in the [Global] menu (Page 6-9).

External Flash Settings

Specify the conditions for when using flash for image capture.



When the external flash is selected as the emission timing for the illumination expansion unit CA-DC40E/DC50E/DC60E (sold separately), the output ON-delay and duration specified in the External Flash Settings are also reflected to the illumination expansion unit.

Live Image

Check this box to display the latest images through a continuous feed.



- [Live Image] is only applied in Setup Mode.
- When the [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings] (Page 7-19), this check box cannot be changed.
- If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-19), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- [Live Image] is not available when MultiSpectrum Mode is enabled.

Strobe Lighting Settings

External FLASH*

Check the box for the subject FLASH* signal and specify the on-delay and duration.

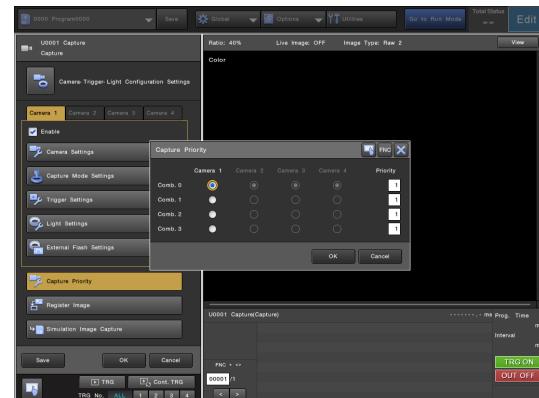
- **ON-Delay:** Set the Emission Timing 1-12 or External Flash signal 1-4 [ON-Delay] in the range from -50000 to 50000 (μ s) (If [Specify Encoder] is set for [Trigger Cycle], the range is -32767 to 32767 pulses.), with the image capture start time as 0 (Default: 0ps = Same time as image capture start).
- **Duration:** Set the FLASH* signal output time in the range between 0.1 to 999.9 (ms).



The values for [ON-Delay] and [Duration] for the CA-DC50E/DC60E are fixed and cannot be changed.

Capture Priority

The [Capture Priority] screen appears, which controls the conditions of the trigger input status for capture unit completion (transition to the next unit) with priority. Normally, the capture unit is complete when the trigger inputs for all enabled cameras are received. It is possible to move to the next unit when the trigger input(s) of the specified camera(s) combination is received.



Comb. 0 to 3

Set up to four condition combinations to complete the capture unit. When all trigger inputs for the specified cameras are received, the process moves to the next unit.



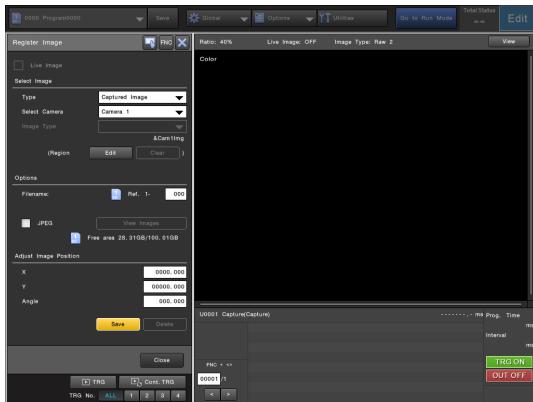
- Trigger input can only be specified for enabled cameras.
- The combination with which the unit was completed is stored as 0 to 3 in unit result data [Passing Status] (RSLT.STAT).

Priority

Specify the priority (from 1 to 4) for when more than one condition is met simultaneously. When the same priority is assigned, the condition met earliest is processed.

Register Image

Register images to use as the basis for measurements and setting.



Live Image

Check this box to display live images through a continuous feed.

Point

- [Live Image] is only applied in Setup Mode.
- When the [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings] (Page 7-19), this cannot be changed.
- If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-19), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- [Live Image] is not available when MultiSpectrum Mode is enabled.

Select Image

Type

Select the image to be the registration source.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified in [Options].

Select Camera

Select the number of the camera used for registration.

Choose from Camera 1-4, and select only the camera number used for the capture unit being edited.

Region

To register only part of an image, select [Edit] then specify the region to register. To cancel the selected region, select [Clear].

Options

Filename

Specify the registered image number used for image registration in the form "(Camera No.)-(Specified No.)".

Reference

The saved file name is "ref (camera No.)(specified No.)" (for full screen image registration) or "ref (camera No.)(specified No.)_XXX_YYY" (for partial image registration).

JPEG

Check this box to save the image in JPEG format. When this box is not checked, the image will be saved in BMP format as either a 24-bit color bitmap image (color camera) or an 8-bit grayscale bitmap image (monochrome camera).

Point

Using image compression may result in some image deterioration, thus measurement results from a compressed image may differ to those when using non compressed images.

View Images

You can check a list of registered images.

Adjust Image Position

Adjust the position of the image being captured.

X

Adjust the movement in the X (horizontal) direction between -8191.000 and 8191.000 pixels.

Y

Adjust the movement in the Y (vertical) direction between -16383.000 and 16383.000 pixels.

Angle

Adjust the position angle (rotation) around the center of the image between -999.999° and 999.999°.

Point

Position adjustment may cause missing peripheries (black areas) due to image movement or jagged edges (jaggies) due to rotation in the registered image.

Save

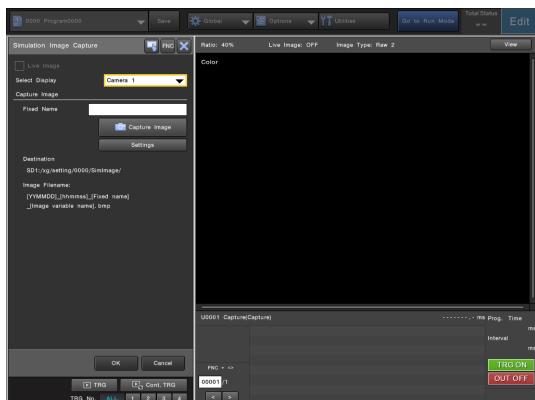
Save the displayed image as a registered image under the conditions specified on the [Register Image] screen.

Delete

When [Registered Image] is selected for [Type], you can delete the registered image specified in [Options].

Simulation Image Capture

The simulation image capture allows you to check the actual images captured by the camera based on the changed settings, or save the captured images to the SD card in the image format specified in the output settings. This is useful for quickly checking camera settings and saving images for simulation in XG-X VisionEditor.



Live Image

Check this box to display the latest images through a continuous feed.



- [Live Image] is only applied in Setup Mode.
- When the [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings] (Page 7-19), this cannot be changed.
- If the capture on trigger input is disabled in the [Trigger Settings] (Page 7-19), this check box is always unchecked and the setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- [Live Image] is not available when MultiSpectrum Mode is enabled.

Select Display

Switch from 4-screen display to 1-screen display of the desired camera.

- **Camera 1:** Displays the image from Camera 1.
- **Camera 2:** Displays the image from Camera 2.
- **Camera 3:** Displays the image from Camera 3.
- **Camera 4:** Displays the image from Camera 4.
- **Camera 1 to 4:** Displays images from all the connected cameras.

Capture Image

Save the current camera image to the SD card in the save format specified in the output settings.

Fixed Name

Enter the fixed name if the file name contains a fixed name.

Capture Image

Save the image with the current settings.

Settings

The current save conditions can be checked in the list and changed as required.



- This function saves images from all cameras, regardless of the selected preview.
- When [Simulation Image Capture] is closed by selecting [OK], the update mode and VIEW bar settings will stay the same until power is turned off.

Save

The settings for all units are saved to the currently used program setting file in SD Card 1 or SD Card 2.



- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation.
As examples of items that can be made so they are not saved, there are the variables and the screen, such as a display pattern screen, display state changed in the current program setting.

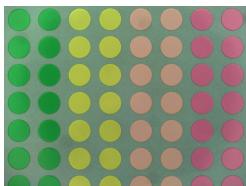
Other Changes When MultiSpectrum Mode is Used

Images that can be generated in MultiSpectrum Mode

The following types of images can be generated in MultiSpectrum Mode:

- All lighting color images and the average grayscale image can be used in measurements.
- The Color, Color-Difference, and Overexposure images are for displaying on the screen and output for adjustment and checking purposes (Overexposure images are only displayed on the screen and cannot be output).

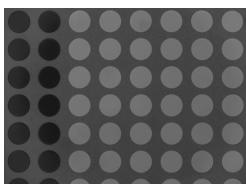
Actual Image of an Object



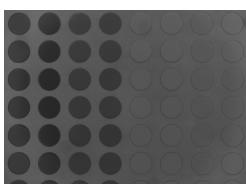
Each Lighting Color Image

These images were obtained by lighting each light color individually.

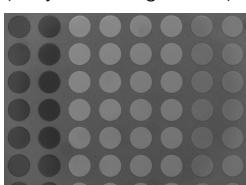
(Only the R light is on)



(Only the B light is on)



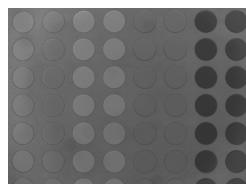
(Only the AM light is on)



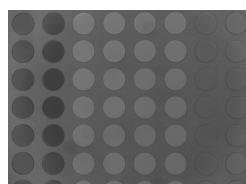
(Only the IR light is on)



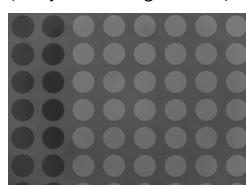
(Only the G light is on)



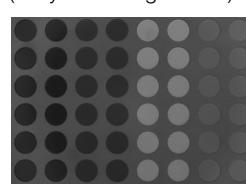
(Only the W light is on)



(Only the FR light is on)

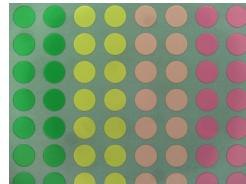


(Only the UV light is on)



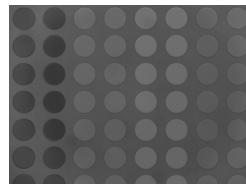
Color Image

This image is the composite color image created from all lighting color images.



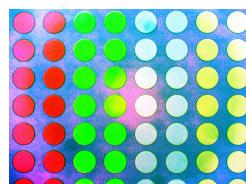
Average Grayscale Image

This image is the image formed when all the lighting color images are combined.



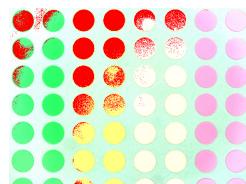
Color-Difference Image

Displays a pseudocolor image that includes visible light as well as UV, FR, and IR light.



Overexposure Image

Any overexposed places on a lighting image with a luminance value of 255 are highlighted in red. The color information for overexposed places may not be correctly extracted.



Types of images used in image processing

The image used differs depending on the color extraction method.

- When Average Grayscale is selected: Average grayscale images are used.
- When Color to Binary, Color to Grayscale, or Fine Color is selected: All lighting color images are used.

Registration Numbers of Images Captured with MultiSpectrum Mode

The registration image number [(Camera No.) - (Specified No.)] becomes as follows when registering images that are captured with MultiSpectrum Mode.

When the Image Variables that are Targets of Batch Registration are Specified

The following images are registered all at once in the 9 types of registered image number ranges below.

- Average Grayscale Image: 000 - 099
- UV (Ultraviolet) image: 100 - 199
- B (Blue) image: 200 - 299
- G (Green) image: 300 - 399
- AM (Amber) image: 400 - 499
- R (Red) image: 500 - 599
- FR (Far-red) image: 600 - 699
- IR (Infrared) image: 700 - 799
- W (White) image: 800 - 899

For more details on the types of images, refer to "Images that can be generated in MultiSpectrum Mode" (Page 7-75).

Registration example:

When only the R image, G image, and B image are enabled as the image types to be obtained in MultiSpectrum Mode and when the images are registered to Registered Image No. 3, three images are registered as follows:

- R image: 503
- G image: 303
- B image: 203

When Standard Lighting Mode is set

Only one image is registered to a range from 000 to 999 in the conventional way.

Handling of variables

When MultiSpectrum Mode is used, you can specify the image to use freely from the images that are captured with MultiSpectrum Mode for each of system image variable and user image variable.

- Gray : Average Grayscale Image
- Color : Color Image
- Extended : Color-Difference Image
- UV : UV (Ultraviolet) image
- B : B (Blue) image
- G : G (Green) image
- AM : AM (Amber) image
- R : R (Red) image
- FR : FR (Far-red) image
- IR : IR (Infrared) image
- W : W (White) image



When the image type is not specified, the MultiSpectrum images are used.

Color Unit

If MultiSpectrum Mode is set, [Colorspace] is set to [MultiSpectrum] on the [Detection Conditions] screen, and the tolerance parameters are fixed to UV, B, G, AM, R, FR, IR, and W on the [Judgment Conditions] screen.

Image Output Unit

You can specify the contents of the output data.

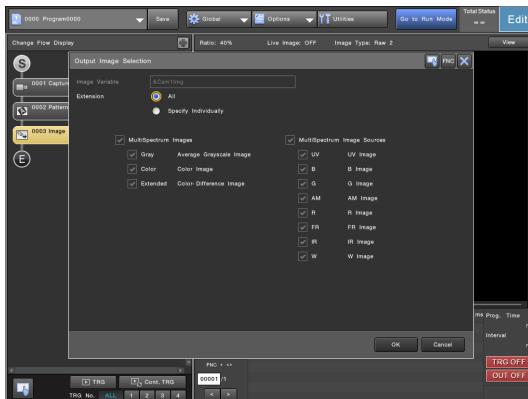
Image Setting

Image Variable

It specifies the image variable to be output.

When specifying an image array variable, specify the index to be output by a numeral value or a variable.

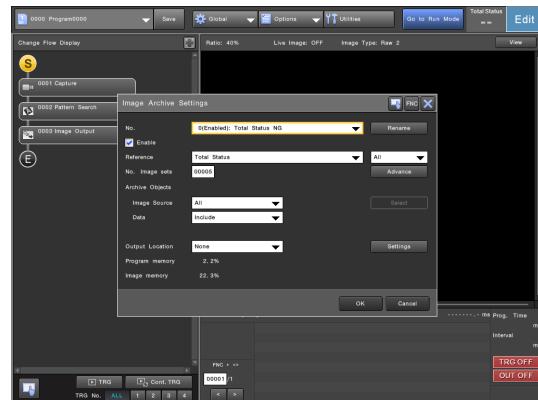
When MultiSpectrum Mode is used, you can specify and output any image from several generated images on the [Output Image Selection] screen displayed when [Settings] is selected.



[Settings] is operable only when the image variable that uses a camera with MultiSpectrum Mode selected is specified.

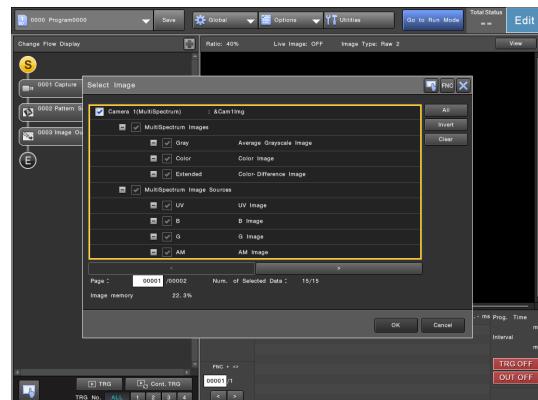
Image Archive Settings

In the state where flow editing is possible, open the [Image Archive Settings] screen by selecting [Utilities] at the upper section of the screen and then [Image Archive Settings]. On the screen, you can specify the detailed conditions for accumulating the images and result data, which were used for the inspections by the controller, to the image memory and resource memory in the controller as the archived data.



Archive Objects

- Image Source:** Select image variables that are subject of accumulation.
 - All:** It sets all image variables in the program setting as subjects of accumulation (accumulates all images other than black images).
 - Select:** Only selected image variables are subjects of accumulation (up to 256 image variables can be selected).



- Data:** It specifies whether or not the archive result data are accumulated (initial setting: Do not include).



When MultiSpectrum Mode is used, you can specify any images from several generated images as subjects of archive accumulation.

Communication Commands

BS Image Registration

Note when the MultiSpectrum Mode image is specified

All types of images that are selected as the image to be used with MultiSpectrum Mode are saved when executing the BS command.

Reference

- You can specify the types of images to be used on [Image Selection] of the capture unit (Page 7-66).
 - See "Registration Numbers of Images Captured with MultiSpectrum Mode" (Page 7-76) for more details on registration image numbers used when registering images captured with MultiSpectrum Mode.
-
- Point**
- Even when 000 to 099 is specified in the BS command, the images that are actually stored to 000 to 099 are the average grayscale images.
 - For more details regarding the BS command, see the XG-X2000 Series Communications Control Manual.

UT Execution of Unit Test

Addition of an error code

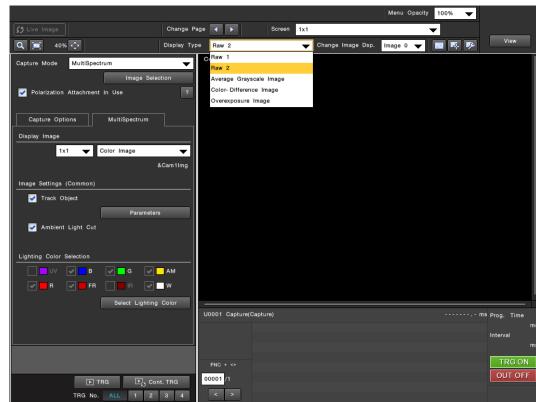
When the unit specified as the subject of the unit test is a capture unit and the capture mode of any of the enabled cameras is not LumiTrax Mode or LumiTrax Specular Reflection Mode, the unit test cannot be executed and the error code 03 will be returned.

Point

For more details regarding the UT command, see the XG-X2000 Series Communications Control Manual.

View bar

In the capture mode settings for a capture unit, you can select [Display Type] on the view toolbar to change the displayed MultiSpectrum Mode image (average grayscale, color-difference, and overexposure images).



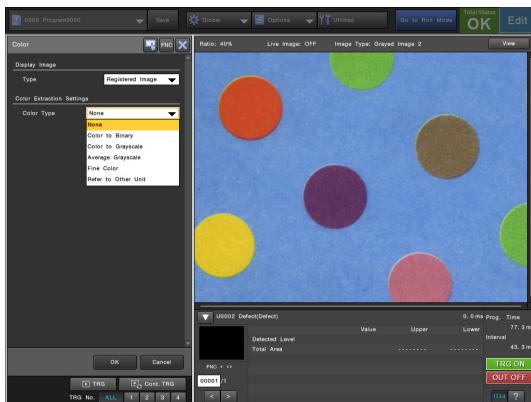
Extracting Colors in MultiSpectrum Mode

More advanced color extraction processing can be executed by using images that were captured in MultiSpectrum Mode.

This section describes color extraction in MultiSpectrum Mode. For more details about the principles and basics of how to use color extraction, and extracting colors from images captured in a lighting mode other than MultiSpectrum Mode, refer to "Color Extraction" (Page 2-483).

How to extract colors in MultiSpectrum Mode

In MultiSpectrum Mode, you can use five different types of color extraction: Color to Binary, Color to Grayscale, Average Grayscale, Fine Color, and Refer to Other Unit.



Mode

- Color to Binary:** Binarization processing is performed by specifying color ranges. (Page 7-80).
- Color to Grayscale:** Converts to a grayscale image with the specified color as the maximum value (Page 7-82).
- Average Grayscale:** Converts to a grayscale image by taking the average of the eight colors for each pixel.
- Fine Color:** Directly processes each lighting color's image and detects color variations as defects.
- Refer to Other Unit:** Uses the color extraction settings specified for another unit as is. In the [Reference Unit] field, select the unit that you want to use the color extraction settings of.

Average

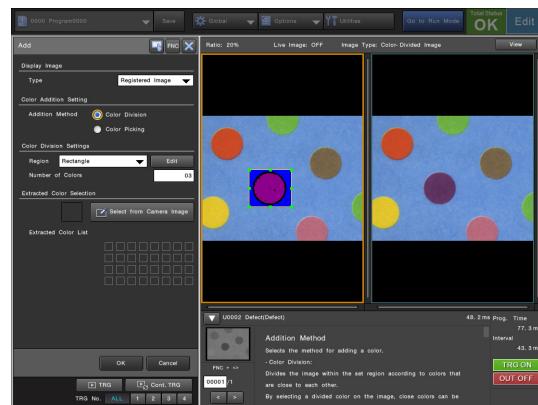
If this setting is enabled, the noise in each lighting color's image is eliminated by applying to the center pixel the average value of the surrounding pixels.

Color Division and Color Picking

For Color to Binary and Color to Grayscale color extraction, you can also use Color Division in addition to Color Picking that is used in normal color extraction.

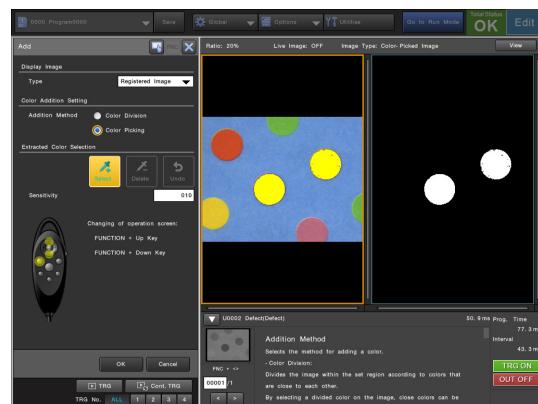
Color Division

Divide similar colors on the image in the specified region into groups of the number of colors specified and select the divided colors on the image. This setting is useful because similar colors can be grouped and added as extracted colors.



Color Picking

Select the color that you want to add directly on the image. This setting is useful when you want to differentiate objects with small color changes or when you want to finely adjust colors that have already been roughly extracted by Color Division.



Extracting Colors in MultiSpectrum Mode

Switching display methods during color extraction

You can switch between 2D Display and 3D Display depending on your needs to check the state of color extraction.

2D Display

You can check the state of color extraction while switching the display image.

3D Display

You can check which range the color ranges that were extracted or excluded using color extraction are in in the 3D color space that is configured using the three specified light colors as axes. This setting is useful when you want to confirm whether the extracted colors and excluded colors registered as different colors are separated into their respective color ranges.

For more details about 3D Display, refer to "Checking the range of the color to be extracted (3D Display)" (Page 7-84).

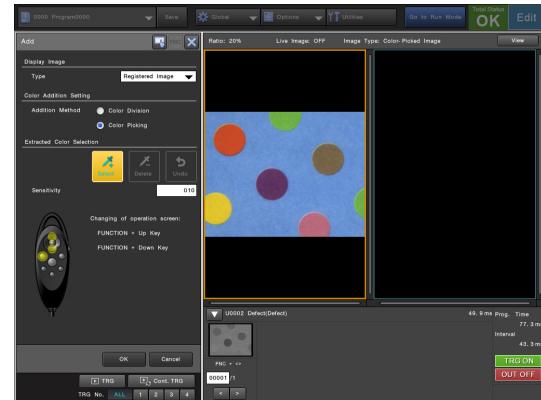
ALL Display

2D Display and 3D Display can be shown at the same time.

Color to Binary color extraction in MultiSpectrum Mode

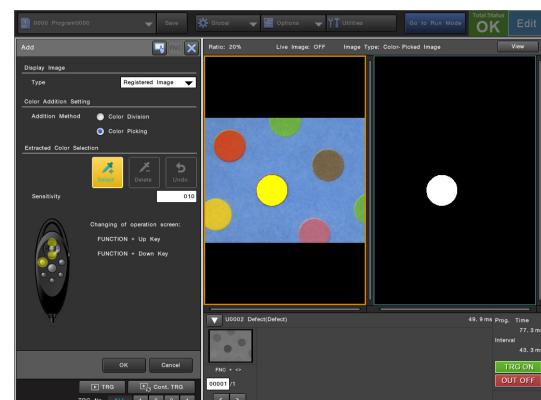
Extracting colors with Color Picking

- 1** In the [Color Type] field on the [Color] screen, select [Color to Binary].
- 2** In the [Extracted Color Specification] field, select [Add].
- 3** In the [Color Addition Setting] field, select [Color Picking].



- 4** Select on the image the color that you want to make white (255) after binary conversion.

Only the part that is of the color that was extracted is displayed in yellow.



- 5** If necessary, add an extracted color.

Selecting colors consecutively extracts the neighboring colors of the first selected color one after another.

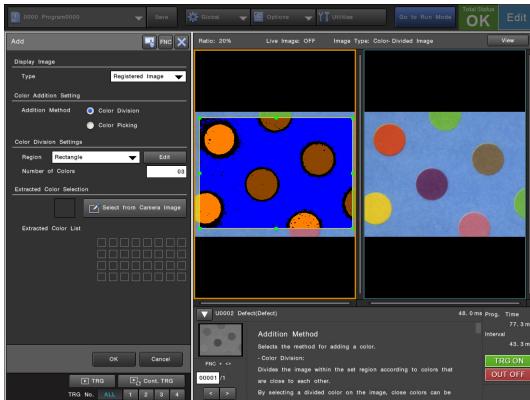
- 6** Once you have finished selecting the color to be extracted, select [OK].
- 7** If necessary, specify the brightness in the [Common Settings] - [Brightness Range] field to finely adjust the extraction range.
- 8** Select [OK].

To omit selected colors from the extraction

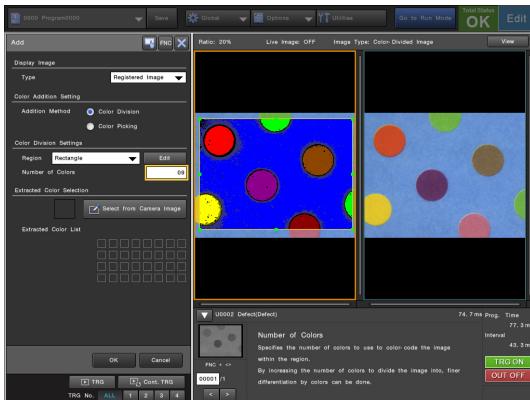
In step 2, you can also select [Add] in the [Excluded Color Specification] field to specify the colors that you want to exclude.

Extracting colors with Color Division

- 1** In the [Color Type] field on the [Color] screen, select [Color to Binary].
- 2** In the [Extracted Color Specification] field, select [Add].
- 3** In the [Color Addition Setting] field, select [Color Division].
- 4** In the [Color Division Settings] - [Region] field, select the region shape for the similar color group that you want to extract, and then draw the region.



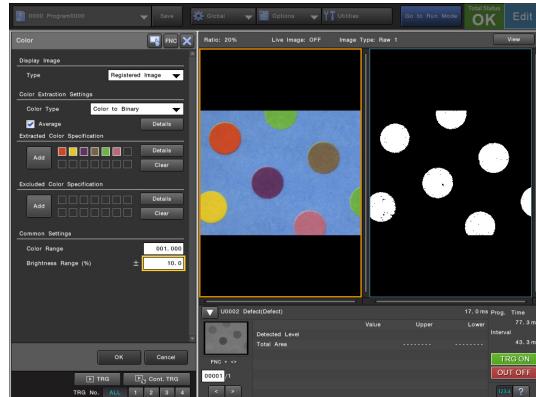
- 5** In the [Color Division Settings] - [Number of Colors] field, specify the split count to color-code inside the region.



- 6** If necessary, enlarge the range of the extracted color.

If you then select another color, the selected color is also registered as an extracted color.

- 7** Once you have finished selecting the colors to be extracted, select [OK].
- 8** If necessary, specify the brightness in the [Common Settings] - [Brightness Range] field to finely adjust the extraction range.



- 9** Select [OK].

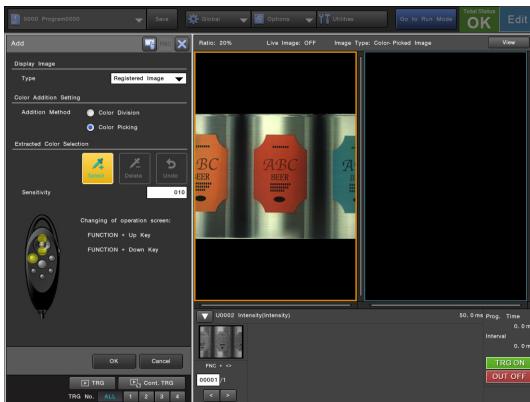
To omit colors from the extraction

In step 2, you can also select [Add] in the [Excluded Color Specification] field to specify the colors that you want to exclude.

Color to Grayscale color extraction in MultiSpectrum Mode

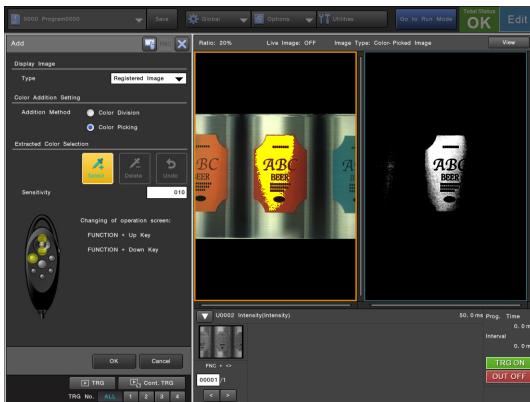
Extracting colors with Color Picking

- 1** In the [Color Type] field on the [Color] screen, select [Color to Grayscale].
- 2** In the [Extracted Color Specification] field, select [Add].
- 3** In the [Color Addition Setting] field, select [Color Picking].



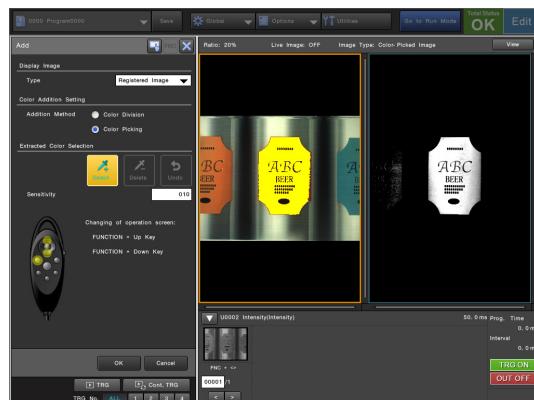
- 4** Select on the image the color that you want to make white (level 255) in the grayscale image after conversion.

The displayed image is converted to grayscale with the selected color as white and only the part that is of the color that was converted to white (level 255) is displayed in yellow.



- 5** If necessary, enlarge the range of the extracted color.

Selecting the color consecutively gradually converts the neighboring colors of the first selected color to a tone approaching full white (level 255).



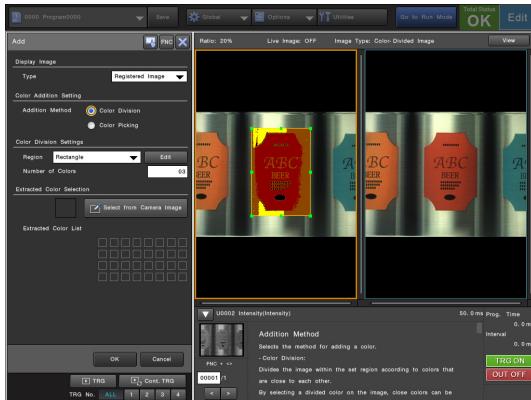
- 6** Once you have finished selecting the color to be extracted, select [OK].
- 7** If necessary, specify the brightness in the [Common Settings] - [Brightness Range] field to finely adjust the extraction range.
- 8** Select [OK].

To omit colors from the extraction

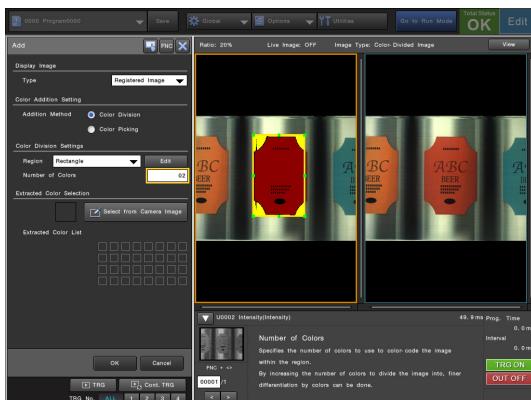
In step 2, you can also select [Add] in the [Excluded Color Specification] field to specify the colors that you want to exclude.

Extracting colors with Color Division

- 1** In the [Color Type] field on the [Color] screen, select [Color to Grayscale].
- 2** In the [Extracted Color Specification] field, select [Add].
- 3** In the [Color Addition Setting] field, select [Color Division].

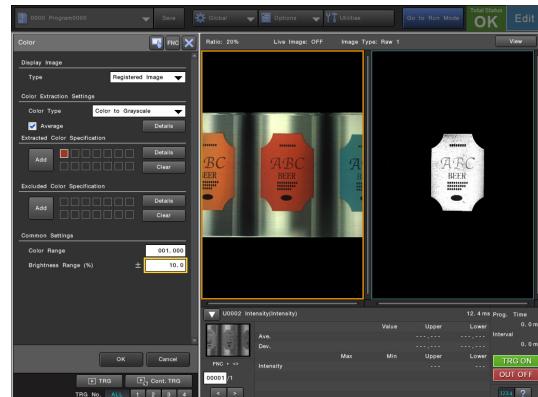


- 4** In the [Color Division Settings] - [Region] field, select the region shape for the similar color group that you want to extract, and then draw the region.
- 5** In the [Color Division Settings] - [Number of Colors] field, specify the split count to color-code inside the region.



- 6** If necessary, enlarge the range of the extracted color.
Then selecting other colors also converts the selected color to a tone approaching full white (level 255).
- 7** Once you have finished selecting the colors to be extracted, select [OK].

- 8** If necessary, specify the brightness in the [Common Settings] - [Brightness Range] field to finely adjust the extraction range.



- 9** Select [OK].

To omit colors from the extraction

In step 2, you can also select [Add] in the [Excluded Color Specification] field to specify the colors that you want to exclude.

Points to note for effective color extraction

When the brightness changes and the parts you want to extract are not extracted

On [Extracted Colors - Individual Settings], adjust the brightness range.

When the object color shade changes and the parts you want to extract are not extracted

- On [Extracted Colors - Individual Settings], widen the color range, or add the color of the part that was not extracted.
- On [Merge Extracted Colors], you can also merge multiple extracted colors and specify the color range that encompasses those colors.

When parts that you do not want to extract are extracted

Add the colors of the parts that you do not want to extract as excluded colors.

To disable color extraction settings and clear colors

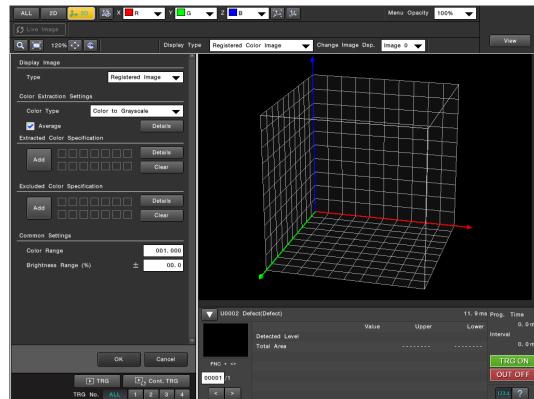
- Select the part displayed as an extracted color or excluded color and select [Disable] or [Delete].
- You can also select the [Details] button to disable multiple colors at the same time or clear all the colors at the same time.

To view the extracted state of the color

- On the VIEW bar, select [Grayed Image 2]. The extracted area is displayed in white.
- On the [3D] display, you can check the display in a color space that was formed using 3 of the light colors that were in use when the extracted colors and excluded colors were specified.

Checking the range of the color to be extracted (3D Display)

The distribution of the registered colors is displayed in 3D using three color light images from among the respective images obtained with eight colors of lighting. You can check the amount of difference (margin) there is between the registered extracted and excluded colors, and whether the supported width of the brightness and chromaticity is set without interfering with other colors.



2D

Displays 2D images.

3D

Displays the range of the extracted color (green) and excluded color (gray) as ovals in the 3D color space that is configured using the three specified light colors as axes. You can visually check whether each of the extracted and excluded colors are not overlapping (there is sufficient space between the colors and they can be distinguished from other colors).

ALL

Displays 2D and 3D images at the same time.



Point When using the Color Grouping unit, the color range of each of the color groups is displayed as an oval for each extracted color.

3D Display Operation

Displays the operation method guide for the 3D display.

X/Y/Z

Select the X,Y, and Z axes for the 3D Display using three light images.

Update to Recommended

You can automatically select the light colors which produce the greatest difference as the X, Y, and Z axes for the 3D Display.

Extraction Result 3D Display

You can check where the color information extracted from the image is positioned on the 3D Display.



Zooms in and out of the 3D Display region.

Standard Lighting Mode (MultiSpectrum light)

Overview of Capture Modes

LumiTrax Mode

LumiTrax Specular Reflection
Mode

MultiSpectrum Mode

▶ **Standard Lighting Mode
(MultiSpectrum light)**

Switching to Standard Lighting Mode Using MultiSpectrum Light

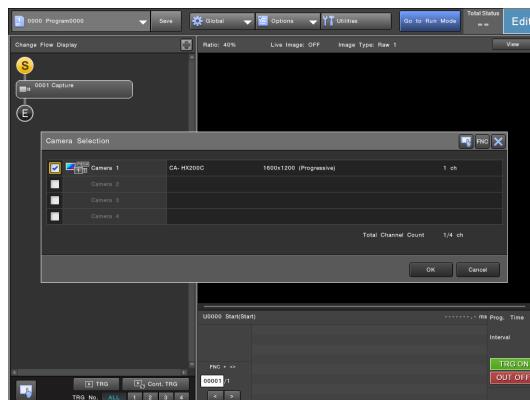
- 1 Prepare and connect the CA-DRM*X MultiSpectrum Light, CA-DC60E Illumination Expansion Unit, and cameras.**

For more details, refer to the XG-X2000 Series Setup Manual.

Point All area cameras can be used in Standard Lighting Mode using MultiSpectrum Light.

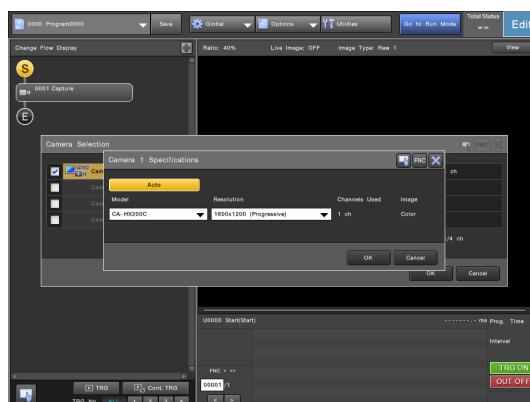
- 2 From the [Options] menu, select [Camera Settings] - [Camera Selection].**

The [Camera Selection] menu appears.



- 3 Select the number of the connected camera to be used.**

The [Camera* Specifications] screen appears.



- 4 Check that the camera model displayed in the [Model] field matches the connected camera.**

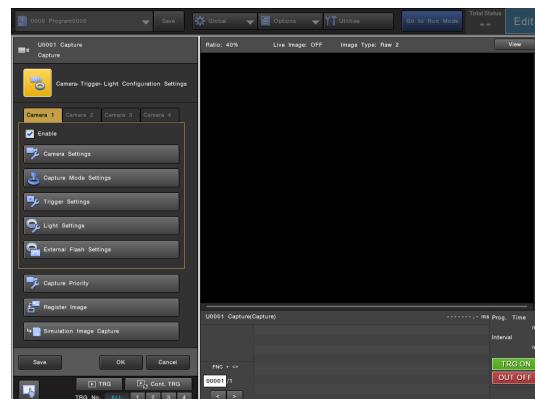
If a Different Camera is Displayed

Select [Auto] on the [Camera * Specifications] screen.

- 5 Select the capture resolution in the [Resolution] field.**

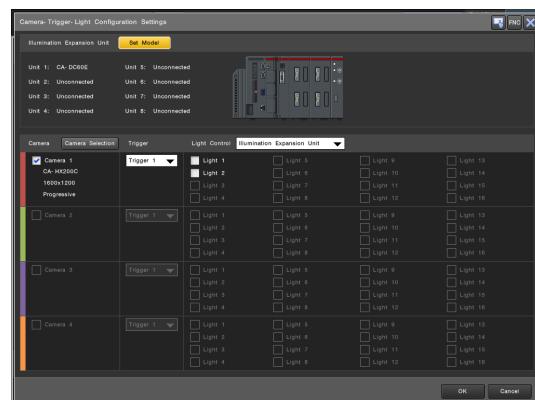
- 6 Select [OK].**

- 7 Select the capture unit from the flowchart.**



- 8 Select [Camera - Trigger - Light Configuration Settings].**

The "Camera - Trigger - Light Configuration Settings" screen appears.



- 9 On the top of the screen, select [Set Model] for [Illumination Expansion Unit].**

The "Illumination Expansion Unit Model Settings" screen appears.

- 10 Check that the connected illumination expansion unit is displayed.**

If an illumination expansion unit is connected but [Unconnected] or a different model is displayed
Select the correct unit or select [Auto].

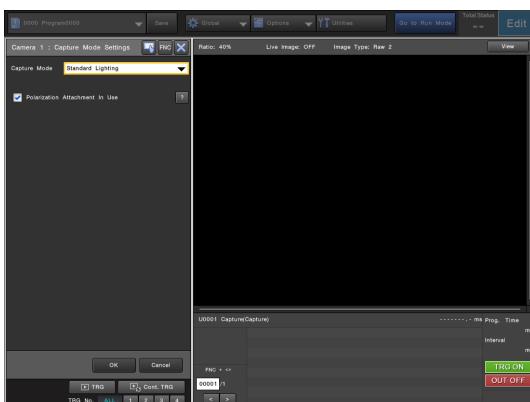
- 11 Select [OK].**

- 12 Select [OK].**

- 13 Select the tab for the number of the connected camera to be used.**

14 Select [Capture Mode Settings].

The "Capture Mode Settings" screen appears.



15 In the [Capture Mode] field, select [Standard Lighting].

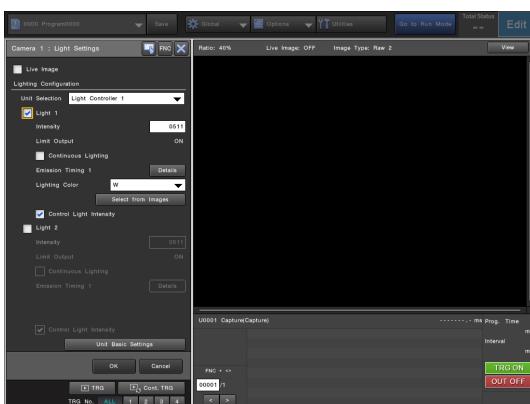


Point When the CA-DRM*PA is attached to the MultiSpectrum Light CA-DRM*X, selecting the [Polarization Attachment In Use] check box can suppress the lighting of the ultraviolet (UV) light, which may cause polarization filter deformation or deterioration.

16 Select [OK].

17 Select [Light Settings].

The [Light Settings] screen appears.



18 In the [Lighting Color] field, select the color that you want to turn on.

If you want to check the image captured for each color, select [Select from Images].

19 Change the capture unit settings according to the measurement target.

When Setting is Done

Add and configure other units that are required for measurement.

The operations and settings are the same as for measurements using area cameras.

Chapter 8

Functions for Special Applications

Documentation for the installation and configuration methods of the controller, software, and CAD data can be downloaded from the following URL.

www.keyence.com/xgx_support

Measurement Using 3D-compatible Cameras

▶ Measurement Using 3D-compatible Cameras

Measurement Using
Line Scan Cameras

Retaining and Using
Different Settings for Each Type
(Recipe Function)

Overview of Measuring With a 3D-Compatible Camera

The XG-X2000 Series has the following features to process height images obtained with a 3D-compatible camera.

Various inspections can be supported flexibly by combining these features together.

Vision Tools that directly process height images:

- Height Measurement Unit (Page 8-36)
- Profile Measurement Unit (Page 8-49)
- Continuous Profile Measurement Unit (Page 8-80)
- 3D Geometry (Page 8-111)

Feature that enables existing Vision Tools to be used by converting height images to grayscale images:

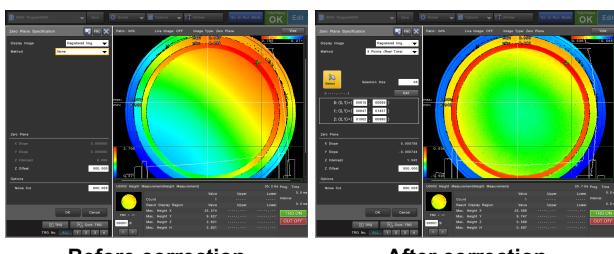
- Height Extraction (Page 8-154)

Height Measurement

An inspection will be performed based on the height data acquired by the 3D Camera or LJ-V series head. You can measure the minimum height, maximum height, convex/concave area, convex/concave volume etc. within the specified inspection region. Highly flexible inspections are possible by specifying an arbitrary plane on the screen as the “zero plane”.

Zero Plane Specification (Page 8-43)

By specifying an individual “Zero Plane” for each workpiece to be used as reference during height measurement, you can constantly perform stable measurements even when the position of the workpiece changes.



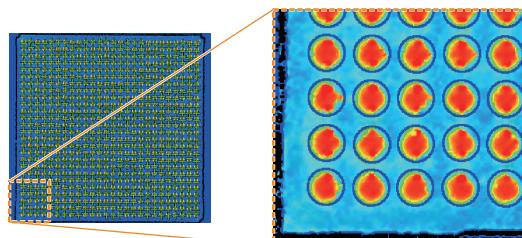
Before correction

After correction

Sets a zero plane fitting to the work automatically and gets the correct shape even when the work is tilted.

Array-specified region (Page 8-42)

You can specify up to 10,000 inspection regions at once and measure the height, area and volume in each inspection region at the same time.



Height/Area/Volume Measurement (Page 8-45)

You can measure the height, area and volume of the section that is surrounded by the inspection region and zero plane.

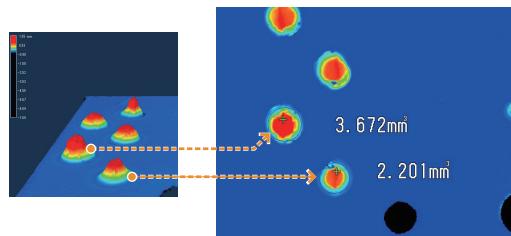
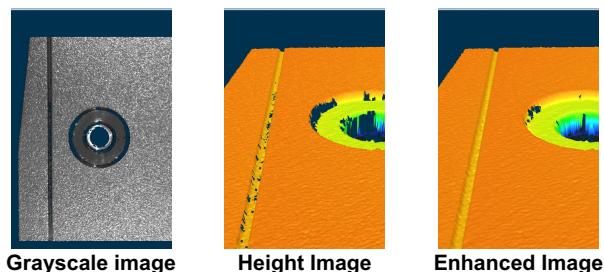
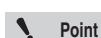


Image enhancements for height image (Page 8-42)

Stable measurements can be performed by utilizing the 6 types of image enhancements dedicated for height images (Median, Average, Gaussian, Smoothing, Invalid Pixel Suppression, Spike Noise Cut).



Parts of the groove with big difference in gloss result in instability in measurement. But image enhancement makes stable measurement possible.



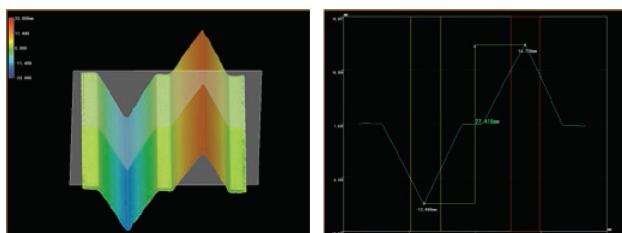
The Height Measurement Unit cannot be used with the XG-X2800LJ.

Profile Measurement

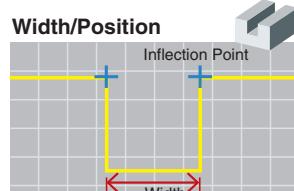
The heights, widths, angles, cross-section areas and so on of the cross-section shapes in specified areas can be measured. You can also inspect dimensions in-line since X-Y-θ position adjustment can be used concurrently.

Measuring the height of the peak point and the bottom point

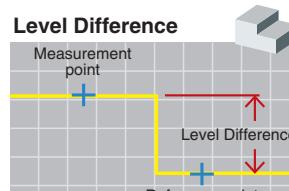
You can perform height and level difference, position, angle, cross-section area, count, and defect detection measurements with regard to the obtained section shape (profile), and execute dimension inspections, appearance inspections and other inspections. You can also execute high precision inspections with plane correction.



Measurement Using 3D-compatible Cameras

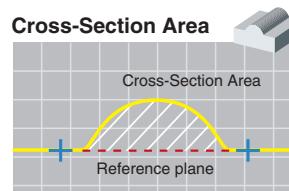
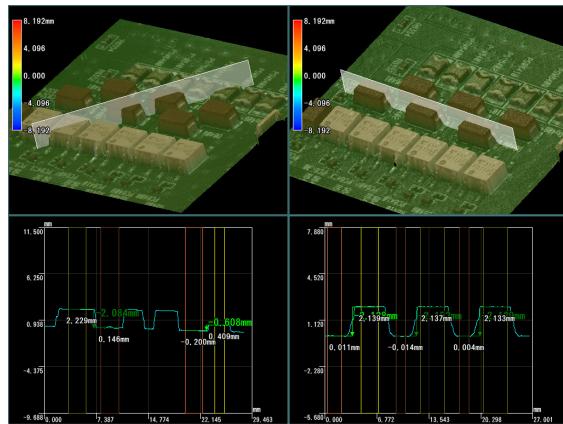


Measures the width and positions under the specified conditions.

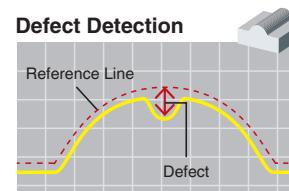


Measures the height difference from a reference point to a measurement point.

Height inspection of board mounted components



Measures the cross sectional area from a reference plane.



Makes a comparison against the reference circle, line or free curve line, and detects parts that deviate greatly from the reference line as defects.

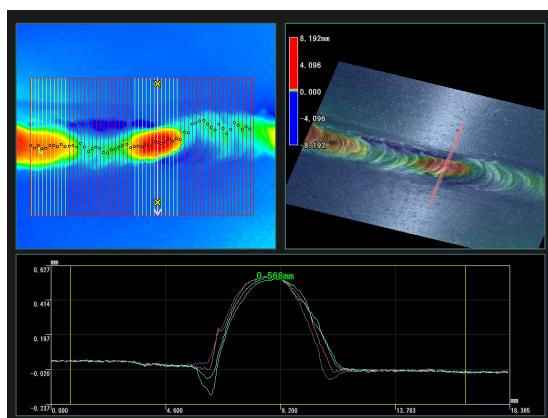
Point The Profile Measurement Unit cannot be used with the XG-X2800LJ.

Continuous Profile Measurement

You can extract minute shape changes from multiple section profiles. This feature is useful for inspecting solders or other objects for which inspection from 360 degrees is necessary and target objects that are continuous, such as welding inspections, by continuously measuring profiles in the specified region at the desired pitch.

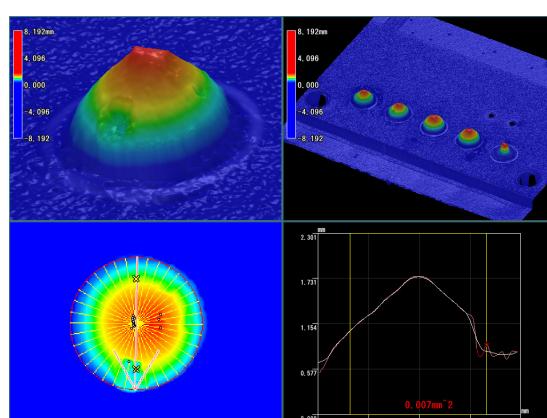
Inspecting weld shapes

Measure height and cross-section areas continuously, and measure the minimum and maximum values to achieve a stable inspection.



Inspecting solder shapes

You can inspect solder shapes from 360 degrees and extract minute surface changes.

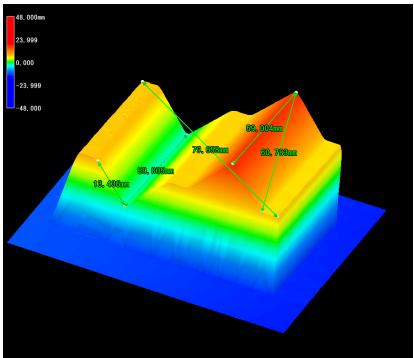


Point The Continuous Profile Measurement Unit cannot be used with the XG-X2800LJ.

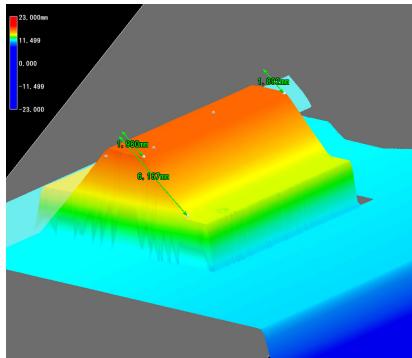
3D Geometry

"Even without complicated spatial operation knowledge," by indicating the measurement points on the screen, you can perform geometric measurements in three dimensional space. You can also reference points, lines, and planes detected with other units.

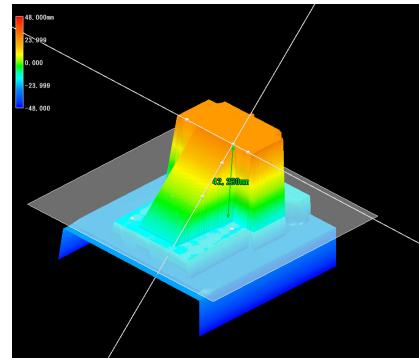
Point/Line Distance



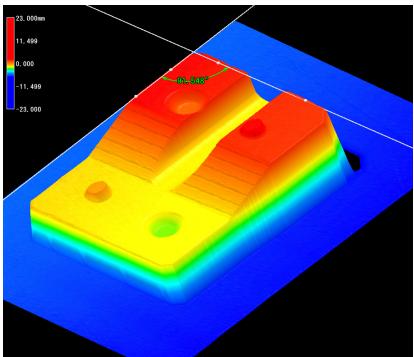
Point/Plane Distance



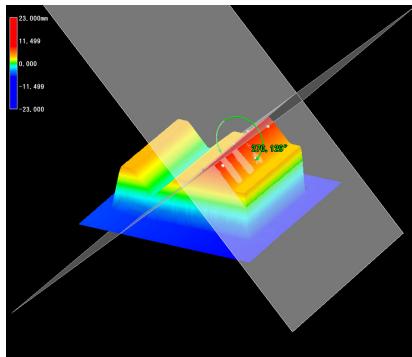
Two Lines Intersection/ Plane Distance



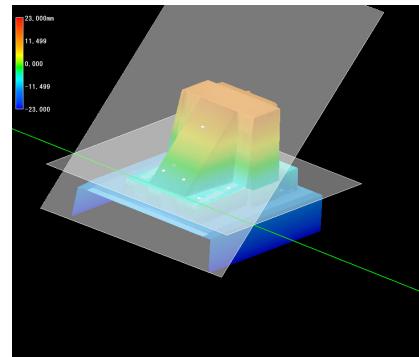
Angle Between Two Lines



Angle Between Two Planes



Line Between Planes



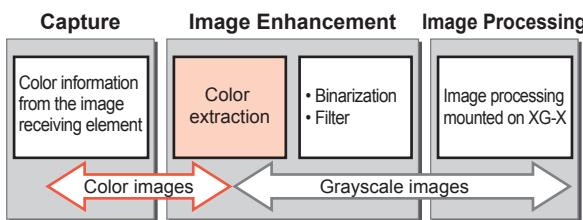
Point The 3D Geometry Unit cannot be used with the XG-X2800LJ.

Height Extraction

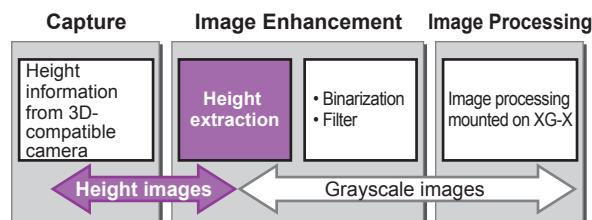
3D compatible image processing can be applied by generating grayscale images which have highlighted the height that is to be focused on based upon the 3D data. The workflow consists of configuring a 3D image to the captured image variable of measurement units other than units that directly process 3D data (height measurement unit, profile measurement unit, continuous profile measurement unit, and 3D geometry unit), then generating a grayscale image based on [Height Extraction], followed by conventional image processing.

Image Processing Flow

Conventional Color Image Processing



Height Image Processing



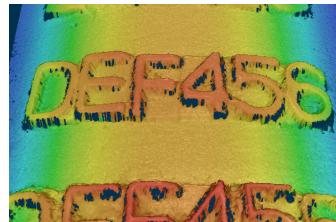
Usage scenes of height extraction

In the height extraction process, you can specify a plane of desired height to generate a grayscale image in which the height differences in reference to the specified plane are expressed in shades of gray.

By using the Free-form Plane extraction function, you can also effectively detect the convex/concave parts on a curved surface.



Image via the Area Camera



Height Image

OCR measurement processing
on the Height Extraction Image
(free-form plane)

Types of 3D Compatible Cameras that Can be Used on the Controller

The types of cameras that can be used as 3D compatible cameras on the controllers are the 3D camera and the LJ-V Series heads.

3D Camera (XR Series)

The 3D camera projects a stripe pattern on the target using specially designed pattern projection optics. The 3D shape is acquired by capturing/calculating the reflected light from the workpiece. Pattern projection is performed from two directions to minimize the influence of the shadow area and enable a stable inspection. Since the camera captures a grayscale image at the same time (as an area camera), both the conventional 2D information-based inspection as well as inspection utilizing height data can be performed.

LJ-V Series Head

A dedicated optical system that uses a cylindrical lens emits a laser light that spreads like a band across the target workpiece. By capturing and calculating diffuse reflections of light from the workpiece, you can obtain the workpiece profile shape and by interfacing that with the transfer direction, you can obtain a three-dimensional shape. Some models can also capture grayscale images.



To acquire the grayscale images via the LJ-V series heads, the CA-E110LJ and the LJ-V series heads that have a B appended at the end of their model codes are needed. For more details, contact a Keyence sales representative.

Height image and grayscale image

Height

The height data obtained using the 3D compatible camera will be stored in an image variable as [Height] in the Capture unit. You can perform image processing based on the height information by specifying the image variable that contains the height image on measurement units that directly process 3D data (Height Measurement unit, Profile Measurement unit, Continuous Profile Measurement unit, and 3D Geometry unit).

You can also output/save the height image in 24-bit color bitmap format (The height data are converted into a format that can be recognized as 2D image).

Grayscale

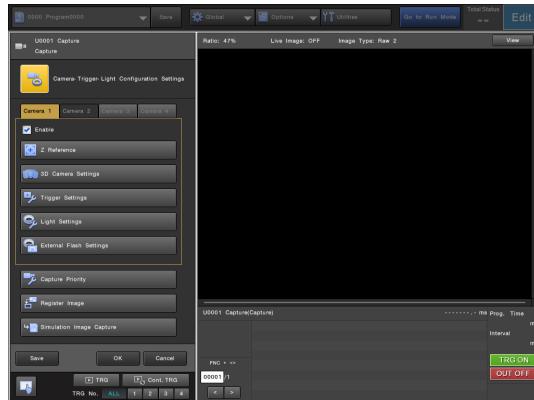
The grayscale image obtained using the 3D compatible camera will be stored in an image variable as [Grayscale] in the Capture unit. You can perform image processing based on grayscale images by specifying the grayscale image on measurement units other than units that directly process 3D data (Height Measurement unit, Profile Measurement unit, Continuous Profile Measurement unit, and 3D Geometry unit). You can also output/save the grayscale image in 8-bit grayscale bitmap format.

Preparing the Camera (When 3D Camera is Used)

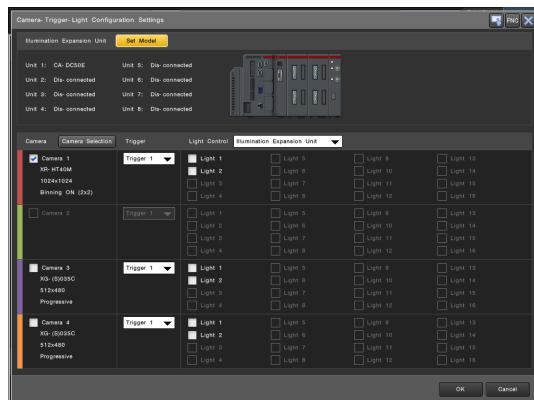
Preparation 1: Changing the Camera, Trigger, and Light Settings

- 1 Prepare and connect a 3D camera.
- 2 Select the capture unit from the flowchart.

The top menu for the capture unit will appear.

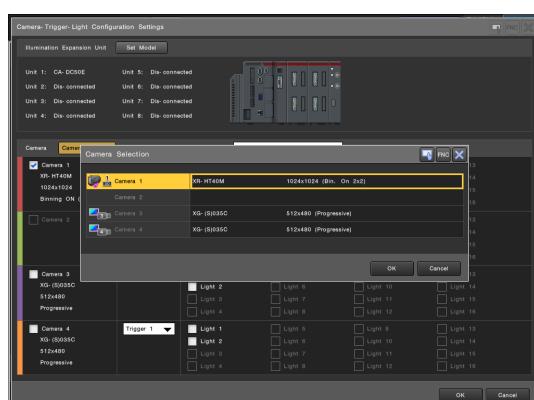


- 3 Select [Camera - Trigger - Light Configuration Settings].
- The [Camera - Trigger - Light Configuration Settings] screen appears.



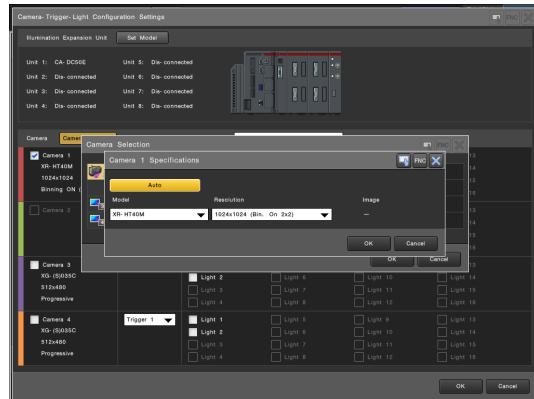
- 4 Select [Camera Selection].

The [Camera Selection] menu appears.



- 5 Select the camera No. where the 3D camera is connected.

The [Camera* Specifications] screen appears.



- 6 Check that the camera model displayed in the [Model] field matches the connected 3D camera.

If a Different Camera is Displayed

Select [Auto] on the [Camera * Specifications] screen.

- 7 Select the capture resolution in the [Resolution] field.

- If [Bin. On] is selected, the binning process will load the neighboring pixels of the original image as one pixel.
 - Bin. On: 2x2** (Default): Loads the neighboring four pixels of the original image as one pixel.
 - Bin. On: 4x4**: The 4x4 binning process will load the neighboring 16 pixels of the original image as one pixel.
 - Bin. On: 8x8**: The 8x8 binning process will load the neighboring 64 pixels of the original image as one pixel.
- [1408 x 1408 (Bin. On)] or [2048 x 2048 (Bin. On)] expands the image size by twofold after executing the 2x2 binning process. The image processing time of the camera will be the same as for other [Bin. On], and image transfer time will be the same as [Bin. Off].



- The in-camera image processing and transfer can be sped up by reducing the image line width and count using the binning process. Note, however, that this will result in lower image resolution.
- When you switch the model to a 3D camera, the scale factor will be set to a camera-specific value.

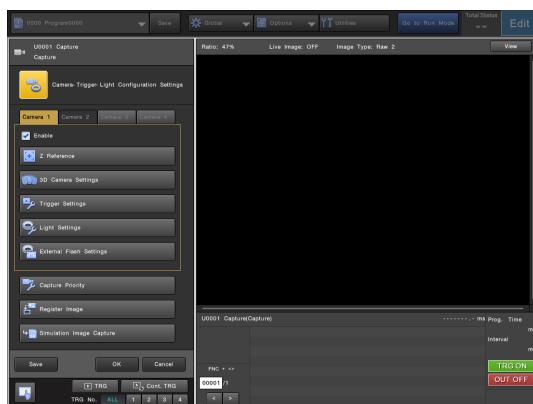
- 8 Select [OK].

- 9 Select [OK].

Preparation 2: Adjusting the Position of the Camera Using Cross Marks

Adjust the position of the camera and workpiece (X/Y/Z) using a guid light for reference.

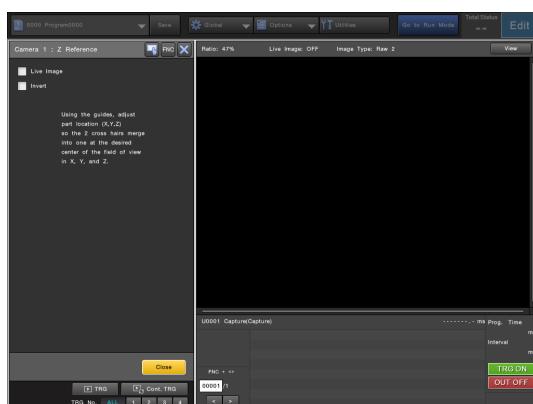
1 Select the capture unit from the flowchart.



2 Select the camera No. tab where the 3D camera is connected.

3 Select [Z Reference].

The [Z Reference] screen appears and cross mark guide lights are projected from the projector of the 3D camera.



4 Adjust the position of the 3D camera or the vertical position of the workpiece such that the cross marks overlap, to optimize the positional relationship of the 3D camera (projector) and the workpiece.

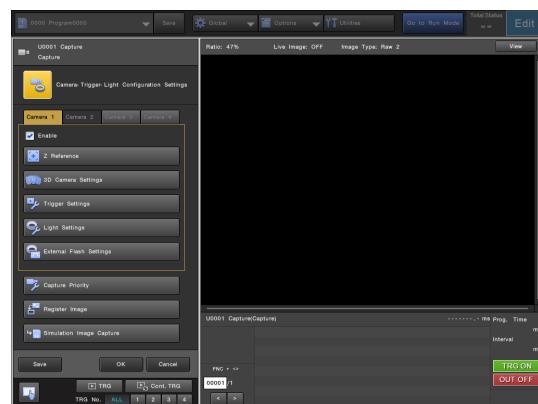
Point If it is difficult to see the cross mark, you can invert light and dark of the cross mark and its surrounding areas.

5 To finish the position adjustment, select [Close].

Preparation 3: Changing the Settings to Capture the Workpiece Correctly

Change the capture options such that the workpiece can be captured correctly.

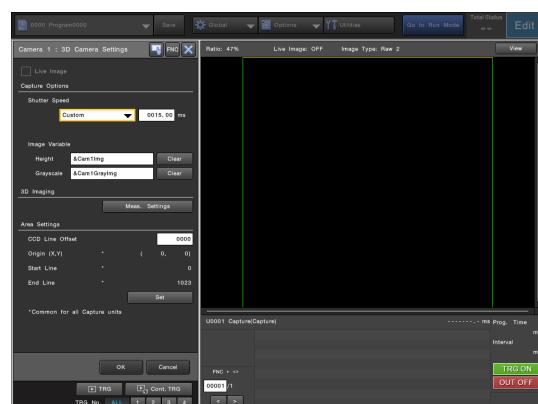
1 Select the capture unit from the flowchart.



2 Select the camera No. tab where the 3D camera is connected.

3 Select [3D Camera Settings].

The [3D Camera Settings] screen appears.

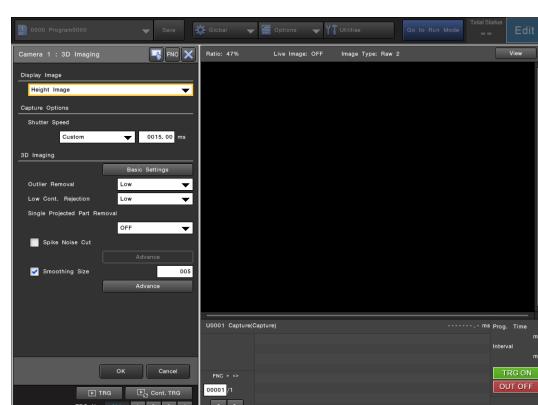


4 Input a trigger.

The image will be captured.

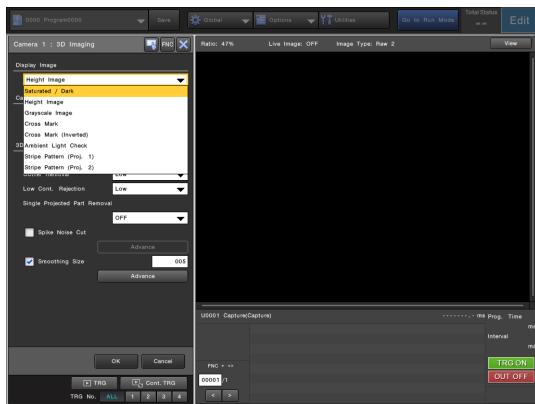
5 Select [Meas. Settings] in the [3D Imaging] field.

The [3D Imaging] screen appears.



6 Select [Saturated / Dark] in the [Display Image] field.

You can check the overexposure/underexposure state of the captured image.



- Saturated (Overexposed) refers to a state in which the height data cannot be acquired normally due to excessive light volume on the CCD.
- Dark (Underexposed) refers to a state in which the height data cannot be acquired normally due to insufficient light volume on the CCD.
- The overexposed section will be displayed in red; and the underexposed section will be displayed in blue.

7 Adjust the settings to eliminate overexposed and underexposed sections in the inspection range.

To capture images correctly, you need to adjust the settings to eliminate overexposure/underexposure in the inspection range.

Eliminating Underexposure

Increase the [Shutter Speed] (Page 8-16).

Eliminating Overexposure

Enable the [One-Shot HDR] (Page 8-18).

8 If the black, invalid pixels are still remaining in the measurement range, select [Advance] and then enable [Inv. Pixel Suppress.].

Adjust the interpolation level as needed. For more details, see "Inv. Pixel Suppress." (Page 8-19).

9 If the workpiece can be captured correctly, select [OK].

10 Change the other capture unit settings according to the measurement target.

See "Capture (When 3D Camera is Used)" (Page 8-14) for more details.

11 After completing the settings, add the other units required for measurement and change their settings.

The operations and settings are the same as for measurements using area cameras. For more details on the functions and restrictions that are specific to 3D cameras, see the description below.

- "Capture (When 3D Camera is Used)" (Page 8-14)
- "Height Measurement" (Page 8-36)
- "Profile Measurement" (Page 8-49)
- "Continuous Profile Measurement" (Page 8-80)
- "3D Geometry" (Page 8-111)
- "Height Extraction" (Page 8-154)
- "Checking the Workpiece Profile (3D Observation)" (Page 8-156)
- "Other Available Functions for Measuring by Means of 3D-compatible Cameras" (Page 8-160)
- "Correcting the 3D Camera" (Page 8-167)

Preparing the Camera (When Using an LJ-V Series Head)

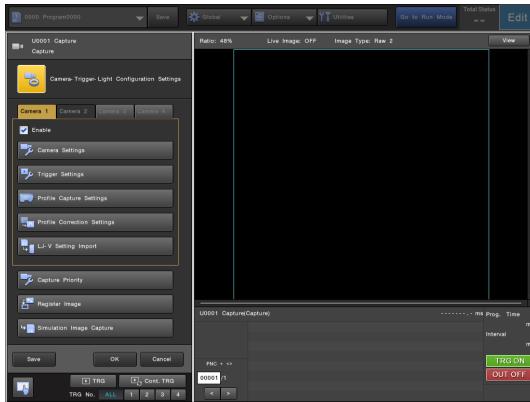
This section describes the procedure for configuring basic settings when the [Sheet-Fed] capture method and [Time Delay] line trigger cycle are set.

Preparation 1: Changing the Camera, Trigger, and Light Settings

Configure the following settings when using [Sheet-Fed].

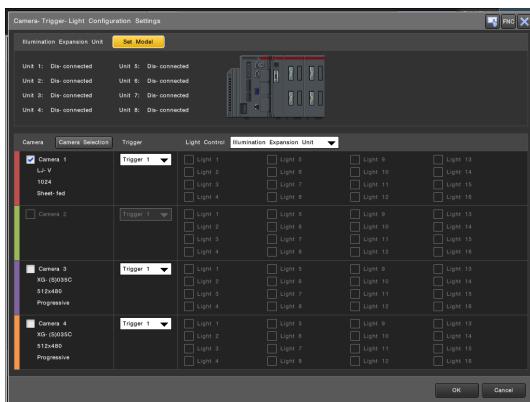
- 1 Prepare and connect the LJ-V Series head.**
- 2 Select the Capture unit from the flowchart.**

The top menu for the Capture unit appears.



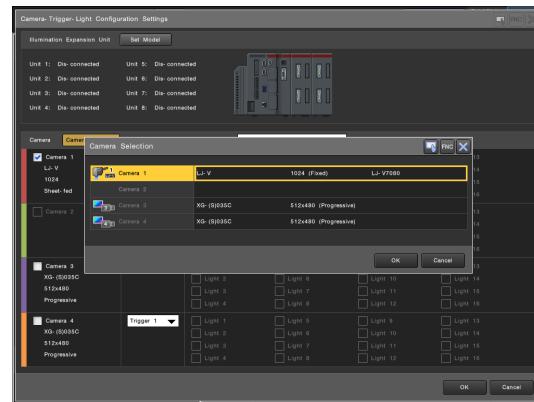
- 3 Select [Camera-Trigger-Light Configuration Settings].**

The [Camera-Trigger-Light Configuration Settings] screen appears.



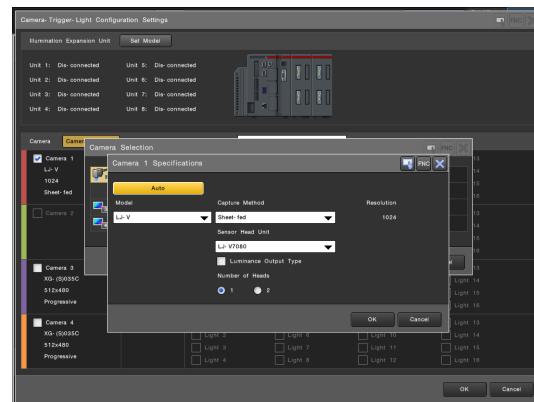
- 4 Select [Camera Selection].**

The [Camera Selection] screen appears.



- 5 Select the camera number that the LJ-V Series head is connected to.**

The [Camera * Specifications] screen appears.



- 6 Check that the camera model displayed in the [Model] and [Sensor Head Unit] fields is the same as the connected LJ-V Series head.**

When using a head that supports luminance output
Select the [Luminance Output Type] check box.

When a head that is different from the one connected is displayed

On the [Camera * Specifications] screen, select [Auto].

- 7 In the [Capture Method] field, select the capture method.**

Here, we will select [Sheet-Fed] as an example.

- 8 Select [OK].**

A confirmation screen appears, and scale factor values specific to the camera are set.

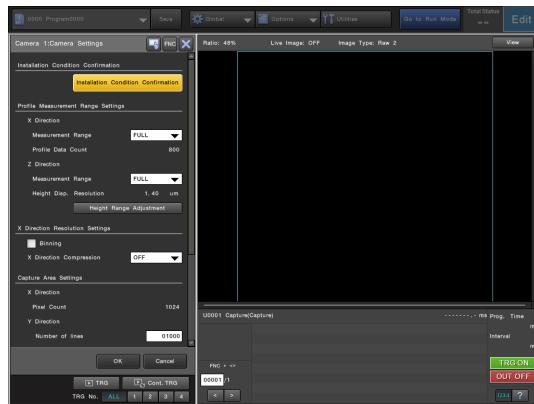
- 9 Select [OK].**

Preparation 2: Adjusting the Installation Position

Adjust the height, gradient, and other LJ-V Series head installation conditions. For more details about the installation conditions for each LJ-V Series head model, see the "XG-X 2000 Series Setup Manual (LJ-V Edition)".

- 1 Select the Capture unit from the flowchart.**
- 2 Select the tab for the camera number that the LJ-V Series head is connected to.**
- 3 Select [Camera Settings].**

The [Camera Settings] screen appears.



- 4 Select [Installation Condition Confirmation].**

The profile obtained by the LJ-V Series head is updated continuously.



- If you want to check the installation conditions, select [Installation Condition], and then check the guide for the installation conditions that match the LJ-V Series head model.
- If you want to check the installation direction, select [Installation Direction], and then check the guide for the installation direction.

- 5 Display the location on the workpiece with a height difference and check the profile of the workpiece.**

Using the Profile Wave Viewer on the View Toolbar, check whether the height of the location whose height is known is displayed correctly in full scale.

- 6 Adjust the installation position.**

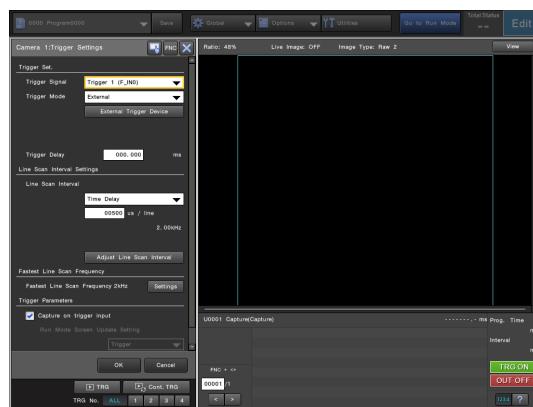
- 7 Once you have completed the adjustment, select [OK].**

Preparation 3: Changing the Settings to Capture the Workpiece Correctly

Change the capture settings so that the work can be properly captured continuously via the sheet-feed.

- 1 Select the Capture unit from the flowchart.**
- 2 Select the tab for the camera number that the LJ-V Series head is connected to.**
- 3 Select [Trigger Settings].**

The [Trigger Settings] screen appears.



- 4 In the [Trigger Mode] field, select [Internal].**

A confirmation screen appears. Select [OK].

- 5 Input a trigger.**

An image is captured.

- 6 In the [Line Scan Interval] field, adjust the line scan interval.**

With the target workpiece moved, input a trigger, and capture an image for adjustment purposes. If the developed image is stretched or reduced vertically, you need to adjust [Line Scan Interval] to match the movement speed of the target workpiece. For more details about how to adjust the line scan interval, see "Notes on Adjusting the Line Scan Interval" (Page 8-186).

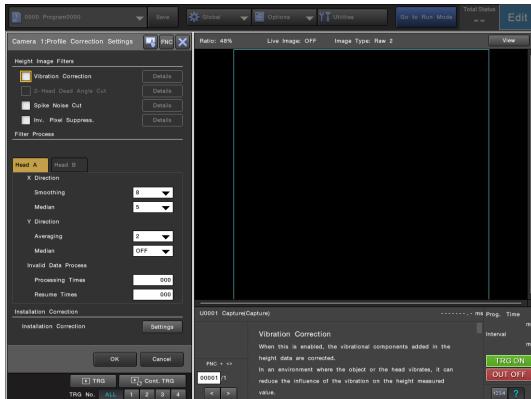
- 7 Once you can correctly capture an image of a workpiece, select [OK].**

- 8 Change the other settings of the Capture unit to suit the measurement target.**

For details, see "Capture (When Using an LJ-V Series Head)" (Page 8-22).

9 If black invalid pixels remain displayed in the measurement range, select [Profile Correction Settings], and then enable [Inv. Pixel Suppress].

If necessary, adjust the interpolation level value. For details, see "Inv. Pixel Suppress." (Page 8-32).



10 Once you can correctly capture the image of the workpiece, select [OK].

11 Once you have configured the settings, add any other units that are required for measurement and change the settings.

Operations and settings are the same as when using an area camera for measurement. For more details about restrictions or functions specific to the LJ-V Series head, see the following explanations.

- "Capture (When Using an LJ-V Series Head)" (Page 8-22)
- "Height Measurement" (Page 8-36)
- "Profile Measurement" (Page 8-49)
- "Continuous Profile Measurement" (Page 8-80)
- "3D Geometry" (Page 8-111)
- "Height Extraction" (Page 8-154)
- "Checking the Workpiece Profile (3D Observation)" (Page 8-156)
- "Other Available Functions for Measuring by Means of 3D-compatible Cameras" (Page 8-160)

Capture (When 3D Camera is Used)

A capture unit is used for capturing images of the inspection/measurement target workpiece using a camera.

- This section describes the settings to use a 3D camera. When using other cameras, refer to the descriptions below:
 - Area Camera: Page 2-25
 - LJ-V Series Head: Page 8-22
 - Line Scan Camera: Page 8-175
- When using Capture Mode, refer to the descriptions below:
 - LumiTrax Mode (area camera only): Page 7-11
 - LumiTrax Specular Reflection Mode (area camera): Page 7-32
 - LumiTrax Specular Reflection Mode (line scan camera): Page 7-44
 - MultiSpectrum Mode (area camera only): Page 7-62
 - Standard Lighting Mode Using MultiSpectrum Light: Page 7-86

Image Capture Setup

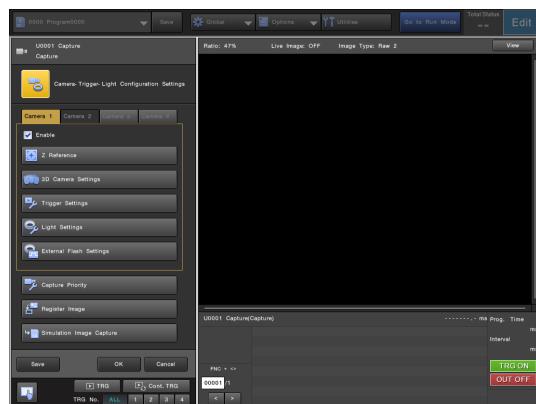
In the capture unit, images are captured by using the 3D cameras, maximum of 2, connected to the controller. The image data is sent from the camera to the controller and assigned to a specified image variable.



- If the cameras used in a capture unit are different from the cameras actually connected to the controller, a camera setting error will occur. No image capturing and subsequent image processing units will be processed. In such cases, set the camera model setting correctly or turn off the controller and connect the correct camera.
- The model and other information for the camera set in a capture unit can be viewed in the [Camera Selection] screen (Page 4-11).

Top Menu

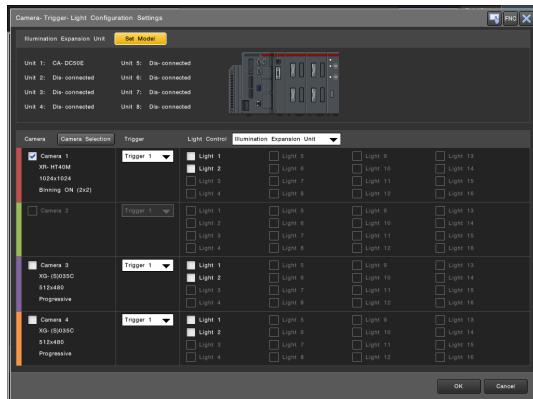
The capture unit menu has the following options. Change the settings as required.



Camera - Trigger - Light Configuration Settings (Page 8-15)	The connected cameras and illumination expansion units, trigger input for each camera, and illumination control targets can be configured together.
Z Reference (Page 8-16)	Projects the guide lights for adjusting the camera position.
3D Camera Settings (Page 8-16)	Image capture options and settings.
Trigger Settings (Page 8-20)	Specify the settings for triggering the controller to take an image.
Light Settings (Page 8-20)	When an illumination expansion unit CA-DC40E/DC50E/DC60E (sold separately) is connected to the controller, the settings related to the light brightness and illumination are configured per light.
External Flash Settings (Page 8-20)	Set the illumination timing for controlling external light equipment using the external FLASH terminal.
Capture Priority (Page 8-20)	This option controls the conditions of the trigger input status for capture unit completion (transition to the next unit) with priority.
Register Image (Page 8-21)	Register images to use as the basis for measurements and setting.
Simulation Image Capture (Page 8-21)	Save the captured image to the SD card. The saved images can be referenced as simulation images in XG-X VisionEditor.

Camera - Trigger - Light Configuration Settings

The connected cameras and illumination expansion units, trigger input for each camera, and illumination control targets can be configured together.



Illumination Expansion Unit

Displays the information of the illumination expansion unit connected to the controller. Select [Set Model] to specify the model of the connected illumination expansion unit for each light unit No.

Camera

Check the camera No. box of the camera to be used. Select [Camera Selection] to specify the model of the connected camera for each camera No. See "Specifying the Model of the Connected Camera (Camera Selection)" (Page 4-11) for more details.

Trigger

Select the trigger to be assigned to each camera.

Light Control

Specify the control method for the light assigned to each camera.

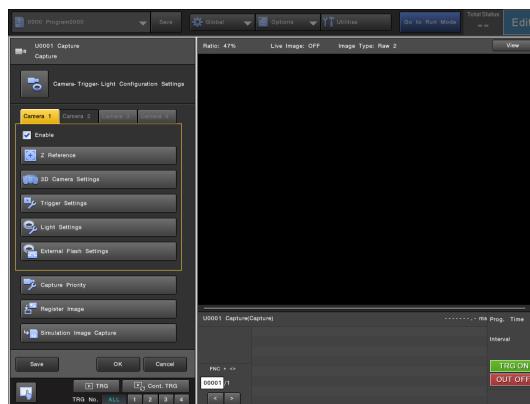
- Illumination Expansion Unit:** Check the light number of the illumination expansion unit to which you wish to assign an illumination control.
- External Flash:** Check the external terminal to which an illumination control will be assigned.

Point These settings are usually not used in measurements using a 3D camera.

Camera 1 to Camera 4

Select the tab of the camera for setting the capture options.

Point The 3D camera will be camera 1 or camera 3.

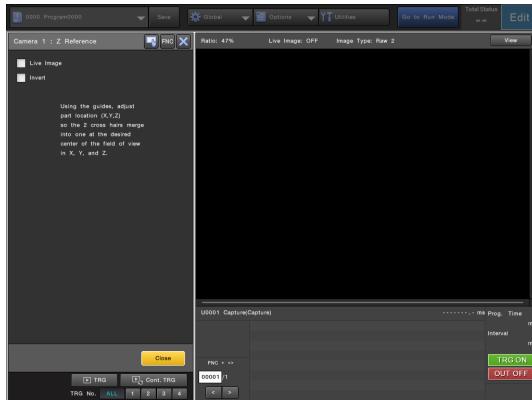


Enable

Check the box to enable the current setting target camera. Remove the check mark if a camera is connected to the controller but is not used.

Z Reference

Projects the guide lights for adjusting the camera position. Refer to "Preparation 2: Adjusting the Position of the Camera Using Cross Marks" (Page 8-9) for more details on adjusting the camera position using the guide lights.



Live Image

Check this box to continuously update and display the most recent image while the cross marks are being projected.



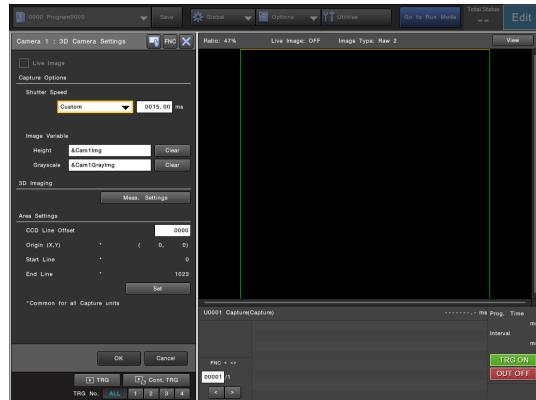
- Live Image will only be active while the [Z Reference] screen is being displayed.
- If the capture on trigger input is disabled in the trigger settings (Page 8-20), this check box is always unchecked and the setting cannot be changed.

Invert

Check this box if you wish to invert the light and dark of the cross marks and their surrounding when projecting the guide lights.

3D Camera Settings

You can specify the conditions for image capture.



You can specify the shutter speed and projection method to suit the workpiece or configure how spike noise, invalid pixels, etc. should be handled.

Capture Options

Shutter speed

Set the shutter speed to be used for Camera 1 and 3 by entering numeric values or selecting from the default values (0.05 to 200.00ms; Default: 10ms (XR-HT15M), 15ms (XR-HT40M)).



If a trigger is input after the 3D camera has not captured any height images for 5 minutes or longer, the capture start may be delayed by up to 10 ms, resulting in longer execution time of the capture unit (No delay will occur if the capture interval is less than 5 minutes).

Image Variable

Specify an image variable which will contain the image captured with the camera selected in camera tab.

- **Height:** Specifies the image variable which will contain the height images.
- **Grayscale:** Specifies a result image variable.



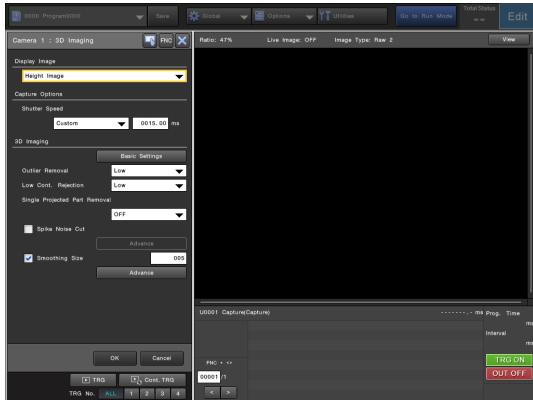
You can use the 3D camera as a monochrome area camera by only specifying the grayscale image variable (i.e. image variable for height is not specified).



- Variables to be specified need to be added in advance in the [Variable Settings] screen.
- Changing the setting clears all image variables, archived data, and target classification results.

3D Imaging

Select [Meas. Settings] and configure the capture conditions for height images according to the capture environment and target.



Display Image

Select the image you wish to display in the [3D Camera Settings] screen.

- Saturated / Dark** (Default): The grayscale image will be displayed with its overexposed and underexposed sections highlighted.
- Height Image**: Displays the latest height image from the specified camera (image variable). Invalid pixels with no height data are displayed in black.
- Grayscale Image**: Displays the latest grayscale image (average grayscale image) from the specified camera (image variable).
- Cross Mark**: Projects a cross mark and border pattern from the projector to help adjust the reference distance.
- Cross Mark (Inverted)**: Projects an inverted cross mark and border pattern from the projector to help adjust the reference distance. This is useful when it is difficult to identify the cross mark when the workpiece is black, etc.
- Ambient Light Check**: Stops the projector emission temporarily to check the effect of the ambient light.
- Stripe Pattern (Proj.1)**: Displays the projection status of the stripe pattern from Projector 1. The higher the contrast of the stripe pattern, the more stable measurements you will be able to perform.
- Stripe Pattern (Proj.2)**: Displays the projection status of the stripe pattern from Projector 2. The higher the contrast of the stripe pattern, the more stable measurements you will be able to perform.

Reference

- A grayscale image is a composite of multiple images that have been captured with stripe pattern projection.
- When [XY Normalization] is [ON], correction by XY normalization is applied to the grayscale image.
- Overexposed refers to a state in which the height data cannot be acquired normally due to excessive light on the CCD. Underexposed refers to a state in which the height data cannot be acquired normally due to insufficient light on the CCD.
- The overexposed section will be displayed in red; and the underexposed section will be displayed in blue.
- Even if [XY Normalization] is ON, correction by XY normalization will not be applied to Saturated/Dark images.
- You can check the contrast of the stripe pattern in the grayscale profile display. Make adjustments such that the pixel value in the bright section will be less than 255.

Basic Settings

- Projector**: Specify the projector to be used.
 - 1**: Only Projector 1 is used.
 - 2**: Only Projector 2 is used.
 - 1+2**: (Default) Projector 1 and Projector 2 are both used.

Reference

The capture time can be shortened by only using one of the projectors. However, this may result in larger unmeasurable area due to light emission from the projector not reaching the target.

- 2-axis Projection**: You can select to turn ON/OFF the [2-axis Projection] option (Default: ON). While selecting [ON] roughly doubles the image capture time in comparison to selecting [OFF], a more stable measurement result can be obtained by using the two types of stripe patterns changed 90 degrees in the axis direction of the stripe pattern.

Point

3D cameras (XR Series) released on or after 9 September, 2014 is required in order to use the 2-axis projection function. This function is not available on 3D cameras (XR Series) released on or before 8 September, 2014.

- XY Normalization**: Corrects the scaling of X and Y coordinates, which changes according to the height within the field of view, when you need to accurately measure the actual size values of the X and Y coordinates. Enabling XY normalization will enable you to convert the pixel values of XY coordinates into actual size values regardless of height.
 - OFF** (Default): XY normalization is not applied. Accurate full-scale values cannot be obtained as the scale of XY coordinates changes according to the height. However, the processing speed will be the fastest in this option.
 - ON**: Applies XY normalization. If two or more height data exist for the same XY coordinates, only the height data with the largest Z coordinate will be used.

Capture (When 3D Camera is Used)

- **ON (Fast):** Applies XY normalization. If two or more height data exist for the same XY coordinates, the average value of the vertically distributed height data will be used. Since comparison of the Z coordinate of the height data will not be performed, the processing will be quicker compared to when set to [ON].

Reference [Scaling] (Page 8-165) needs to be set correctly in order to obtain the actual size value.

- **Space Encoding:** This process is executed to reserve the measurement range in the height direction (Default: ON (Max.)). When Space Encoding is turned OFF, the capture time will be shorter but the measurable range for the height direction will be narrowed. Also, values outside the measurement range become unreliable.

Reference While reducing the number of ON images narrows the Z direction range that can be correctly measured, you can shorten the image capture time (values outside the range will become unreliable).

- **One-Shot HDR:** Select [ON] if you wish to capture images with wider dynamic range by decreasing the sensitivity on the bright side. It has the effect of reducing overexposure (Default: ON).

Reference As opposed to normal HDR capture, the capture time will not be increased as this is a one-time capture.

- **Multi-Shot HDR:** To capture an image with greater dynamic range by capturing the image multiple times with different exposures, set the capture count value to 2 or larger (Default: 1).

Reference You can obtain images with high dynamic range, but the capture time will be longer due to increased number of image captures.

Outlier Removal

The pixels values that deviate greatly from the surrounding pixel values are treated as invalid pixels (Default: Low). Unreliable height data due to multi-reflected stripe pattern light will be eliminated.

Reference Selecting [High] for [Outlier Removal] will increase the invalid pixels but will produce stable measurement results. You can reduce the invalid pixels by selecting [Low], but it may result in greater variations in the measured values.

Low Cont. Rejection

Set the low-contrast section when the stripe pattern is projected as invalid pixels (Default: Low)

Reference Selecting [High] for [Low Cont. Rejection] will increase the invalid pixels but will produce stable measurement results. You can reduce the invalid pixels by selecting [Low], but it may result in greater variations in the measured values.

Singly Projected Part Removal

You can select to turn ON/OFF the [Singly Projected Part Removal] option (Default: OFF).

Selecting [ON] leaves only the highly reliable areas where the light of both Projector 1 and Projector 2 are illuminating and areas where the light of only one projector is illuminating become invalid pixels. While the number of invalid pixels increase, areas with unstable measurement results can be forcibly omitted.

Spike Noise Cut

You can eliminate the points with prominent height due to noise and the like. To remove such spike noise, check this option (Default: Disabled) and select [Advance], and then specify the removal size (2 to 30 pixels, Default: 4).

- **Specify Processing Direction:** To specify the processing direction, check this option and then select a direction in the [Processing Direction] field.

- **X:** Eliminates the continuous spike noise in the vertical direction of the image and retains the continuous protrusions in the horizontal direction.

- **Y:** Eliminates the continuous spike noise in the horizontal direction of the image and retains the continuous protrusions in the vertical direction.

- **XY Individual:** The removal size can be specified separately for each direction.

- **Cut Size:** Eliminates spike noises having a size width that is equal to or less than that specified.

• **Cut Threshold (mm):** Eliminates protrusions that are , in relation to the surroundings, away from the specified height as noise (0.000 to 99.999 mm; Default: 0.050).

- **Cut Target:** You can choose from [Upper], [Lower], and [Both] (Default: Upper).

Smoothing Size

The height information can be smoothed. When activating the smoothing processing, check the box (Default: Disabled), then specify the size (3 to 127 pixels, Default: 5).

Advance

- **Process:** Specify the type and count of the image enhancement that is executed by the internal process of the 3D camera during image capture.
 - **None:** Does not use image enhancement.
 - **Median:** This option has the effect of eliminating abnormal height values that occur in the form of spike-like noise by applying the median of the surrounding pixel heights to the center pixel.
 - **Gaussian:** This process reduces noise by applying heavier smoothing on pixels closer to the center. You can obtain a more natural blur compared to [Average], but the noise reduction effect will be weaker.
 - **Average** (Default): Smoothens and stabilizes the height variations that occur on the plane in a wave-like pattern. It also has the effect of interpolation on invalid pixels by applying the average value of the surrounding pixels.
- **Inv. Pixel Suppress.:** To interpolate the invalid pixels without height data with the height data estimated from the surrounding valid pixels, check the box (Default: Enabled) and specify the level (level 0 to 9, where level 0 means no interpolation). The greater the level, the wider the range of invalid pixels that can be suppressed. Inv. Pixel Suppress. does not affect the values of the valid pixels surrounding the invalid pixel. You can further specify the adjustment width and target by selecting [Detail].
 - **Adj. Width:** Selecting [Small] reduces the intensity of the effect but the degree of suppression of invalid pixels can be finely adjusted. The border between the remaining invalid and valid pixels stays as is for [Small] and there will be an interpolation of invalid pixels as zero for [Large] (Default: Small).
 - **Target:** Select the type of image to which Inv. Pixel Suppress. will be applied (Default: Height + Grayscale).

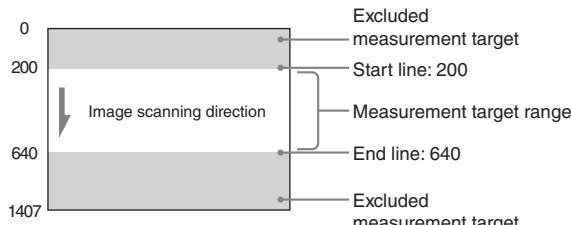
Reference

Invalid pixels are pixels that do not contain height information as a result of failure to obtain the height during capture or due to unreliable measured values.

Area Settings

The image capture range set for the camera is displayed.

Example: Image capture range is set to “Start Line: 200, End Line: 640” when XR-H15M is used



An example when the image capture range is set from 200 to 640

CCD Line Offset

Set the offset for the start line in the image capture area settings. The range of setting values available are from 0 (Default) to (Maximum capture lines of the camera used - Specified end line).

Reference

When the CCD line offset is set, the line positions following the offset are shown in blue next to the [Start Line] and [End Line].

Set

Set the image capture range.

- **Origin X:** Specify the X coordinate of the origin (upper left) of the capture range.
- **Origin Y:** Specify the Y coordinate of the origin (upper left) of the capture range.
- **Start Line:** Specify the start line of the capture range.
- **End Line:** Specify the end line of the capture range.

Point

- If the destination image variable for height has not been specified, normal capture will be performed while setting the image capture range, even if HDR capture is enabled.
- Workpieces will not be processed if they do not lie between the start and end lines, even if they are in the process area.
- These settings are common for all capture units.
- When setting the image capture range, all image variables, archived data, and the output buffer are cleared.
- On a 3D camera, the number of lines can only be set to a multiple of 8. If [Binning ON] (Exp.) is enabled, the number of lines can only be set to a multiple of 16.

- **Mirror Invert:** Select whether to capture images with mirror invert or rotation for the camera selected in camera tab.

- **OFF** (Default): Does not mirror the image horizontally.
- **Horizontal:** Captures the image horizontally inverted.
- **Vertical:** Captures the image vertically inverted.
- **180° Rotate:** Rotates the image by 180° during image capture.

- **Rotation:** Select whether to capture images with 90 or 270 degrees rotation for the camera selected in camera tab.

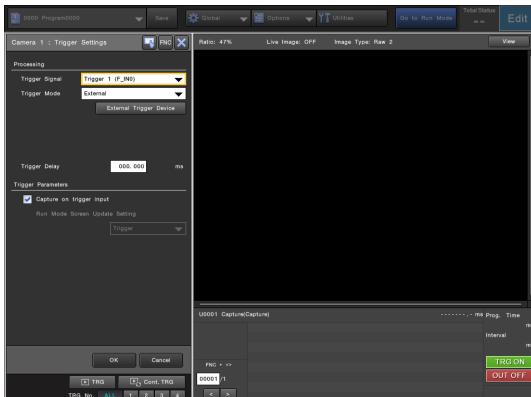
- **None** (Default): Does not rotate the image.
- **90° Rotate:** Rotates the image by 90° during image capture.
- **270° Rotate:** Rotates the image by 270° during image capture.

Point

- If 90/270 deg. rotation is enabled, the rotation processing time will be added to the transfer time.
- If 90/270 degrees rotation and limiting of the image capture range are configured at the same time, only the effective image capture range before the rotation will be acquired from the rotated image.
- It can also be used in combination with the mirror inversion function.

Trigger Settings

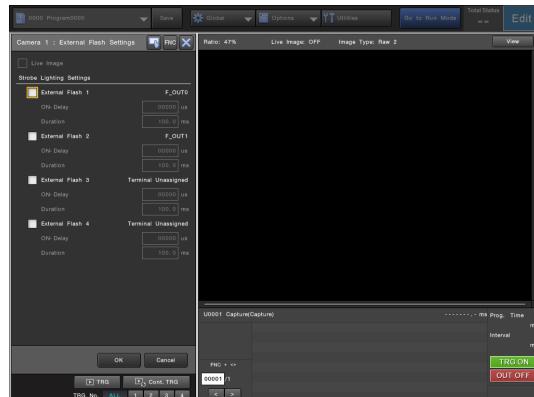
Specify the settings for triggering the controller to take an image.



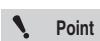
The settings are the same as for area cameras. See "Trigger Settings" (Page 2-30) for more details.

External Flash Settings

Specify the conditions for when using the external FLASH terminal for image capture.



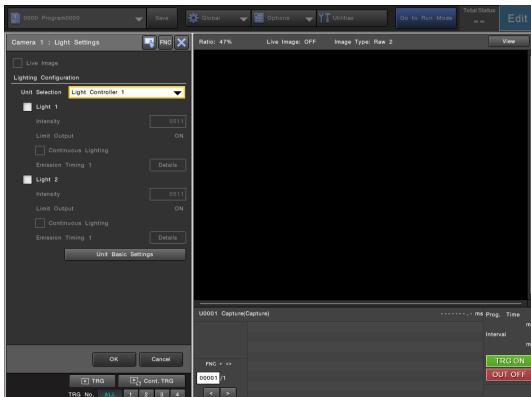
The settings are the same as for area cameras. See "External Flash Settings" (Page 2-33) for more details.



These settings are usually not used in measurements using a 3D camera.

Light Settings

When an illumination expansion unit CA-DC40E/DC50E/DC60E (sold separately) is connected to the controller, the settings related to the light brightness and illumination are configured per light.



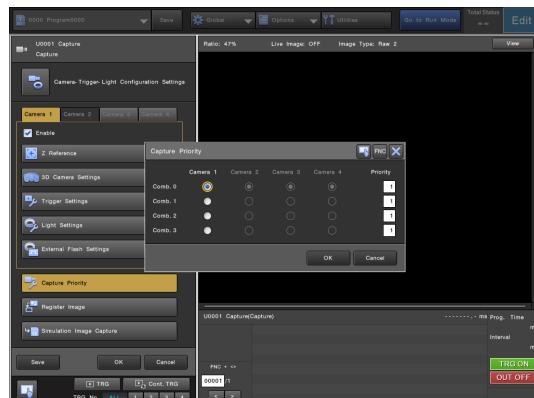
The settings are the same as for area cameras. See "Light Settings" (Page 2-32) for more details.



These settings are usually not used in measurements using a 3D camera.

Capture Priority

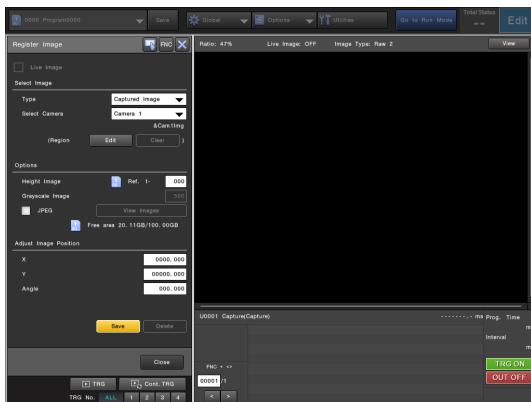
The [Capture Priority] screen will appear, which controls the conditions of the trigger input status for capture unit completion (transition to the next unit) with priority. Normally, the capture unit is complete when the trigger inputs for all enabled cameras are received. It is possible to move to the next unit when the trigger input(s) of the specified camera(s) combination is received.



The settings are the same as for area cameras. See "Capture Priority" (Page 2-34) for more details.

Register Image

Register images to use as the basis for measurements and setting.



The settings other than [Options] are the same as for area cameras. See "Register Image" (Page 2-34) for more details.

Point

- When registering the height image only, the grayscale image will be deleted if a grayscale image is already registered for the corresponding registered image No. Note that the same applies when registering the grayscale image only.
- When a registered image is deleted, the registered height image and grayscale image will be deleted at the same time. It is not possible to delete only either of the images.

Options

No.

Specify the registered image number used for image registration in the form "(Camera No.)-(Specified No.)". The height image will be registered to the specified number (0 to 499). The grayscale image will be registered to the number that is the sum of the specified number and 500.

Reference

The saved file name is "ref (camera No.)(specified No.)" (for full screen image registration) or "ref (camera No.)(specified No.)_XXX_YYY" (for partial image registration).

JPEG

Check this box to save the registered image in JPEG format. When this box is not checked, the image will be saved in BMP format as either a 24-bit color bitmap image (color camera, 3D camera or LJ-V Series head) or an 8-bit grayscale bitmap image (monochrome camera).

Point

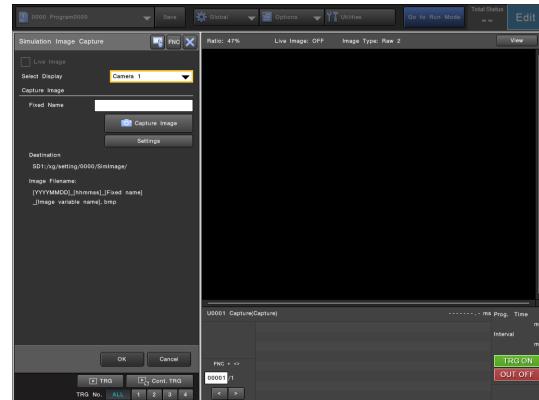
- Using image compression may result in some image deterioration, thus measurement results from a compressed image may differ to those when using non compressed images.
- Using image compression on the height image will prevent you from obtaining correct height data due to image deterioration caused by the compression.

View Images

You can check a list of registered images.

Simulation Image Capture

The simulation image capture allows you to check the actual images captured by the camera based on the changed settings, or save the captured images to the SD card in the image format specified in the output settings. This is useful for quickly checking camera settings and saving images for simulation in XG-X VisionEditor.



The settings are the same as for area cameras. See "Simulation Image Capture" (Page 2-35) for more details.

Save

The settings for all units are saved to the currently used program setting file in SD Card 1 or SD Card 2.

Point

- If the device is turned off before any settings are saved, all of those changes will be deleted.
 - Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
 - Items specified not to be saved are excluded from the saving operation.
- As examples of items that can be made so they are not saved, there are the variables and the screen, such as a display pattern screen, display state changed in the current program setting.

Capture (When Using an LJ-V Series Head)

A Capture unit is used for capturing images of the inspection/measurement target workpiece using a camera.

- This section describes the settings to use an LJ-V Series Head. When using other cameras, refer to the descriptions below:
 - Area Camera: Page 2-25
 - 3D Camera: Page 8-14
 - Line Scan Camera: Page 8-175
- When using Capture Mode, refer to the descriptions below:
 - LumiTrax Mode (area camera only): Page 7-11
 - LumiTrax Specular Reflection Mode (area camera): Page 7-32
 - LumiTrax Specular Reflection Mode (line scan camera): Page 7-44
 - MultiSpectrum Mode (area camera only): Page 7-62
 - Standard Lighting Mode Using MultiSpectrum Light: Page 7-86

Image Capture Setup

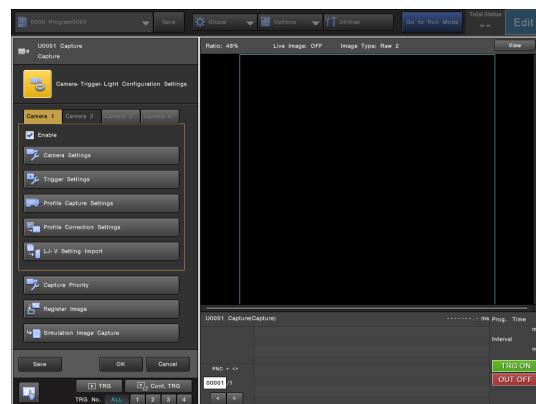
In the Capture unit, image capture is performed using the LJ-V series heads (maximum of 4 heads) connected to the controller. The image data is sent from the camera (LJ-V) to the controller and assigned to an arbitrary image variable.



- The LJ-V Series head models connected to the same camera input unit must be the same.
- For the XG-X2800LJ, only one CA-E100LJ camera input unit can be connected and up to two LJ-V Series head sensors can be connected. Additionally, the CA-E110LJ model and luminance output type heads cannot be connected.
- If the cameras set in the Capture unit are different from the cameras actually connected to the controller, a camera setting error will occur. No image capturing will be performed and subsequent image processing units will not be processed. In such cases, set the camera model correctly, or turn off the controller and connect the correct camera.
- The model and other information of the camera set in a Capture unit can be viewed in the [Camera Selection] screen.

Top Menu

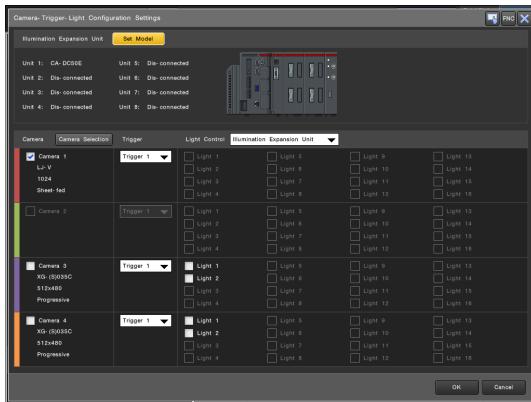
The Capture unit menu has the following options. Change the settings as required.



Camera-Trigger-Light Configuration Settings (Page 8-23)	You can collectively set the connected cameras, illumination expansion units, trigger inputs and light controls for each camera.
Camera Settings (Page 8-24)	Specify the capturing conditions for images to be used for processing by other units.
Trigger Settings (Page 8-26)	Specify setting conditions related to triggers.
Profile Capture Settings (Page 8-29)	Change profile capture settings, such as sensitivity, exposure time, and light intensity.
Profile Correction Settings (Page 8-31)	You can cancel data that is invalid due to dead zones and remove abnormalities with the smoothing filter for the captured profile.
LJ-V Setting Import (Page 8-34)	Load the LJ-V Series controller configuration file saved on the SD card and apply the content to the Capture unit settings.
Capture Priority (Page 8-34)	You can configure condition settings for the trigger input status that completes the Capture unit (moves to the next unit) with a priority level.
Register Image (Page 8-35)	Register the image to use as reference for measurement and setting.
Simulation Image Capture (Page 8-35)	Save a captured image to the SD card. You can browse the saved image as an image for simulation on the XG-X VisionEditor.

Camera -Trigger-Light Configuration Settings

You can collectively set the connected cameras, illumination expansion units, trigger inputs and light controls for each camera.



Illumination Expansion Unit

Display information about the illumination expansion unit connected to the controller. If you select [Set Model], you can specify the model of the connected illumination expansion units by unit number.

Camera

Check the camera No. box of the camera to be used. Select [Camera Selection] to specify the model of the connected camera for each camera No. See "Specifying the Model of the Connected Camera (Camera Selection)" (Page 4-11) for more details.

Trigger

Select the trigger to be assigned to each camera.

Light Control

Specify the control method for the light assigned to each camera.

- Illumination Expansion Unit:** Check the light number of the illumination expansion unit to which you wish to assign an illumination control.
- External Flash:** Check the external terminal to which an illumination control will be assigned.

Point If you use an LJ-V Series head to capture images, you cannot use light.

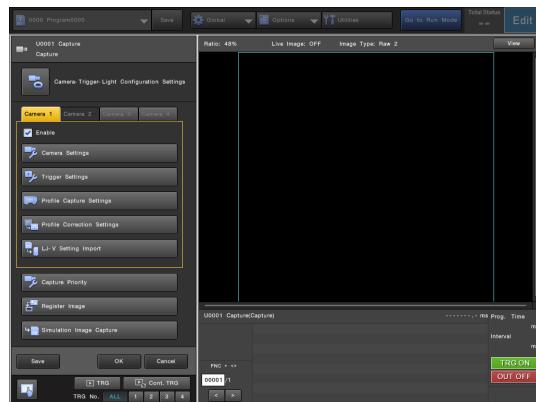
Camera 1 - Camera 4

Select the tab of the camera for which capture settings are to be set.



Point

The LJ-V Series head is Camera 1 or Camera 3.

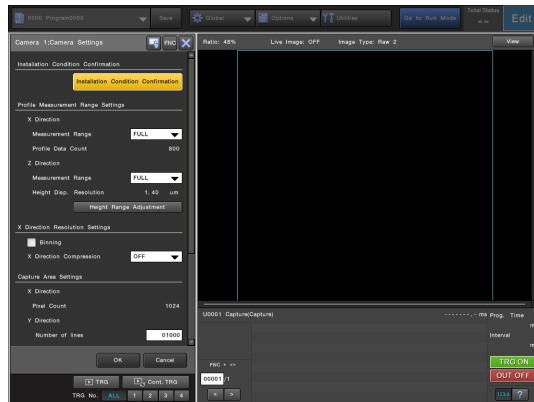


Enable

Check the box to enable the current setting target camera. Remove the check mark if a camera is connected to the controller but is not used.

Camera Settings

Specify the capturing conditions for images to be used for processing by other units.



Installation Condition Confirmation

While checking the profile obtained with the LJ-V Series head, check the installation conditions. While checking the [Installation Condition] and [Installation Direction] guide, you can check whether the measurement range and reference height are appropriate or not.

Profile Measurement Range Settings

You can reduce the amount of transmitted data and speed up measurement time by limiting the range of data captured with the capture elements inside the sensor head that will be transmitted to the controller. Select from [FULL], [MIDDLE], and [SMALL] for the enabled range of the capture elements for both the X direction and Z direction. The profile data count is determined in accordance with the selected measurement range.

X Direction

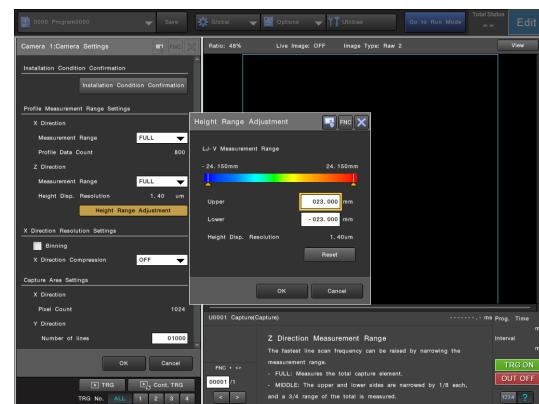
- Measurement Range:** You can shorten the fastest line scan frequency by narrowing the measurement range.
 - **FULL:** Transmits all the data captured with the capture elements.
 - **MIDDLE:** Of the data captured with the capture elements, 1/8th of the data on the left and right of the range is eliminated and data is transmitted (only 3/4 of the data in the center of the horizontal direction is selected).
 - **SMALL:** Of the data captured with the capture elements, 1/4th of the data on the left and right of the range is eliminated and data is transmitted (only 1/2 of the data in the center of the horizontal direction is selected).

Z Direction

- Measurement Range:** You can shorten the fastest line scan frequency by narrowing the measurement range.
 - **FULL:** Transmits all the data captured with the capture elements.
 - **MIDDLE:** Of the data captured with the capture elements, 1/8th of the data on the top and bottom of the range is eliminated and data is transmitted (only 3/4 of the data in the center of the vertical direction is selected).
 - **SMALL:** Of the data captured with the capture elements, 1/4th of the data on the top and bottom of the range is eliminated and data is transmitted (only 1/2 of the data in the center of the vertical direction is selected).

Height Range Adjustment

Specify the upper and lower limit for the height information obtained from the LJ-V Series head.



Point

- If you change the settings, all image variables, archive information, and target classification results are cleared.
- If you change the settings, measured values using image files which include height information, such as reference, master, and output images, saved before the settings were changed will change. If you change the settings, you must recapture those image files.

X Direction Resolution Settings

Binning

To enable binning processing, select the check box. If you enable binning processing, since 2x2 pixel data are deemed and processed as 1 pixel on the capture element, the fastest line scan frequency can be reduced without narrowing the measurement range.



- This setting affects the generated profile data count and the fastest line scan frequency that can be input (Page 8-28).
- If you enable binning processing, the profile data count for the X direction is halved, and the resolution becomes coarse.

X Direction Compression

The data count for the X direction is reduced by taking and using only one point of profile data from every specified number of points (two or four).

By reducing the profile data count, you can improve the measurement processing speed and increase the number of captures that can be saved while using the X direction measurement range as is.



- If you enable X direction compression, the X direction resolution becomes coarse.
- X direction compression settings have no effect on the fastest line scan frequency.

Capture Area Settings

Scan Line Settings

- **Number of lines:** Specify the number of image capture lines.
- **Overlapping lines** (for [Continuous] only): Specify the number of lines to overlap the image. Even if there is foreign matter in the border section between images, inspection can be performed without omission because the image continues on from the image of the previous capture.
- **Total number of lines** (for [Continuous] only): This is used when there are not enough lines in [Sheet-Fed]. When this is enabled, capture stops when capturing of the total number of lines is complete after the trigger is input. Images are captured only for the capture image count until the total number of lines is reached.



- If you enable the total number of lines, the last line is extended for the deficient number of lines in the last capture.

Image Variable

Specify the image variables to store images captured by the camera you selected in camera tab.

- **For Height:** Specify the image variable to store height images.
- **For Grayscale:** Specify a resultant image variable.



- The image variable field for grayscale is displayed only if a luminance output type sensor head is used.
- You must add the variables to specify in advance on the [Variable Settings] screen.
- If you change settings, all image variables, archive information, and target classification results are cleared.

Grayscale Image Gain Adjustment

Select [Settings] and adjust the image gain.



- The [Grayscale Image Gain Adjustment] settings are displayed only if a luminance output type sensor head is used on the XG-X2900/X2800.

Gain Adjustment

- **Black Level:** Specify the reference luminance value for a black grayscale image. Increase the value to make the grayscale image dark.
- **White Level:** Specify the reference luminance value for a white grayscale image. Reduce the value to make the grayscale image bright.
- **Gamma:** Specify the brightness balance of the grayscale image. When the value is larger, the brightness changes, in dark parts, are emphasized more.

Control Light Intensity

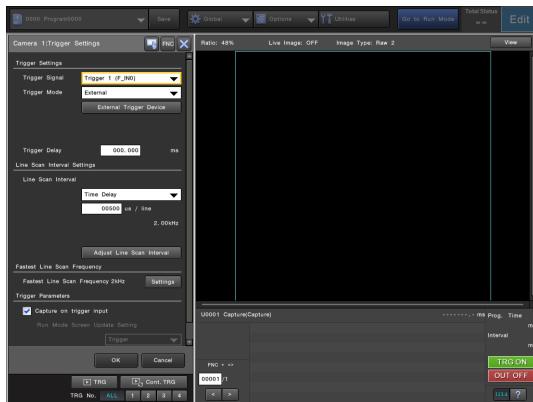
- **Control Mode:** Select the method ([AUTO] or [MANUAL]) to adjust the brightness that is determined by the combination of the laser light intensity and exposure time.
- **Upper Limit / Lower Limit:** Lower the upper limit when you want to suppress excessive laser light emission. The specifiable range for both the Upper Limit and the Lower Limit is 1 to 99 (default setting for the upper limit: 99; default setting for the lower limit: 1).



- When using the luminance output type head, the Control Mode is set to [MANUAL] and the control range Upper Limit and Lower Limit are both set to 50 by default. In order to obtain a grayscale image of uniform light intensity and a stable height image when using luminance output type heads, adjustments must be made with the Control Mode set to [MANUAL] and the control range Upper Limit and Lower Limit set to the same value as much as possible.

Trigger Settings

Specify setting conditions related to triggers.



Trigger Settings

Trigger Signal

Select the trigger signal that you want to use. Specify trigger signals and terminal assignments on the [Terminal Block & Parallel Port] screen in the Global Settings.

Trigger Mode

Select the trigger type that you want to use.

- External** (default value): Capture images through trigger input from the handheld controller and trigger signals from external devices. Processing is performed only once for each trigger input.
- Internal**: Set the interval time and capture images through trigger signals that occur at a constant interval. You can do loop processing by setting off an internal trigger during operation even if there is no trigger input. To use internal triggers, enter a trigger interval time between 1 and 99999 ms.



If you select an internal trigger, the trigger will always be set off in Run mode. If you want to pause internal triggers externally, follow the procedure below and prohibit trigger input. Note that when the internal trigger is paused, the output of the result data up to that point continues.

- Prohibit internal triggers with terminal block input (EXT terminal)
- Prohibit internal triggers with a communication command (TE, 0 command)

For more details, see the "XG-X2000 Series Communications Control Manual".

Trigger Cycle (Only When [Internal] is Selected)

- Time Delay** (default setting): Select this setting if you specify trigger cycle and line scan interval with time.
- Specify Encoder**: Select this setting if you specify trigger cycle and line scan interval with encoder counts.

External Trigger Device (Only When [External] is Selected)

If you want to use external triggers, select the type of trigger that you want to use in capturing images by selecting the check box for the related external device.

- Terminal Block**: A trigger input from an external terminal with %Trg1 to 4 assigned
- Handheld Controller/Mouse**: A trigger input with the No. 3 (TRIGGER) button on the handheld controller or the TRG button on the screen
- RS-232C**: A trigger input with the RS-232C command
- Ethernet (TCP/IP)**: A trigger input with the Ethernet command
- PLC-Link**: A trigger input with the RS-232C or Ethernet PLC-Link command
- CC-Link**: A trigger input with the CC-Link bit device or command
- EtherNet/IP**: A trigger input with EtherNet/IP™ cyclic communication, message communication, or a command
- PROFINET**: A trigger input with PROFINET cyclic communication, message communication, or a command
- EtherCAT**: Trigger input through the EtherCAT cyclic communication, mailbox communication, or commands
- PC Program**: A trigger input with the ActiveX control method



During Setup mode, you can always use external triggers from the handheld controller/mouse.

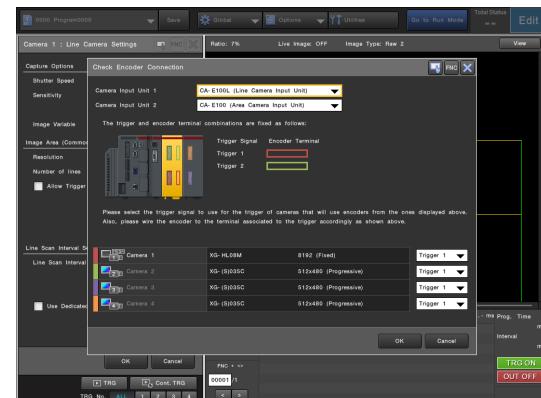
Trigger Delay

To delay the start of image capture by a set time after inputting the selected trigger, specify the trigger delay time.

- You can set trigger delay for each camera in a range of 0 to 999.999 ms.
- If you set [Trigger Cycle] or [Line Scan Interval] to [Specify Encoder], specify the encoder count (0 to 65535; default setting is 0).

Check Encoder Connection (When [Specify Encoder] is Set)

The [Check Encoder Connection] screen appears.



The encoder terminal to use differs depending on the model of the camera input unit and the selected trigger signal. On the

[Check Encoder Connection] screen, you can check the position of the encoder terminal to use with the current settings.

- When [Specify Encoder] is set: Specify the encoder input count number per line.

Line Scan Interval Settings

Line Scan Interval

Specify the line scan interval.

- When [Time Delay] is set: Specify the line scan interval with time (12 to 30000 µs/line).
- When [Specify Encoder] is set: Specify the line scan interval with an encoder count (1 to 99999999).

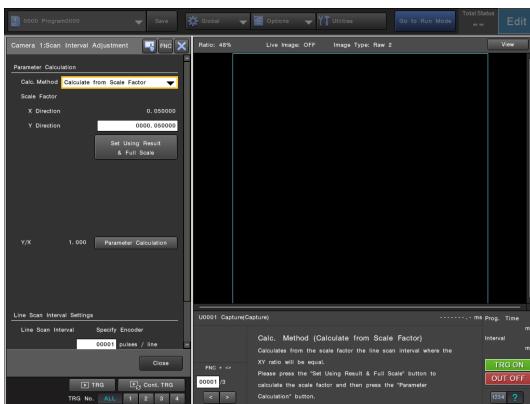
Use Dedicated Encoder

If you want to use the Keyence encoder that is made for this image processing system, select this check box. If you connect the controller to the Keyence encoder made for this image processing system with an RS-232C cable, you can change the encoder settings on the [Adjust Line Scan Interval] screen.

Adjust Line Scan Interval

Adjust the parameters related to the line scan interval so that the X/Y resolution is uniform. By changing the settings for the line scan interval, you can match up the X/Y resolution. For more details about the adjustment procedure, see "Notes on Adjusting the Line Scan Interval" (Page 8-186).

Point If the X/Y resolution differs, an image may be generated in which it is stretched or shrunk in the Y direction. In this case, as the length and shape changes due to the rotation angle of the measurement target, it cannot be measured correctly.



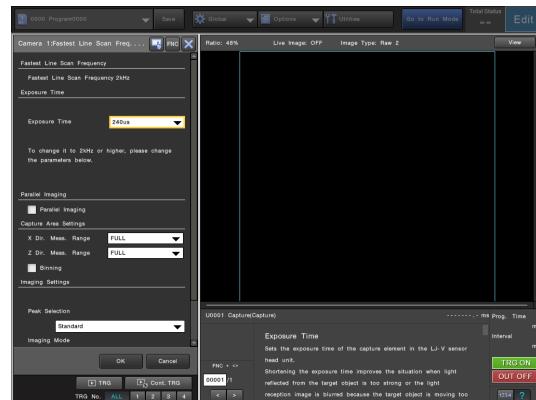
- **Calc. Method:** Select the method to calculate setting values related to the encoder. For more details about the adjustment procedures and setting values for each calculation method, see "Notes on Adjusting the Line Scan Interval" (Page 8-186).
- **Pulse Count Per 1 Revolution** (only when [Use Dedicated Encoder] is selected): Specify the number of pulses for one revolution for the dedicated encoder.
- **Line Scan Interval:**
 - When [Time Delay] is set: Specify the interval per line with time.

Capture (When Using an LJ-V Series Head)

- Sampling Mode (only when [Specify Encoder] is set)**
 - **x1**: Counts at the rise of the encoder A phase.
 - **x2**: Counts at the rise and fall of the encoder A phase.
 - **x4**: Counts at the rise and fall of the encoder A and B phases.
- Details (only when [Specify Encoder] is set)**
 - Encoder Direction:**
 - OFF** (default setting): Counts both the clockwise and counter clockwise directions.
 - CW**: Only counts in the clockwise direction.
 - CW and CCW**: Counts in the clockwise direction and if there is a count in the counter clockwise direction, reverts that amount and then counts.
 - Reverse Detection:**
 - OFF** (default setting): Counts in the clockwise direction.
 - ON**: Counts in the counter clockwise direction.
 - Z-Phase Function:**
 - None** (default setting): Does not use Z-phase input.
 - Trigger**: Uses Z-phase input as trigger input.
 - Reset Pulse Count**: Uses Z-phase input as the encoder count reset.
 - Reset Pulse Count and Trigger**: Uses Z-phase input as the encoder count reset and trigger input.
 - External Trigger**:
 - Trigger**: Uses External Trigger as trigger input.
 - Reset Pulse Count and Trigger**: Uses External Trigger as the encoder count reset and trigger input.
 - Detect Timeout**: Set the time to timeout from when the encoder count is interrupted (in milliseconds).

Fastest Line Scan Frequency

You can collectively change settings related to the fastest line scan frequency.



The settings changed here are reflected on the respective settings screens.

- Exposure Time** (Page 8-30)
- Parallel Imaging**: If you enable this setting, exposure of capture elements and transmission of profiles is processed in parallel. The fastest line scan frequency can be raised, but if the sampling interval is 10 ms or more, the height data is lost and an invalid pixel line is captured.
- X Dir. Meas. Range** (Page 8-24)
- Z Dir. Meas. Range** (Page 8-24)
- Binning** (Page 8-25)
- Peak Selection** (Page 8-30)
- Imaging Mode** (Page 8-31)
- Prevent Mutual Interference (common)**: When two LJ-V Series heads are in use, select this check box if you want to adjust the laser emission timing so that the lasers emitted from the sensor head units do not interfere with each other.

Trigger Parameters

Capture on trigger input

Select whether or not to wait for trigger signal input to do capture processing by the Capture unit. If you clear this check box, capture processing will be done regardless of whether there is a trigger signal or not and all set cameras will capture images.

When [Image Capture Buffer] is enabled, if the buffer is empty when capture processing from a Capture unit starts execution, the controller will function as stated above. However, if an image that meets the capture priority conditions is in the background buffer, capture processing will complete regardless of this setting and the next unit will be executed.

End capture by EXT signal

If you enable this setting, you can end capture processing by inputting an EXT signal.



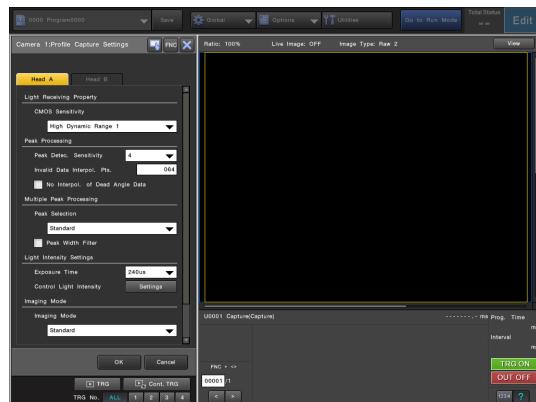
- The information of the line that was captured last will be copied for the lines where capture was not performed.
- When you are using an LJ-V Series head, you cannot disable this setting.

Run Mode Screen Update Setting

During trigger signal standby, camera images are updated only when a trigger is input.

Profile Capture Settings

Change profile capture settings, such as sensitivity, exposure time, and light intensity.



Light Receiving Property

CMOS Sensitivity

Select the light sensitivity of the capture element in the LJ-V sensor head unit.

- High Dynamic Range 1 to 3:** Increases the dynamic range for image capture. The peak can be measured even for workpieces that have a large difference in reflectance. When this value is larger, greater differences in reflectance can be supported.
- High Precision:** The dynamic range is lowered, and the peak is measured at high sensitivity. This is used for workpieces that have a small difference in reflectance.

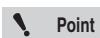
Peak Processing

Peak Detec. Sensitivity

Sets the threshold value for the received light quantity to detect as a peak. Increasing this value makes it easier for the received light to be detected as a peak. Reduce this value to prevent mis-detection of peaks due to ambient light or multiple reflections.

Invalid Data Interpol. Pts.

When profile data (invalid data) that cannot be detected due to excessive or insufficient light intensity continues in the X direction only in a number equal to or lower than the number of interpolation points, the invalid data is replaced with a value that was linearly interpolated from the valid data on both sides of the invalid data.



- If the continuous points of invalid data exceeds the specified interpolation points, interpolation is not executed.
- Invalid data includes profile data handled as invalid data due to [Peak Selection] settings.
- If you set interpolation points to 255, linear interpolation is executed regardless of the number of continuous points of invalid data.

Capture (When Using an LJ-V Series Head)

No Interpol. of Dead Angle Data

The dead angle data will not be interpolated during invalid data interpolation. The parts of the dead angle can be set as invalid pixels. Use this option to judge the border of the work.

Multiple Peak Processing

Peak Selection

If multiple peaks are detected on the same X coordinate on the light reception image, you can select which peaks are measured. This setting is effective when you want to prevent mis-detection of peaks due to multiple reflections.

- **Standard:** Measures the peak that has the maximum received light quantity.
- **NEAR:** Measures the peak closest to the head.
- **FAR:** Measures the peak farthest from the head.
- **Remove X Multiple Reflection:** Emits X/Y polarized light and removes multiple reflection peaks in the X direction. This setting is effective in preventing mis-detections in workpieces that have concave/convex in the laser line direction. The fastest line scan frequency slows down because the capture count doubles.
- **Remove Y Multiple Reflection:** Emits X/Y polarized light and removes multiple reflection peaks in the Y direction. This setting is effective in preventing mis-detections in workpieces that have concave/convex in the direction perpendicular to the laser line. The fastest line scan frequency slows down because the capture count doubles.
- **Invalidate Data:** When there are multiple peaks on the same X coordinate, the data is handled as invalid data.

Point

- X/Y polarization is a function that emits the laser beam twice in different polarization directions (p/s) for one trigger. Multiple reflection utilizes a property in which a difference in received light volume occurs due to the polarization direction, and compares the data of two captured images to invalidate data with large differences. By doing so, you can remove the influence of multiple reflections.
- If you selected [Remove Multiple Reflection], the fastest trigger frequency is affected because the laser is emitted (X/Y polarization) twice (p- and s-polarized light) by one trigger.
- Depending on the surface condition of the target workpiece, a sufficient effect may not be observed even when [Remove X Multiple Reflection] is selected when there is concave/convex in the laser beam direction. In this case, also try using [Remove Y Multiple Reflection].
- When you use an LJ-V7020(B)/V7020K(B) head, there is no effect even if you select [Remove Multiple Reflection].

Peak Width Filter

When this is enabled, peaks that have a thick width are not detected when multiple peaks are detected on the same X coordinate on the light reception image. This reduces mis-detections due to ambient light or multiple reflected light because the peak width of ambient light or multiple reflected light is thicker on the light reception image.

Point

The peak width filter has no effect on the fastest line scan frequency.

Light Intensity Settings

Exposure Time

Set the exposure time of the capture element in the LJ-V head unit. Shortening the exposure time improves cases in which light reflected from the workpiece is too strong or the light reception image is blurred because the workpiece is moving too fast.

Point

Exposure time settings are ignored if Imaging mode is set to [Multi Emission (Synthesis)].

Control Light Intensity

Set the brightness adjustment range. Brightness is determined by the combination of the laser light intensity and exposure time.

- **Control Mode:** Select [MANUAL] if you want to limit the adjustment range of the light quantity, such as when you want to suppress excessive laser light emission, and the like.
- **Control Range:** Lower the upper limit when you want to suppress excessive laser light emission. The specifiable range for both the Upper Limit and the Lower Limit is 1 to 99 (default setting for the upper limit: 99; default setting for the lower limit: 1).

Point

When using the luminance output type head, the Control Mode is set to [MANUAL] and the control range Upper Limit and Lower Limit are both set to 50 by default. In order to obtain a grayscale image of uniform light intensity and a stable height image when using luminance output type heads, adjustments must be made with the Control Mode set to [MANUAL] and the control range Upper Limit and Lower Limit set to the same value as much as possible.

- **FB Target Area:** Sets what area of the capture element is to be used as reference for controlling the feedback of the light volume. The light intensity can be controlled to be more stable by limiting the FB target area to the locations that you want to measure.

Imaging Mode

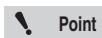
Imaging Mode

- Standard:** The received light quantity from the previous capture is fed back and the capture parameters for the next capture are adjusted. Select multi emission when measurement is not stable with the standard setting.



Depending on the CMOS Sensitivity setting, there are times when exposure time is subject to feedback processing and times when it is not. When exposure time is not subject to feedback processing, the time is fixed.

- Multi Emission (Synthesis):** Brightness is only changed the same number of times as the emission times for capture for one sample, and the profiles for each capture number are combined. Stable profiles can be generated even for objects that have a large difference in reflectance because profiles are combined from locations where the optimum received light quantity is received. The exposure time settings are ignored because the brightness is changed for capture.
- Multi Emission (Optimized Int.):** Capture is only performed for the number of emission times for one sample, and the profile is generated from the last capture results. Stable profiles can be obtained because the capture parameters are adjusted from feedback of the received light quantity for each capture count.



If you select multi emission, the fastest line scan frequency that you can set is slow.

Image Mask

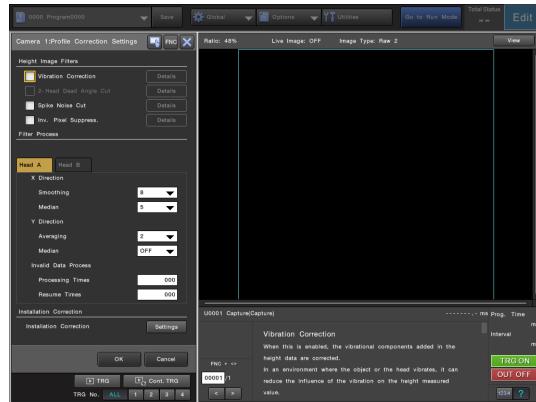
Light Reception Mask

Depending on the shape and surface conditions of the target workpiece and those of the environment where it is placed, multi-reflected laser light (stray light) may occur, and the correct profile may not be able to be obtained. By using the Light Reception Mask function and setting the mask area that disables peak detection, you can suppress the effect of stray light.

- You can set up to three mask regions for both the top and bottom.
- Select the mask region shape (rectangle or triangle) and then draw the mask region.

Profile Correction Settings

You can cancel data that is invalid due to dead zones and remove abnormalities with the smoothing filter for the captured profile. You can also correct the influence of vibrations on the conveyor or tilting at the time of installation.



Height Image Filters

Vibration Correction

If you want to correct the vibrational components added to the height data, select this check box and then select [Details]. Specify the correction conditions. In an environment where the workpiece or the sensor head vibrates, you can reduce the influence of vibrations on the height measurement value. You can also reduce the influence of eccentricity on rotating workpieces.

- Set Individually by Head:** If you want to set vibration correction settings for each sensor head individually, select this check box.
- Correction Type:** Select the processing type for vibration correction.
 - Plane (Z0):** Use the plane in the acquired data as a reference, and correct the vertical and rotational vibrations.
 - Plane (Z):** Use the plane in the acquired data as a reference and correct the vertical vibrations.
 - Uniform Section (Z):** Select this setting when there is no plane that can serve as a reference. Correct the vertical vibrations on workpieces, such as cables, where almost the same cross section continues.
- Allowable Range for Ref. Detection:** Specify the height range that will be allowed when detecting the reference for vibration correction. When it is made smaller, vibrations can be corrected more accurately. However, this will lead to the inability to correct when the curve of the reference plane and the vibrations become larger.
- Reference Line Count:** The number of lines that are vertically referenced during correction reference detection if [Uniform Section] is selected for the correction type.
- Correction Strength:** Specify the level of correction processing to apply to the detected vibration.
- Correction Reference Region:** Specify the region for detecting the reference to use in vibration correction.



If you use two correction reference regions, specify regions with the same height.

Capture (When Using an LJ-V Series Head)

2-Head Dead Angle Cut

If you use two sensor heads (head A and B) for measurement, you can create an image where the influence of dead angles is reduced or where noise components are reduced with both heads by generating a composite height image from the height images captured with both heads that were shifted by the correction value that was set in advance.

To generate a height image that is a composite of profile information from two directions, select the check box and then select [Details]. Specify the composite conditions.



- The 2-Head Dead Angle Cut function cannot be used with the XG-X2800LJ.
- The two heads, A and B, must be installed facing the scan direction and touching each other.
- As there are models in the LJ-V Series sensor heads range for which the center of the laser and the housing do not match, you must align the center of the sensor head laser with the scan direction. For more details, see the "XG-X2000 Series Setup Manual".
- **Set Detection Region:** Specify the part having common distinctive characteristics in the images captured by the two sensor heads.
- **Execute Calibration:** Calculate the correction value so that the characteristics in the range specified with the Set Detection Region settings overlap on the displayed image captured with the A and B heads.
- **Check Correction Values:** You can check and edit the correction value calculated with calibration.
- **Processing Type:** Select the method to combine the profiles from Head A and B.
 - **Noise Cut:** Reduce noise by eliminating the parts where the height difference of the measured values of Head A and B is large. This is effective for eliminating ambient light such as multiple reflections.
 - **Dead Angle Cut:** Reduces the influence of dead angles by mutually correcting the dead angle areas of the sensor with two sensor heads.
 - **Height Diff. Display:** Output the height difference of the measured values of Head A and B. This can be used to check the calibration precision when configuring settings.
- **Noise Judg. Threshold (mm):** Compares the height of Head A and B and judges as noise the pixels where the height difference is greater than the specified threshold value.
- **Use Grayscale Img. Also in Dead Angle Judgment:** Select this check box to use the grayscale image for dead angle judgment of noise pixels. When this setting is enabled, you can output stable and accurate height data for dead angle sections.

Spike Noise Cut

If you want to eliminate pixels (spike noise) with heights that stand out from the surroundings due to noise and other reasons, select the check box and then select [Details]. Specify the cut conditions.



The eliminated spike points become invalid pixels.

- **Specify Processing Direction:** To specify the processing direction, select the check box and then select the direction in the [Processing Direction] field.
 - **X:** Spike noises that continue in the vertical direction of the image are eliminated while spike points that continue in the horizontal direction are retained.
 - **Y:** Spike noises that continue in the horizontal direction of the image are eliminated while spike points that continue in the vertical direction are retained.
 - **XY Individual:** The cut size can be individually adjusted for each direction.
- **Cut Size:** Eliminates spike noises having a size width that is equal to or less than that specified.
- **Cut Threshold (mm):** Eliminates as noise the spike points that are more remote than the specified height relative to the surroundings.
- **Cut Target:** Select the type of spike points that are to be targets of elimination.
 - **Upper:** Eliminate only the spike points that are higher relative to the surroundings.
 - **Lower:** Eliminate only the spike points that are lower relative to the surroundings.
 - **Both:** Eliminate both spike points that are higher and lower relative to the surroundings.

Inv. Pixel Suppress.

If you want to interpolate height data estimated from valid pixel values surrounding invalid pixels for which height data was unable to be obtained, select the check box and then specify the suppression conditions.



Invalid pixel suppression does not affect the values of the valid pixels surrounding the invalid pixels.

- **Level:** Specify the level of the range to suppress invalid pixels (10 levels: 0 (no interpolation processing) to 9). The greater the level is, the wider is the range of invalid pixels that can be suppressed.
- **Adj. Width:** If you select [Small], the level of effectiveness will decrease but the degree of suppression of invalid pixels can be finely adjusted. With regard to the boundary between remaining invalid pixels and valid pixels, there is no interpolation when [Small] is selected, but when [Large] is selected, interpolation with an invalid pixel value of 0 is done (default setting value: [Small]).

Filter Process

Set this filter if a stable profile cannot be obtained due to the shape and surface conditions of the target workpiece.

Set Individually by Head

If you want to change filter processing by sensor head, select this check box.

X Direction

- Smoothing:** Select the number of points to perform shift average processing in the X direction on the profile data. Increase the setting value to reduce variability of the profile data.
- Median:** Select the number of points in the vicinity to use for median processing in the X direction of the profile data. Median processing is a process that uses the center value of nearby data values that have been arranged in descending order. Suddenly occurring abnormal data can be removed.

Y Direction

- Averaging:** Select the number of points to perform shift average processing in the Y direction on the profile data. Increase the setting value to increase the repeatability of the profile data.
- Median:** Select the number of points in the vicinity to use for median processing in the Y direction of the profile data.

 If you set the averaging setting value to 2 or higher or the median (Y direction) setting value to 3 or higher, invalid pixels occur at the start of capture.

Invalid Data Process

- Processing Times:** Specify conditions to cancel invalid data that suddenly occurs. The normal value directly before in the same X coordinate is held until invalid data continues to occur for the specified number of processing times in the Y direction.
- Resume Times:** Specify conditions to cancel normal values that suddenly occur during invalid data processing. Invalid data is held until normal values are continually acquired in the Y direction for the specified number of resume times.

Installation Correction

If you want to correct measurement errors caused by the place where the sensor head is installed or tilting of the target workpiece or the mounting on which the target is installed, select [Settings] and then specify the correction conditions.

Wide Combination

If you want to combine the height images from two sensor heads in the X direction and read as one image, select this check box. Adjust the settings in the [Invert/Offset] field if the combination section is misaligned.

 If you enable [Wide Combination], individual settings for filter processing will be cancelled.

Mirror Display

If you want to horizontally mirror the full height image acquired using the two sensor heads, select this check box.

Invert/Offset

- X direction**
 - Invert:** If you want to invert the height image in the X direction, select this check box. Enable this setting when the head is installed in the inverted direction. Images are inverted individually for each sensor head when there are two sensor heads.
 - Shift (only when two sensor heads are in use):** Specify the offset in the X direction to correct height image misalignment. This setting is used when the installation position of the sensor head is misaligned compared to the standard position or when the combined position in relation to the opposite sensor head is misaligned when using [Wide Combination].

Z Direction (only when two sensor heads are in use)

- Invert:** If you want to invert the profile in the Z direction, select this check box. Images are inverted individually for each sensor head.
- Shift:** Specify the offset in the Z direction to correct profile misalignment. This setting is used when the installation position of the sensor head is misaligned compared to the standard position or when the combined position in relation to the opposite sensor head is misaligned when using [Wide Combination].

Y Direction

- Invert:** If you want to invert the height image in the Y direction, select this check box. Enable this setting when the head is installed in the inverted direction. Images are inverted individually for each sensor head when there are two sensor heads.

Offset (only when two sensor heads are in use):

If you want to specify the offset in the Y direction to correct height image misalignment, select the check box and then specify the offset. This setting is used when the installation position of the sensor head is misaligned compared to the standard position or when the combined position in relation to the opposite sensor head is misaligned when using [Wide Combination]. The two sensor heads are individually offset.

 If you want to specify the offset for continuous capture, set the number of overlapping lines to a greater value than the Y direction offset.

Capture (When Using an LJ-V Series Head)

Tilt Correction

The angle of the true straight line is calculated from the measured data of tilt calculation area 1 and tilt calculation area 2. If you want to correct tilt errors in the X axis direction that occur due to tilting of the sensor head or target workpiece using a fixed value, select the check box, and then select [Settings]. Specify the correction conditions.

- Point** The range that you can perform tilt correction is -45° to +45°.

- Tilt Calculation Area:** Specify two locations for which you know the correct angle as Tilt Calculation Area 1 and 2.
- Update Reference Profile:** Obtain the latest profile data which will serve as the reference for calculation.
- Reference Profile Angle:** Displays the calculated tilt.
- Corrected Angle:** Specify the actual angle of the line. After entering the angle, select [Reflect Calculation Result], and then check the profile image displayed on the screen.
- Calculation Result:** Displays the difference between the actual angle and calculated angle.
- Reflect Calculation Result:** Sets the calculation result as the installation tilt correction angle.
- Installation Tilt Correction Angle:** The measured profile tilt is rotated and corrected by only the amount of the angle that is input.

Height Correction

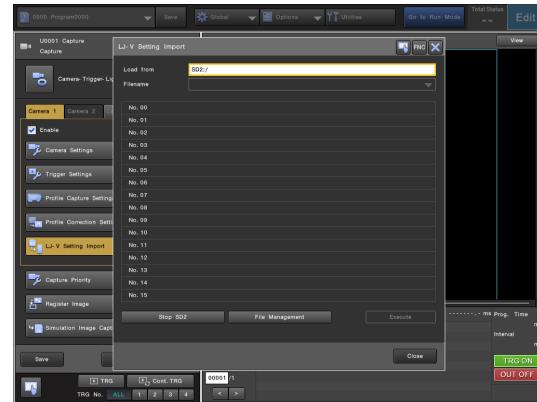
If you want to correct height errors in the Z axis direction that occur due to tilting of the sensor head or target workpiece using a fixed value, select the check box, and then select [Settings]. Specify the correction conditions.

- Point** The range that you can perform height correction is 0 to 2 times.

- Height Calculation Area:** Specify two locations for which you know the correct level difference as Height Calculation Area 1 and 2.
- Update Reference Profile:** Obtain the latest profile data which will serve as the reference for calculation.
- Reference Profile Height:** This is the level difference calculated from the difference of the average height of height calculation area 1 and height calculation area 2.
- Multiplying Factor Calculation:** Calculate the installation height correction factor from the reference profile height and entered corrected height.
- Corrected Height:** Specify the actual height of the level difference. After entering the height, select [Reflect Calculation Result], and then check the profile image displayed on the screen.
- Calculation Result:** Displays the difference between the corrected height and calculated height.
- Reflect Calculation Result:** Sets the calculation result as the installation height correction value.
- Installation Height Correction Factor:** Correct the height by multiplying the measured profile height by the factor that is specified.

LJ-V Setting Import

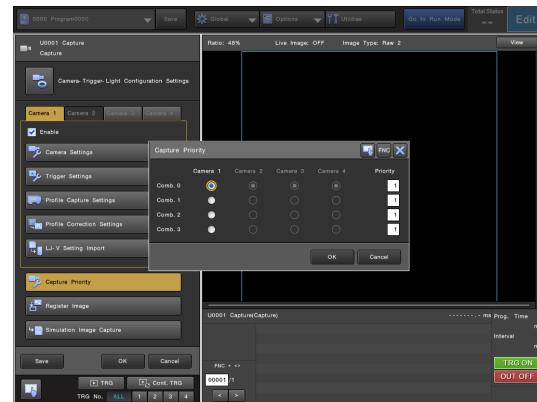
Load the LJ-V Series controller configuration file (MSS file) saved on the SD card and apply the content to the Capture unit settings.



Select the configuration file that you want to load in the [Load from] field, specify the target setting number, and then select [Execute].

Capture Priority

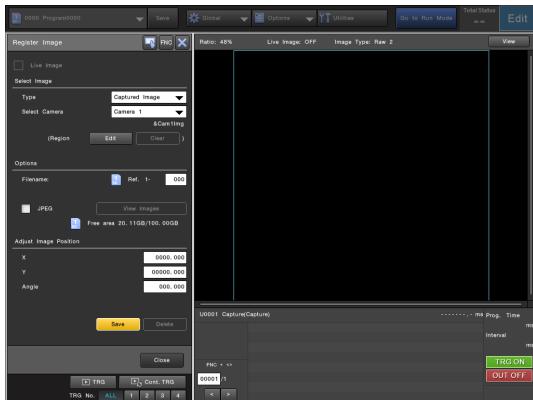
You can configure condition settings for the trigger input status that completes the Capture unit (moves to the next unit) with a priority level. Normally, the Capture unit ends when trigger inputs for all enabled cameras end, but you can also move to the next unit when the trigger input of the desired camera ends.



The settings are the same as for an area camera.
For more details, see "Capture Priority" (Page 2-34).

Register Image

Register the image to use as reference for measurement and setting.



The settings other than the [Options] are the same as for an area camera.

For more details, see "Register Image" (Page 2-34).



- When registering the height image only, the grayscale image will be deleted if a grayscale image is already registered for the corresponding registered image number.
- When you are using an LJ-V Series sensor head, you cannot register only grayscale images.
- When deleting a registered image, the registered height image and grayscale image will be deleted at the same time. It is not possible to delete only one of the images.

Options

No.

Specify the registered image number "(camera No.)-(specified No.)" to register the image to. The height image will be registered to the specified number (0 to 499). The grayscale image will be registered to the number that is the sum of the specified number and 500.



The saved file name is "ref(camera number)_(specified No.)" (for full screen image registration) or "ref(camera No.)(specified No.)_XXX_YYY" (for partial image registration).

JPEG

Check this option to save the registered image in JPEG format. If the option is not checked, the image will be saved as either a 24-bit color bitmap image (when a color camera, 3D camera or LJ-V Series head is used) or an 8-bit grayscale bitmap image (when a monochrome camera is used) in BMP format.



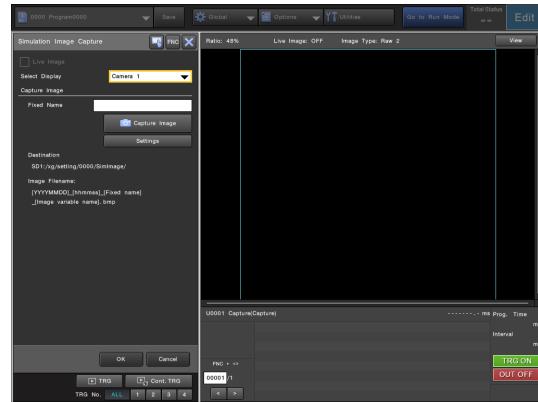
- Using image compression may result in some image deterioration, thus measurement results from a compressed image may be different from those when a non-compressed image is used.
- Using image compression on the height image will prevent you from obtaining correct height data due to image deterioration caused by the compression.

View Images

You can view all registered images in a list.

Simulation Image Capture

You can check camera images actually captured by the changed camera settings and save captured images on an SD card as an image file in the format that you specified in the output settings. This is handy for checking camera settings and saving image data for performing simulations on the XG-X VisionEditor.

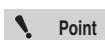


The settings are the same as for an area camera.

For more details, see "Simulation Image Capture" (Page 2-35).

Save

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.



- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. For example, variable values or the default display, such as the screen, changed in the current program can be excluded when saving.

Height Measurement

Height Measurement

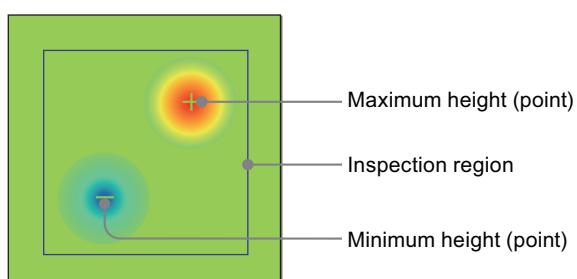
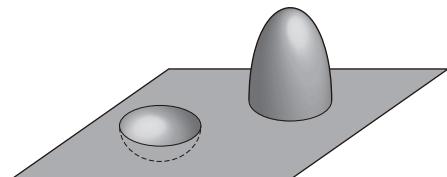
An inspection will be performed based on the height data acquired by the 3D camera or LJ-V series head. You can measure the minimum height, maximum height, convex/concave area, convex/concave volume etc. within the specified inspection region. By specifying not only the height from a virtual plane (reference plane) that passes through the position corresponding to the reference distance of the camera or sensor head, but also the desired plane on the screen as the [Zero Plane], you can achieve an extremely flexible program.

- Point
 - The height measurement unit cannot be used with the XG-X2800LJ.
 - The following setting is necessary to perform 3D measurements accurately (normally, there is no need to modify the settings as correct settings are configured by default).
 - Select [ON] or [ON (fast)] in [XY Normalization] for the 3D imaging settings of the capture unit (Page 8-17).
 - For 3D cameras, use a calibration plate then after implementing 3D calibration (Page 4-19), specify the scaling factor which supports the camera which is connected via "Scaling Settings" (Page 8-165).
 - Enable [Scaling] in the [Parameters] screen (Page 8-165).
 - When you select [Contrast Image] as the image type on the height measurement unit, the height distribution based on the zero plane will be displayed.

Reference

Also refer to "Height Measurement" (Page 8-3) regarding height measurement.

Image of the Measurement

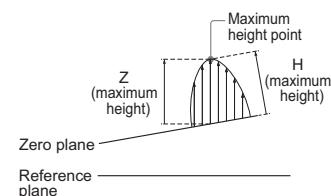


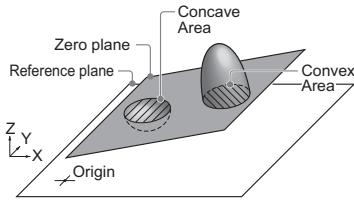
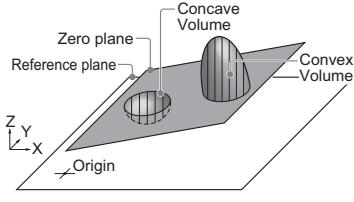
Measurement results

The measurement results output by the height measurement are as follows.

Zero Plane Information	Outputs the X/Y slopes and Z intercept of the calculated zero plane. [Origin], [Scaling], and [Coordinate Value] in [Parameters] will be reflected on the measured values (MS) of the zero plane.
Best Fit Plane Information	Outputs the X/Y slopes and Z intercept of the minimum square plane calculated from the captured image in the inspection region as the best fit plane. The measured value (MS) for the detected plane is a value that reflects [Origin], [Scaling], and [Coordinate Value] in [Parameters].
Count	Outputs the number of regions containing valid pixels in the case when two or more inspection regions have been set. Tolerance Judgment Target
Valid Inspection Region Count	Outputs the number of measurement target regions. Of the region count and detection count parameter settings, the smaller value will be the valid inspection region count.
Max. Height/Min. Height (X, Y, Z, H) []	Outputs the position coordinates of the maximum height point/minimum height point in the inspection region in full-scale values (mm or μm). Tolerance Judgment Target Label Specification Target <ul style="list-style-type: none"> • Outputs two types of values (Z and H) as the height measurement result. • Z is the height of the reference plane in the normal direction; and H is the height of the zero plane in the normal direction. • The height in the Z direction consists of measured values based on the zero plane (Z: MS) and the absolute measured value based on the reference plane (Z: AB).

- Maximum height/minimum height points are defined using the height in the Z direction based on the zero plane.
- Maximum height H/Minimum height H is the height in the H direction of the maximum height point/minimum height point.

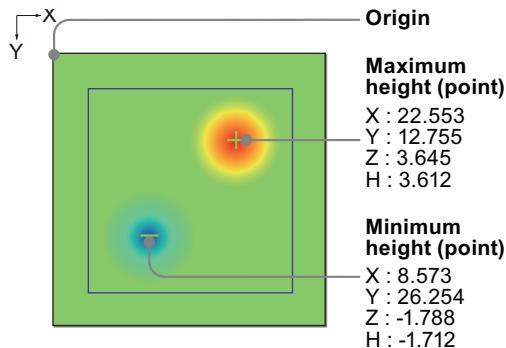


Ave. Height (X, Y, Z, H) []	Outputs the position coordinates of the average height point in the inspection region in full-scale values (mm or μm). Tolerance Judgment Target Label Specification Target
	<ul style="list-style-type: none"> XY coordinates of the average height will be the center coordinates of the bounding rectangle of the inspection region. The value of average height Z/H will be the average value of height Z/H within the inspection region.
Standard Deviation (Z, H) []	Outputs the standard deviation of the Z and H height in the inspection region. Tolerance Judgment Target Label Specification Target
Valid Pix. Count []	Outputs the number of valid pixels in the inspection region. Tolerance Judgment Target Label Specification Target
Convex Area/ Concave Area []	Outputs the convex area/concave area in the inspection region in a full-scale value (mm^2). Tolerance Judgment Target Label Specification Target <ul style="list-style-type: none"> A concave area is an area on the zero plane occupied by the section lower than the zero plane (opposite side of the camera). A convex area is an area on the zero plane occupied by the section higher than the zero plane (camera side). 
Convex Volume/ Concave Volume []	Outputs the convex volume/concave volume in the inspection region in a full-scale value (mm^3). Tolerance Judgment Target Label Specification Target <ul style="list-style-type: none"> Of the space enclosed by the group of detected points and the zero plane, the concave volume is the volume of the section lower than the zero plane (opposite side of the camera) in an actual size value. Of the space enclosed by the group of detected points and the zero plane, the convex volume is the volume of the section higher than the zero plane (camera side) in an actual size value. 
Unit judgment value	When the measurement result is outside the specified tolerance range (between the upper and lower limits), it is judged as [NG]. When the result is within the tolerance range, it is judged as [OK].

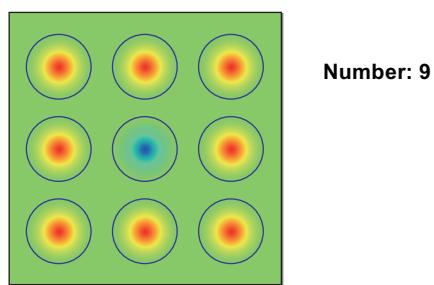
 **Reference** For the lists of available measurement output values and setting parameters, refer to "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Measurement sample

Example: When the inspection region is a rectangle

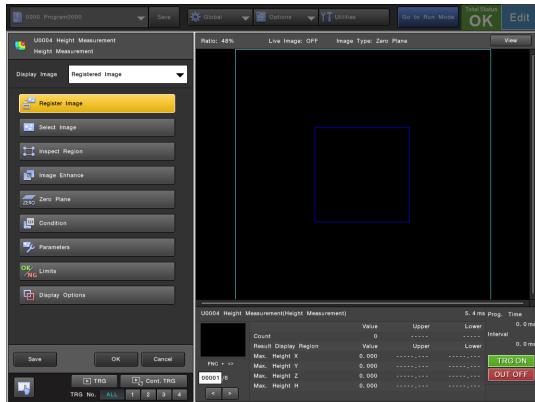


Example: When the inspection region is an array-specified region (Shape: Circle, Number: 9)



Top Menu

The top menu of the Height Measurement unit consists of the following options. Configure settings under each option as required for the inspection.

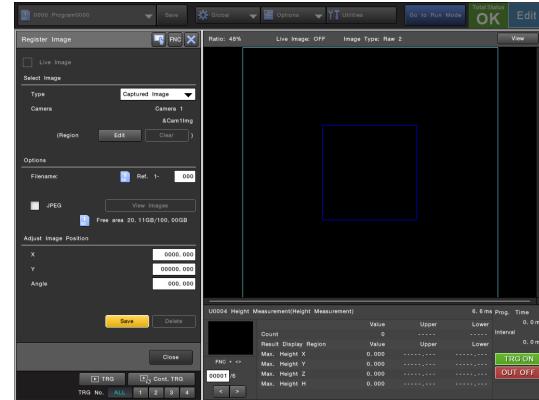


Measurement Using 3D-compatible Cameras

Register Image (Page 8-38)	Register the image to be used as reference for measurement and setting as the Registered Image.
Select Image (Page 8-40)	Specify the registered image and captured image to be used as reference for the measurements and settings.
Inspect Region (Page 8-41)	Outline the region on the captured image to be used for measurement.
Image Enhance (Page 8-42)	Specify the filter processing to apply to the image.
Zero Plane (Page 8-43)	Use this setting if you wish to set a plane with a different height/slope than the reference plane as the reference for measurement.
Condition (Page 8-44)	Define the detection target for height measurement.
Parameters (Page 8-45)	Specify the other conditions that can be specified for height measurement as needed.
Limits (Page 8-46)	Set the tolerance (upper and lower limits) settings for the measured value.
Display Options (Page 8-47)	Specify the inspection region and mask region display settings.
Save (Page 8-48)	The present state is saved to the program file.

Register Image

An image can be saved to the controller to be used as a template for measurements and settings. It is recommended to adjust lighting and other conditions completely before registering an image.



Live Image (only when using 3D cameras)

Check this box to display the latest images through a continuous feed.

Point

- [Live Image] is not available when the LJ-V series head is being used.
- [Live Image] is only available while the unit is being edited.
- When [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings], this cannot be changed.
- When configured to not wait for triggers in [Trigger Settings], this check is always cleared and cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is on, the live image is applied even if the capture unit is not running if the unit being edited is the capture unit that was recently run.
- [Live Image] cannot be used if image capture using an area camera is enabled.
- The image variable used for the captured image of the measurement unit should be the same as the destination image variable used for the capture unit being executed (waiting for a trigger). When the image capture buffer is set to enabled, the destination image variable of the capture unit executed most recently will be the subject of comparison.

Select Image

Type

Select an image to register.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** The registered image specified under [Options] is displayed.

Region

To register a portion of the image, select [Edit] and specify the area you wish to register.

Options

Height Image

Specify the registered image number “(camera No.)-(specified No.)” to register the image. The height image will be registered to the specified number (0 to 499).

Point

- The saved file name is “ref(camera number)_(specified No.)” (for full screen image registration) or “ref (camera No.)_(specified No.)_XXX_YYY” (for partial image registration).

Grayscale Image

The grayscale image is registered as a registered image of a number which is the sum of 500 and the number specified for [Height Image].

JPEG

Check this option to save the registered image in JPEG format. When this box is not checked, the image will be saved in BMP format as either a 24-bit color bitmap image (when a color camera, 3D camera or LJ-V series head is used) or an 8-bit grayscale bitmap image (when a monochrome camera is used).

Point

- Using image compression may result in some image deterioration, thus measurement results from a compressed image may be different from those when non-compressed image is used.
- Using image compression on the height image will prevent you from obtaining correct height data due to image deterioration caused by the compression.

View Images

You can view all registered images in a list.

Adjust Image Position

Adjust the position of the image being captured.

X

X (horizontal) adjustment between -8191.000 and 8191.000 pixels.

Y

Y (vertical) adjustment between -16383.000 and 16383.000 pixels.

Angle

Adjust the position to the θ angle (rotation) around the center of the image between -999.999° and 999.999° .

Point

- When [Captured Image] is selected as the [Type] and a [Position Adjustment ID] is selected in [Inspect Region] (Page 8-41), [Pos. Adjust. value] can be selected in addition to [Number Input]. This option is useful because even when the image capture position deviates, the current image is automatically adjusted using the adjustment value based on the reference unit. However, note that when [Pos. Adjust. value] is selected in the state where a proper adjustment value cannot be measured for the current image, the position used for registration may be incorrect.
- Position adjustment may cause missing peripheries (black areas) due to image movement or jagged edges (jaggies) due to rotation in the registered image, or expansion of invalid pixels with no height data.

Save

Save the displayed image as a registered image under the conditions specified in the [Register Image] screen.

Point

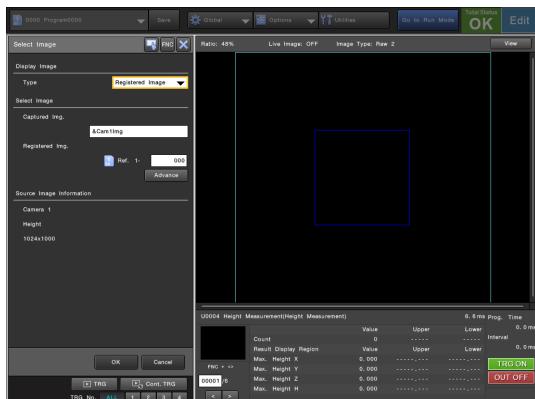
- The image cannot be registered if [Live Image] is enabled. Please stop live image update first before executing.
- When registering the height image only, the grayscale image will be deleted if a grayscale image is already registered for the corresponding registered image number. Note that the same applies when registering the grayscale image only.

Delete

When [Registered Image] is selected for [Type], you can delete the registered image specified under [Options].

Select Image

Specify the registered image and captured image to be used as reference for the measurements and settings.



Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** The registered image specified under [Select Image] is displayed.

Select Image

Captured Image

Set an image variable to be used as the captured image for the unit.

Registered Image

Specify the registered image number for the registered image to be used.

- The registered images of height images are managed as "ref (Camera No.)-(registered image number 0 to 499)". In addition, the number where 500 is added to the registered image number of the height image will be the registered image number of the corresponding grayscale image.
- The camera number is fixed to that of the camera of the image variable specified in the [Captured Image] field.

Advance

Set advanced options for the switching of registered images as necessary.

- Use numerical variable for registered image No.:** To use a variable to specify the registered image number to be switched to for the unit, check this box and then assign a numerical or numerical array type variable as a destination to be referenced. By using a variable for the registered image number and then issuing a variable reference value apply command (NU), the image is switched to the specified registered image in the variable and the image reference information is updated. For details, refer to the XG-X2000 Series Communications Control Manual.

- Process variable when changing programs:** Check this option to switch to the registered image specified with the Numerical variable (variable initial value) when the program is changed or the system is next powered up.



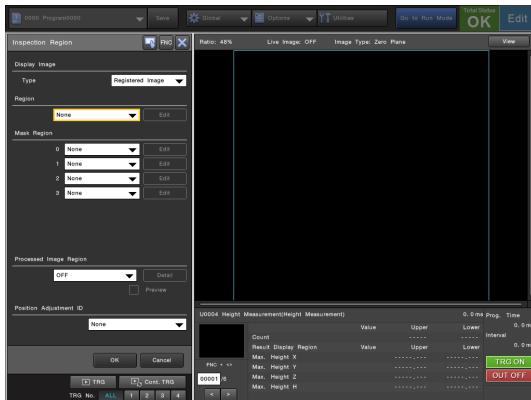
Note that the registered image number does not switch in synchronization with a change in the variable value.

Source Image Information

The camera number, image type, and resolution of the camera corresponding to the image variable specified for the captured image will be displayed.

Inspection Region

Outline the region on the captured image to be used for measuring.



Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** The registered image is displayed.

Region

Select a shape for the inspection region and then draw the region, or select [Edit] and specify the region with numerical values.



You can configure multiple regions by selecting [Array-specified] (Page 8-42). As opposed to [Composition] region, you can perform measurements for each region and output their results independently.

Mask Region

A mask region is an area which can be defined in the inspection region and will be excluded from the inspection. Up to four mask regions can be set per inspection region. A mask region is typically used for hiding an area that does not require inspection.

Select a shape for the mask region and then draw the region, or select [Edit] and specify the region with numerical values.



If you want to define a complex region which can not be set through the available masks, draw an inspection region as a composition region.

Processed Image Region

To use a processed region based on a resultant image variable, select [ON] and then select [Detail] for configuration.



Refer to "Generating a Region from an Image (Processed Image Region)" (Page 2-482) for more details on processed image region.

Image

Specify the resultant image variable used for the processed image region.

Area

Select the areas to set as the inspection region from the image data in the resultant image variable by selecting either [Black] (Level 0) or [White] (Level 255, default).

Preview

When this box is checked, the specified resultant image variable is displayed. When the checkmark is removed, the display returns to its normal state.



It cannot be used when [Array-specified] is selected as the inspection region.

Position Adjustment ID

To apply position adjustment to the region, select the position adjustment unit to be referenced.



The position adjustment is applied to the inspection, mask, processed image, zero plane, and zero plane mask regions.

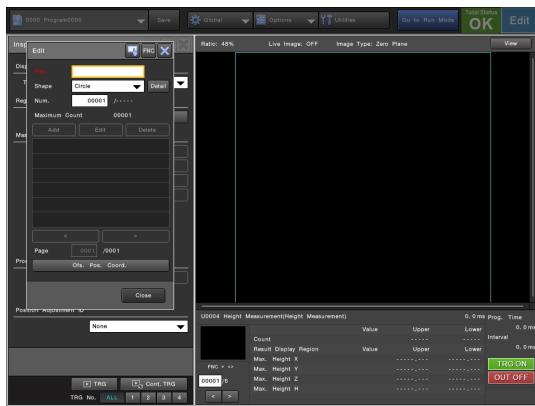
Height Measurement

Specifying two or more inspection regions with the same shape at the same time (Array-specified region)

By selecting [Array-specified] in [Region], two or more measurement regions with the same shape can be specified as the inspection region at the same time. Each region is specified using a position type array variable.

Point

- Array-specified regions can only be used in the height measurement unit.
- If [Array-specified] is selected as the inspection region and the result held for each region is set as the statistics analysis target, the result of the region specified under [Result Disp. Reg. #] (Page 8-46) in the judgment conditions will be subject to statistics analysis.



Pos.

Specify a position type array variable.

Shape

Specify the shape of the region. By selecting [Detail], you can specify the radius of the circular region (if [Circle] is selected in [Shape]) or the width, height and angle of the rectangle (if [Rotated Rect] is selected in [Shape]).

Point

The size of each region can be specified individually by assigning a numerical array type variable to each item with the index in empty state (e.g. #A[]). To make an index empty, select a [Variable] in the [Reference Variable] menu and specify [*] for the index.

Num.

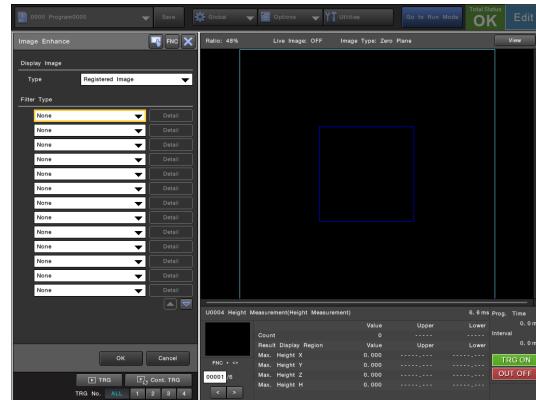
Specify the number of regions using an array count (Max. 10000).

Ofs. Pos. Coord.

Specify the position (position type variable) and the offset amount for X and Y coordinates when setting the XY offsets together to the array-specified region.

Image Enhance

Specify the filter processing to apply to the image.



Display Image

Type

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** The registered image is displayed.

Filter Type

Select the [Filter Type] field and then select the filter to apply.

- **None:** Image enhancement is not used.
- **Average:** This process smoothes and stabilizes the height variations that occur on the plane in a wave-like pattern. It also interpolates invalid pixels by applying the average value of the surrounding pixels. The filter application size (default: 3x3; or 5x5 for a bigger processing area) and the count (0 to 9, where 0 turns the filter off) can be configured.
- **Median:** It has the effect of eliminating abnormal height values that occur in the form of spike-like noise by applying the median of the surrounding pixel heights to the center pixel. The filter application size (default: 3x3; or 5x5 for a bigger processing area) and the count (0 to 9, where 0 turns the filter off) can be configured.
- **Gaussian:** This process reduces noise by applying heavier smoothing on pixels closer to the center. You can obtain a more natural blur compared to [Average], but the noise reduction effect will be weaker. The filter application size (default: 3x3; or 5x5 for a bigger processing area) and the count (0 to 9, where 0 turns the filter off) can be configured.

- Smoothing:** This image enhancement is equivalent to [Average], but you can obtain a stronger smoothing effect by increasing the filter size. You can set the filter size (3 to 127) and the count (0 to 9, where 0 turns the filter off). In addition, by using [Border], you can select whether to perform smoothing at the boundary of the region by referring to height information outside the region or by considering them to be of the same height as the region boundary part.
- Inv. Pixel Suppress.:** This option suppresses invalid pixels by interpolating invalid pixels without height data with the height data estimated from the surrounding valid pixels. Invalid pixel suppression does not affect the values of valid pixels around the invalid pixels. [Level] (1 (default) to 9), [Adj. Width] (Small (default), Large) and [Count] (0 to 1, where 0 turns the filter off) can be configured. The greater the level and the larger the adjustment width, the wider the range of invalid pixels that can be suppressed.
- Spike Noise Cut:** Eliminates pixels (spike noise) whose heights spike out from the surroundings due to noise, etc. The processing direction and [Cut Size] (eliminates spike noise which is equal to or below the specified size width), [Cut Threshold] (eliminates spike points which stray from the specified height in relation to the surrounding as noise), and [Cut Target] can be specified. Specify the [Cut Size] from 2 - 30 (default setting value: 4), the [Cut Threshold] (mm) from 0.000 - 99.999 (default setting value: 0.050), and the [Cut Target] as Upper or Lower or Both (default setting value: Upper).

Point

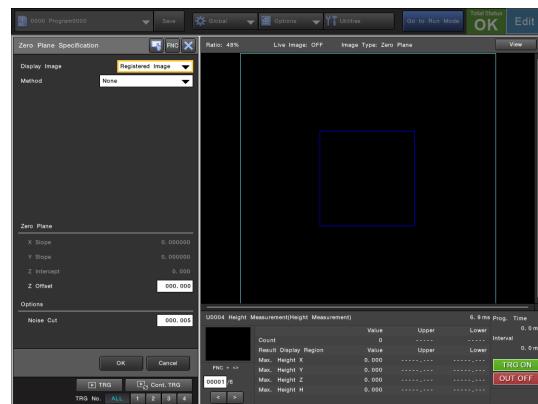
- When multiple filters are set, they are processed one by one from the top.
- Spike points which are eliminated via the spike noise cut filter become invalid pixels.
- Invalid pixels are pixels that do not contain height information as a result of failure to obtain the height during capture or due to unreliable measured values.

Reference

With a filter selected in the [Filter Type] field, if you move the 8-way key up and down while holding the No. 1 (FUNCTION) key on the console, you can change the filter application order.

Zero Plane

Use this setting if you wish to set a plane with a different height/slope than the reference plane as the reference for measurement.



Point

- The zero plane is configured separately for each height measurement unit.
- [Zero Plane Specification] corrects the height but not XY directions.
- If you have selected [Zero Plane Specification], [Zero Plane] can be specified as the display image type. The zero plane image will show the height distribution based on the zero plane.

Display Image

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** The registered image is displayed.

Method

Choose the method for specifying the Zero plane according to the measurement purpose and target.

Specifiable Zero Plane

	Changes According to the Captured Image	Does Not Change According to the Captured Image
Plane Parallel to Reference Plane	Region (Ave. Height)	None
Arbitrary Plane	Region (Best Fit), 3 Points (Real-Time)	-
Free-form Plane	Free-form Plane	-

* The zero plane can also be specified by referring to result data (From Result Data) or by specifying values (User Specified).

- None** (Default): Specify the reference plane as the zero plane.
- Region (Best Fit):** The least square plane calculated using the 3D information of the captured image within the specified region will be used as the zero plane.
- Region (Ave. Height):** The zero plane will be the plane that is parallel to the reference plane whose Z intercept is the average Z value of the captured image in the specified region.

Height Measurement

- 3 Points (Real-Time):** The plane calculated using the 3D information of the captured image at the specified three points will be used as the zero plane.
- Free-form Plane:** This method uses the curved plane estimated based on the extract size and the extract direction as the zero plane. When [Border] is turned ON, images outside of the region are also referenced and processed.
- From Result Data:** Enter a plane type variable into the [Plane] field or directly specify and reference the zero planes, height extract planes, detected planes, etc. of other units. Selecting [Input Assistant] opens a menu in which the result data of other units can be selected easily.



If the reference unit itself refers to the result data of another unit, the setting will result in an error.

- User Specified:** Specify the zero plane by specifying the values for the XY direction slopes and Z intercept.



- The XY slopes are specified using the slope amount per pixel in the Z direction (mm/pixel).
- When specifying variable reference of a plane type variable, specify the absolute measured value (AB) for the plane to be substituted into the variable. Planes that have been adjusted using position adjustment or scaling will not be converted properly.
- When [Free-form Plane] is selected, [Best Fit Plane] in the condition settings will be fixed to OFF.
- When [Free-form Plane] is selected, reducing the extract size will increase the responsiveness to steeper curved surfaces, enabling extraction of finer irregularities (however, the processing time will be longer).

Z Offset

Specify the offset value for the Z axis direction for the zero plane.

Noise Cut

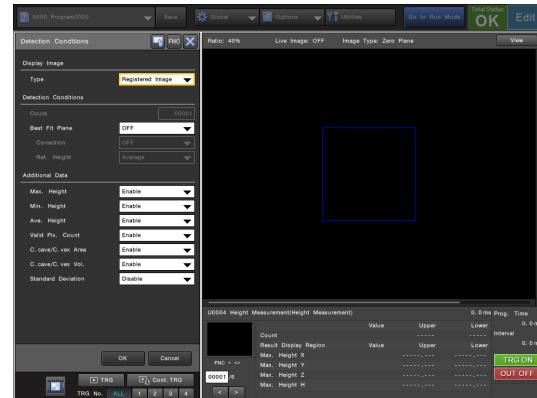
The range in which the height from the zero plane is equal to or lower than the specified value will be removed as noise (Default: 0.005).



- The sections that have been removed as noise will be included in the valid pixel count, but they will be ignored when measuring the convex/concave area and convex/concave volume.
- The unit for the noise cut setting value is the unit specified in "Height Unit" (Page 8-46).

Conditions

Define the detection target for height measurement.



Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** The registered image is displayed.

Detection Conditions

Count

Specify the number of measurement target regions for height measurement if [Array-specified] has been selected as the inspection region.



- The maximum count that can actually be configured will vary depending on the settings.
- The count may be fixed and cannot be changed in some settings.

Best Fit Plane

If this is switched ON, only when the array-specified region is set via the inspection region shape, a representative XYZ coordinate is extracted from each of the multiple regions and the plane is detected from that group of points using the least squares method.

- Correction:** Diminishes the noise effects when detecting the plane (default setting: OFF (0)). If noise information is included in the point group inside the inspection region, the plane that is detected might end up being greatly deformed due to their effects. By switching the deformation correction to "ON" (1) and eliminating the noise from the calculations of the best fit plane, the effects might be able to be diminished.

- **Ref. Height:** Specifies the point that is to represent each region when detecting the best fit plane via array-specified regions.
 - **Average:** Assumes the average height inside the region to be the height of the representative point. The XY coordinates are the region's center coordinates.
 - **Maximum:** Assumes the point of the maximum height inside the region to be the representative point.
 - **Minimum:** Assumes the point of the minimum height inside the region to be the representative point.

Additional Data

Define the detection target for height measurement.

Max. Height

To detect the maximum height in the inspection region, select [Enable] (Default).

Min. Height

To detect the minimum height in the inspection region, select [Enable] (Default).

Ave. Height

To detect the average height in the inspection region, select [Enable] (Default).

Valid Pix. Count

To detect the valid pixel count in the inspection region, select [Enable] (Default).

C. cave/C. vex Area

To detect the concave/convex area in the inspection region, select [Enable] (Default).

C. cave/C. vex Vol.

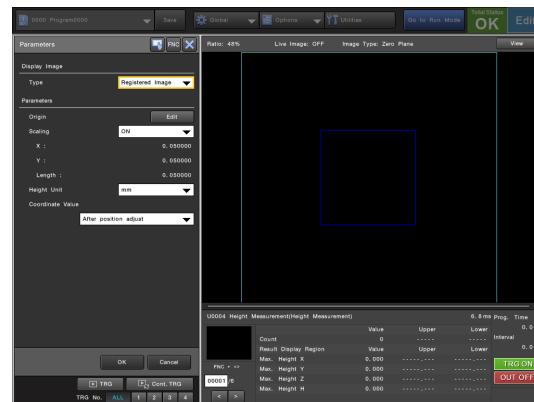
To detect the concave/convex volume in the inspection region, select [Enable] (Default).

Standard Deviation

To detect the standard deviation of the Z and H height in the inspection region, select [Enable].

Parameters

Specify the other conditions that can be specified for height measurement as needed.



Display Image

Type

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** The registered image is displayed.

Parameters

Origin

By default, the origin is set to the top left point of the camera but you can specify its position as required. To specify the origin, select [Edit] and then input the coordinates.



The origin can be set outside the processing region. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Scaling

The controller processes image data in pixels internally. However, you can convert the result data and setting parameters used for on-screen display, judgment and calculation to actual dimension values (This process is called "scaling"). You can perform accurate 3D measurements using the height measurement unit by enabling scaling with the scaling values set for the connected 3D camera or LJ-V series head.

- **OFF:** Do not use scaling.
- **ON** (Default): Use scaling.



- The scaling correction value can be changed with the [Options] menu of the Flowchart Editor (Page 4-18).
- For details on the list of results data that supports scaling, see "List of Setting Parameters/Result Data" in the XG-X2000 Series Communications Control Manual.

Height Measurement

Height Unit

Select the unit for the measurement results in the height direction from [mm] (Default) or [μm].

Point

- The display units for area and volume will be mm^2 and mm^3 , respectively, even if μm is specified as the height direction unit.
- If you have selected μm as the height direction unit, the unit of [Noise Cut] (Page 8-44) will also be μm .

Coordinate Value

Select the coordinate value to be used after position adjustment. If position adjustment is not used, this setting will have no effect on the measurement.

- After position adjust** (Default): The inspection uses the adjusted coordinate value determined after position adjustment.
- Before position adjust**: The distance from the position specified for the [Origin] of the inspection will be measured.

Region Update Mode

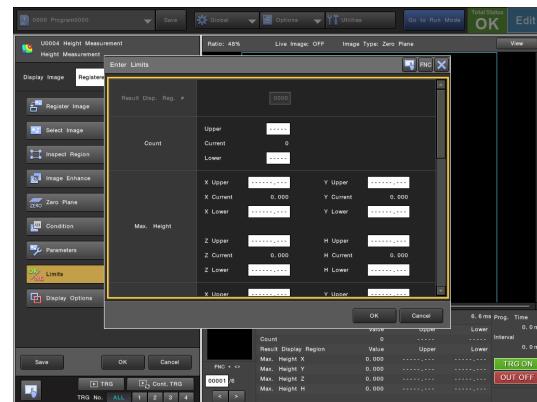
Select whether to recalculate the region information for each measurement when [Array-specified] is selected as the inspection region.

- Update Each Process** (Default): You can recalculate the region information for each measurement. Even if the value of the array variable referenced in the array-specified region setting changes, measurement will always be performed on the region that is calculated using the values at the time of measurement.
- Update by User**: Faster processing compared to the [Update Each Process] setting is achieved by omitting the recalculation of the array-specified region information during measurement (The size and number of regions that can be configured are limited by the amount of available work memory). Updates to the region information made by the set array variable are reflected on the image processing by issuing the recalculation command for the image reference information (RU) in the desired timing. For details, refer to the XG-X2000 Series Communications Control Manual (You can also recalculate the region information by executing [Update Registered Image Information]).

Limits

Set the pass / fail tolerance (upper and lower limits) settings for the measured value.

When the measurement result is outside of the specified tolerance range, it is judged as [NG]. When the result is within the tolerance range, it is judged as [OK].



Use [Direct Input] to enter a value and set the tolerance.

Point

- [----] indicates an empty state where no tolerance is set. In this state, judgment will not be performed after the measurement.
- To reset the tolerance setting to an empty state, select [Clear]. Select the desired tolerance and then enter a value.

Result Disp. Reg.

In the [Limits] dialog, select the region number of which you wish to display the current value when [Array-specified] is specified as the inspection region.

The region corresponding to the number selected here will be displayed using the line thickness and color configured in [Result Display Region] in the [Display Options].

Count

Set the tolerance for the number of regions in which valid pixels exist.

Max. Height

Set the tolerance of the maximum height.

The unit of tolerance of Z and H is the unit specified in [Height Unit] in the [Parameters] menu.

Min. Height

Set the tolerance of the minimum height.

The unit of tolerance of Z and H is the unit specified in [Height Unit] in the [Parameters] menu.

Ave. Height

Set the tolerance of the average height.

The unit of tolerance of Z and H is the unit specified in [Height Unit] in the [Parameters] menu.

Valid Pix. Count

Set the tolerance for the number of valid pixels.

The unit of tolerance is the [Pixel Count] (0 to 99999999) of the measurement area.

Concave Area/Convex Area

Set the tolerance for the area.

The unit of tolerance is mm².

Concave Volume/Convex Volume

Set the tolerance for the volume.

The unit of tolerance is mm³.

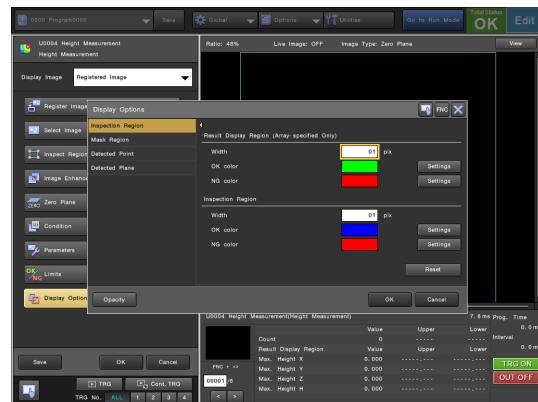
Standard Deviation

Set the tolerance for the Standard Deviation.

Display Options

Specify the inspection region and mask region display settings.

The display color can be changed based on the judgment result for that unit. The visual indicator can also be made transparent by selecting [Settings] - [Select Color] - [None].



Inspection Region

Specify the line thickness and display color of the inspection region and the region of the result display region number specified in the [Limits] dialog.

Mask Region

Specify the line thickness and display color of the mask region.

Detected Point

Specify the size and display color of the points detected as the maximum/minimum heights.

Detected Plane

Specify the display/non-display, display color, and whether to display in the foreground the plane that was detected.

Reset

Returns the display options to their defaults.

Opacity

This function can be used to change the opacity of this dialog so that what is going on in the background can be seen.

Save

The present state is saved to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

Point

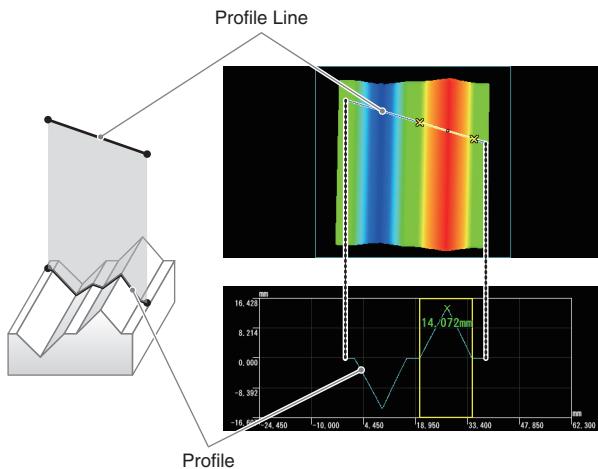
- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. For example, variable values or the default display, such as the screen, changed in the current program can be excluded when saving.

Profile Measurement

Profile Measurement

An inspection will be performed with the height data acquired by the 3D camera or LJ-V Series sensor head. The height of an arbitrary point, the distance between arbitrary points, the angle of an approximate line or radius of an approximate circle obtained by specifying a region, the cross-section area surrounded by the profile and approximate line, etc. can be measured in the cross section of the height image (profile) designated by the position of a line or circle specified on the height image.

In addition to height inspections from virtual planes (reference plane) that pass through the position that corresponds to the camera or sensor head reference distance, specifying a desired plane on the screen as the [Zero Plane] can increase inspection flexibility.



Point The profile measurement unit cannot be used with the XG-X2800LJ.

Image of the Measurement

A profile measurement specifies what measurement target is to be measured using which profile measurement setting in what measurement range with regard to the profile obtained from the height image.

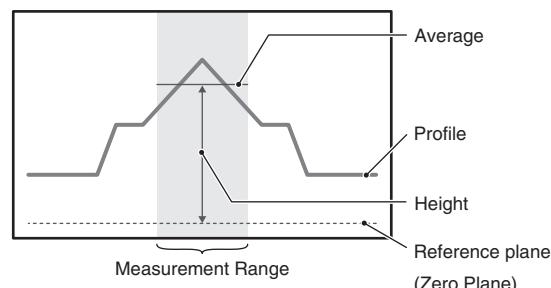
For example, the following measurement targets can be selected in the [Height] profile measurement settings: [Average], [Peak], [Bottom], [Inflection Point], [Two Lines Intersection], [Circle/Line Intersection], [Center of Circle], and [Distance to Reference Line].

A measurement range can be specified directly on the profile or by using the measurement result of other profile measurements, and so on.

Profile Measurement Setting Types

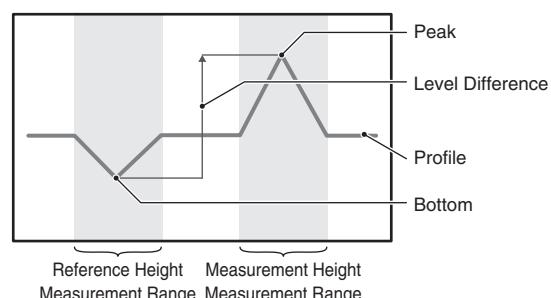
- Height

Example: Measurement Target: Average



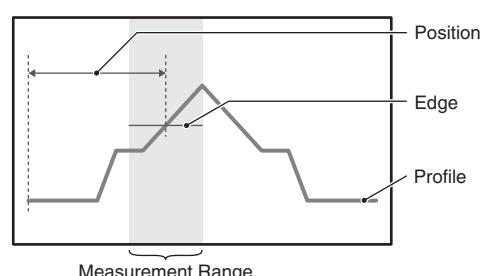
- Level Difference

Example: Measurement Target: Reference Height : Bottom, Measurement Height: Peak



- Position

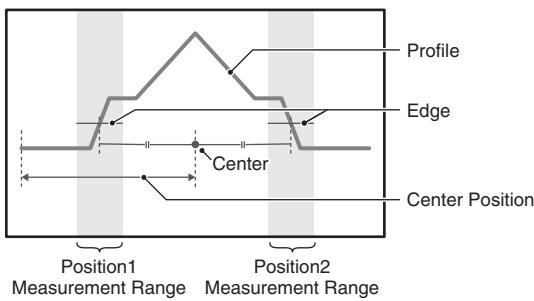
Example: Measurement Target: Edge



Profile Measurement

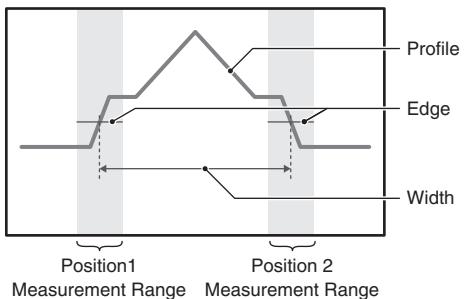
- Center Position

Example: Measurement Target: Position1/2: Edge



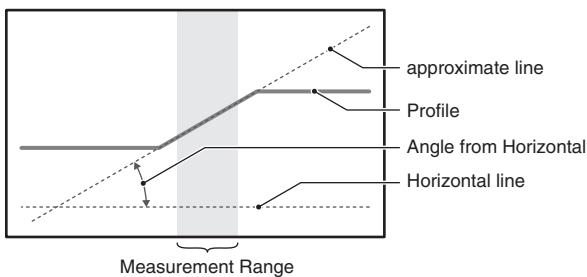
- Width

Example: Measurement Target: Position1/2: Edge



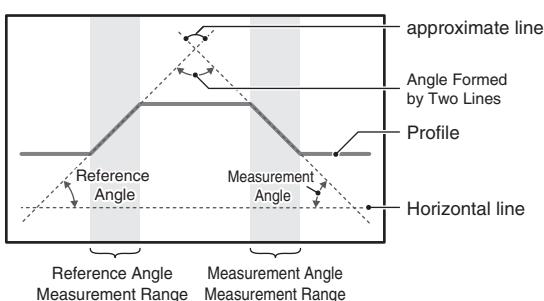
- Angle from Horizontal

Example: Measurement Target: Line



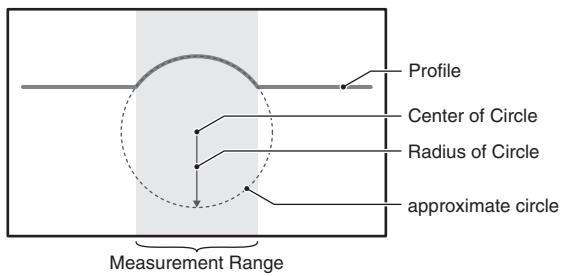
- Angle Formed by Two Lines

Example: Measurement Target: Reference Angle/
Measurement Angle: Line



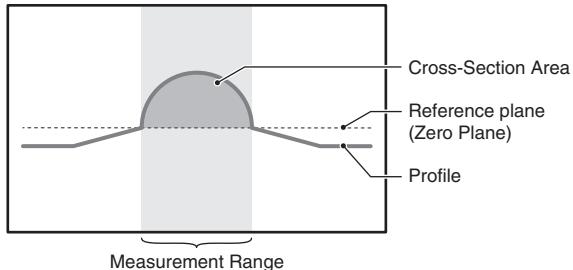
- Radius of Circle

Example: Measurement Target: Center of Circle



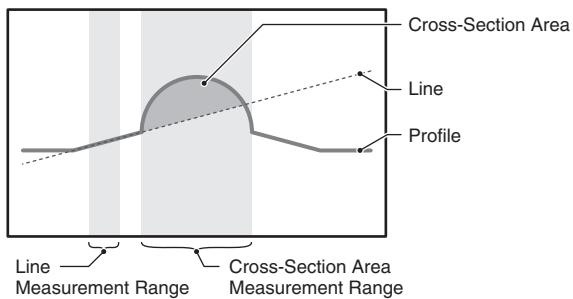
- Cross-Section Area

Example: Measurement Target: Cross-Section Area



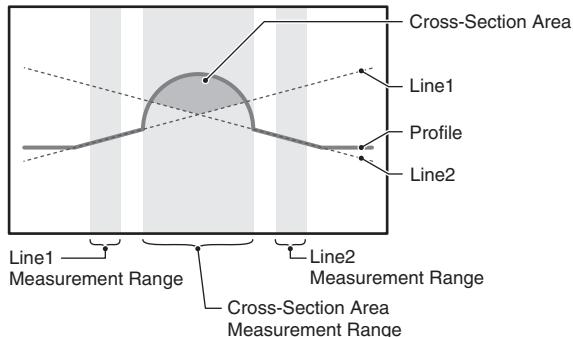
- 1-Line Cross-Section Area

Example: Measurement Target: Line, Cross-Section Area



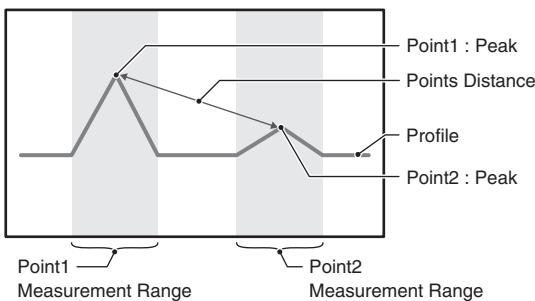
- 2-Line Cross-Section Area

Example: Measurement Target: Line, Cross-Section Area



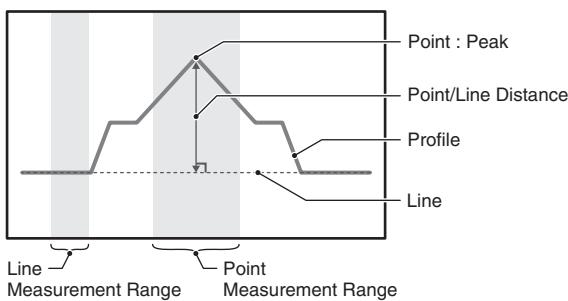
- Points Distance

Example: Measurement Target: Point 1/2: Peak



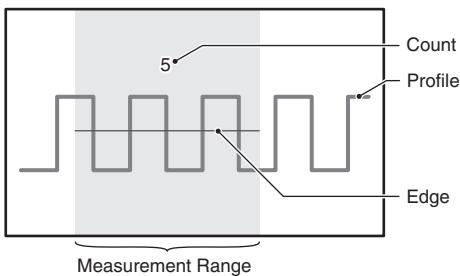
- Point/Line Distance

Example: Measurement Target: Point: Peak, Line



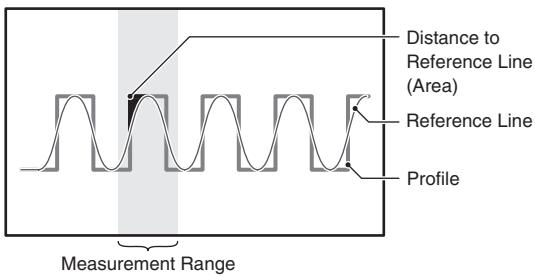
- Count

Example: Measurement Target: Edge



- Defect Detection

Example: Measurement Target: Distance to Reference Line

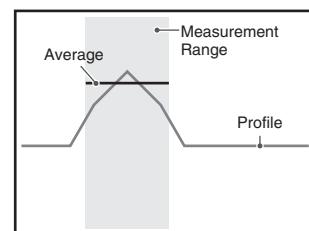


Measurement Target Type

The measurement target includes the following types.

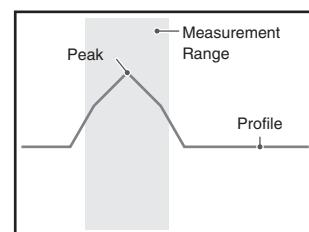
- Average

Measures the average position/height of the profile in the measurement range.



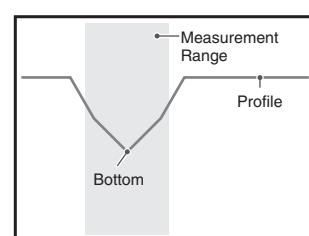
- Peak

Measures the highest position/height of the profile in the measurement range.



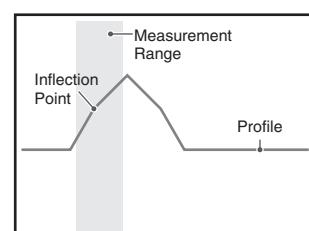
- Bottom

Measures the lowest position/height of the profile in the measurement range.



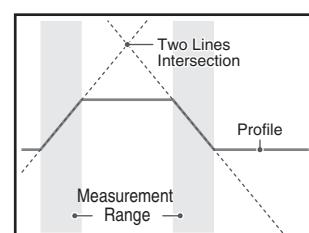
- Inflection Point

Measures the position/height where the profile in the measurement range is bent.



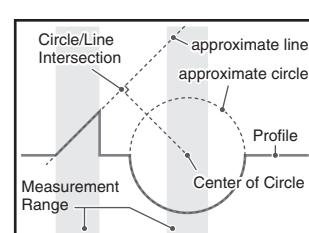
- Two Lines Intersection

Specify two measurement ranges to measure the position/height of the point where the approximate lines calculated from the profile in each measurement range intersect.



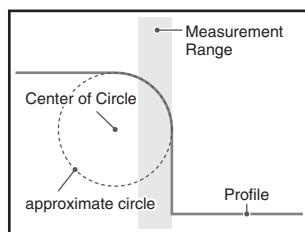
- Circle/Line Intersection

Specify a profile for calculating an approximate circle and the profile for calculating an approximate line, and measure the position/height of the point where the perpendicular line drawn from the center of the approximate circle and the approximate line intersect.

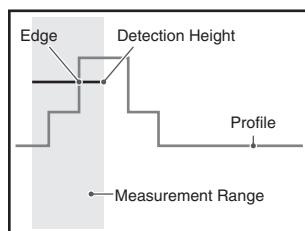


Profile Measurement

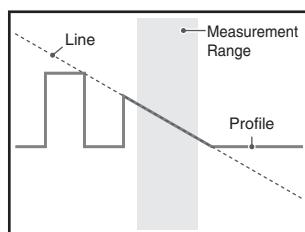
- Center of Circle
Measures the position/height of the center of the approximate circle calculated from the profile in the measurement range.



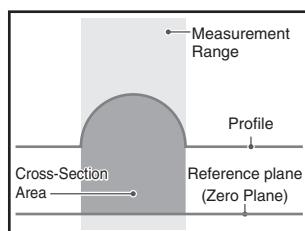
- Edge
Measures the position where the profile in the measurement range crosses an arbitrary [Detection Height].



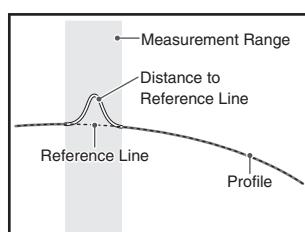
- Line
Calculates the approximate line from the profile in the measurement range.
It is used for calculating the angle or delimiting profiles.



- Cross-Section Area
Measures the area of the region delimited by the measurement range and the profile.
It can also be combined with the horizontal line or "line" to measure the area of the region delimited by the measurement range, profile and horizontal line (line).



- Distance to Reference Line
Measures the area of the differential region between the profile and the reference line, or the position or height of the spots on the profile which are farthest from the reference line within the measurement range.



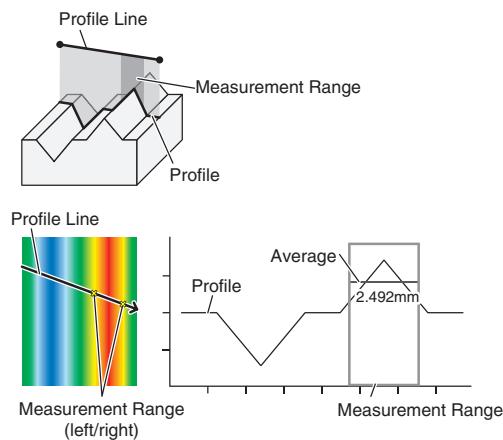
Combination of Profile Measurement Settings and Measurement Targets

Profile Measurement Settings	Measurement Targets					
	Distance to Reference Line (Page 8-76)	Cross-Section Area (Page 8-75)	Line (Page 8-75)	Center of Circle (Page 8-74)	Circle/Line Intersection (Page 8-73)	Two Lines Intersection (Page 8-73)
Height (Page 8-60)	O	O	O	O	O	O
Level Difference (Page 8-61)	O	O	O	O	O	O
Position (Page 8-61)	O	O	O	O	O	O
Center Position (Page 8-62)	O	O	O	O	O	O
Width (Page 8-62)	O	O	O	O	O	O
Angle from Horizontal (Page 8-63)						O
Angle Formed by Two Lines (Page 8-63)						O
Radius of Circle (Page 8-64)						O
Cross-Section Area (Page 8-64)						O
1-Line Cross-Section Area (Page 8-65)						O
2-Line Cross-Section Area (Page 8-65)						O
Points Distance (Page 8-66)	O	O	O	O	O	O
Point/Line Distance (Page 8-66)	O	O	O	O	O	O
Count (Page 8-67)	O			O		
Defect Detection (Page 8-67)						

Measurement Sample

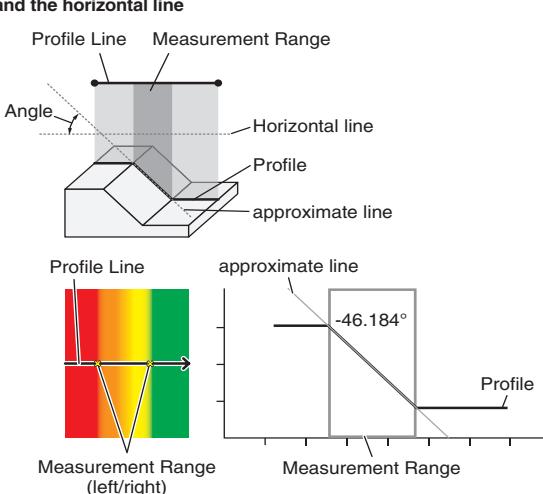
Profile Measurement Settings: [Height] (Average) Example

Measuring the average height in the measurement range



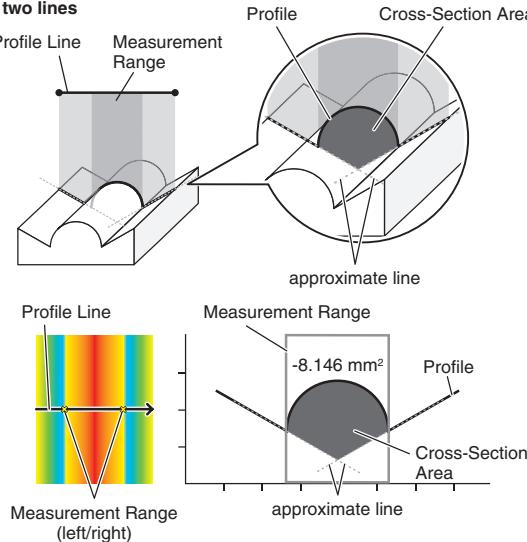
Profile Measurement Settings: [Angle from Horizontal] Example

Measuring the angle formed by the profile in the measurement range and the horizontal line



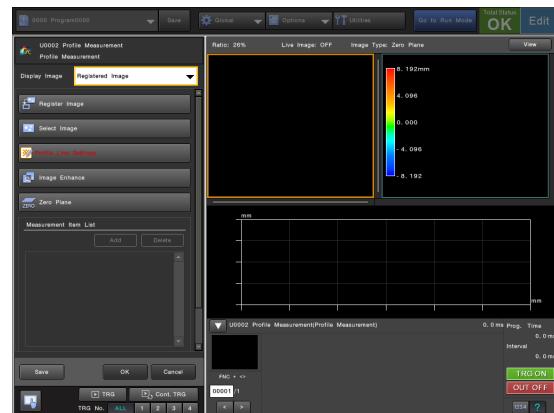
Profile Measurement Settings: [2-Line Cross-Section Area] Example

Measuring the area delimited by the profile in the measurement range and two lines



Top Menu

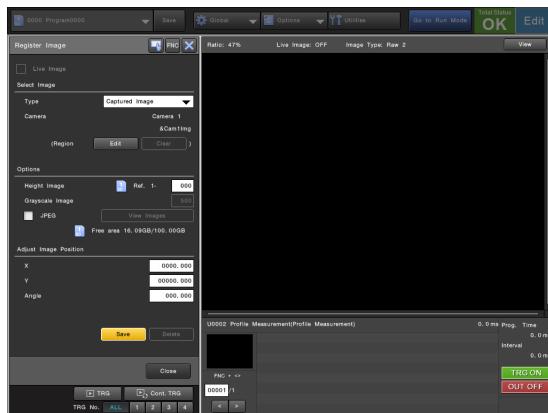
The top menu of the Profile Measurement unit consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 8-54)	Register the image to be used as reference for measurement and setting as the Registered Image.
Select Image (Page 8-55)	Specify the registered image and captured image to be used as reference for the measurements and settings.
Profile Line Settings (Page 8-56)	Specify the position for obtaining the profile on the height image.
Image Enhance (Page 8-58)	Specify the filter processing to apply to the image.
Zero Plane (Page 8-59)	Use this setting if you wish to set a plane with a different height/slope than the reference plane as the reference for measurement.
Measurement Item List (Page 8-60)	Set the profile measurement type (height, level difference, position, etc.) for the obtained profile according to the measurement details.
Display Options (Page 8-68)	Specify the measurement range and measurement results display settings.
Save (Page 8-69)	The present state is saved to the program file.

Register Image

An image can be saved to the controller to be used as a template for measurements and settings. It is recommended to adjust lighting and other conditions completely before registering an image.



Live Image (only when using 3D cameras)

Check this box to display the latest images through a continuous feed.

Point

- [Live Image] is not available when the LJ-V series head is being used.
- [Live Image] is only available while the unit is being edited.
- When [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings], this cannot be changed.
- When configured to not wait for triggers in [Trigger Settings], this check is always cleared and cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is on, the live image is applied even if the capture unit is not running if the unit being edited is the capture unit that was recently run.
- [Live Image] cannot be used if image capture using an area camera is enabled.
- The image variable used for the captured image of the measurement unit should be the same as the destination image variable used for the capture unit being executed (waiting for a trigger). When the image capture buffer is set to enabled, the destination image variable of the capture unit executed most recently will be the subject of comparison.

Select Image

Type

Select an image to register.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** The registered image specified under [Options] is displayed.

Region

To register a portion of the image, select [Edit] and specify the area you wish to register.

Options

Height Image

Specify the registered image number "(camera No.)-(specified No.)" to register the image. The height image will be registered to the specified number (0 to 499).

Point

The saved file name is "ref(camera number)_(specified No.)" (for full screen image registration) or "ref (camera No.)_(specified No.)_XXX_YYY" (for partial image registration).

Grayscale Image

The grayscale image is registered as a registered image of a number which is the sum of 500 and the number specified for [Height Image].

JPEG

Check this option to save the registered image in JPEG format. When this box is not checked, the image will be saved in BMP format as either a 24-bit color bitmap image (when a color camera, 3D camera or LJ-V series head is used) or an 8-bit grayscale bitmap image (when a monochrome camera is used).

Point

- Using image compression may result in some image deterioration, thus measurement results from a compressed image may be different from those when non-compressed image is used.
- Using image compression on the height image will prevent you from obtaining correct height data due to image deterioration caused by the compression.

View Images

You can view all registered images in a list.

Adjust Image Position

Adjust the position of the image being captured.

X

X (horizontal) adjustment between -8191.000 and 8191.000 pixels.

Y

Y (vertical) adjustment between -16383.000 and 16383.000 pixels.

Angle

Adjust the position to the θ angle (rotation) around the center of the image between -999.999° and 999.999°.

Point

- When [Captured Image] is selected as the [Type] and a [Position Adjustment ID] is selected in [Profile Line Settings] (Page 8-57), [Pos. Adjust. value] can be selected in addition to [Number Input]. This option is useful because even when the image capture position deviates, the current image is automatically adjusted using the adjustment value based on the reference unit. However, note that when [Pos. Adjust. value] is selected in the state where a proper adjustment value cannot be measured for the current image, the position used for registration may be incorrect.
- Position adjustment may cause missing peripheries (black areas) due to image movement or jagged edges (jaggies) due to rotation in the registered image, or expansion of invalid pixels with no height data.

Save

Save the displayed image as a registered image under the conditions specified in the [Register Image] screen.

Point

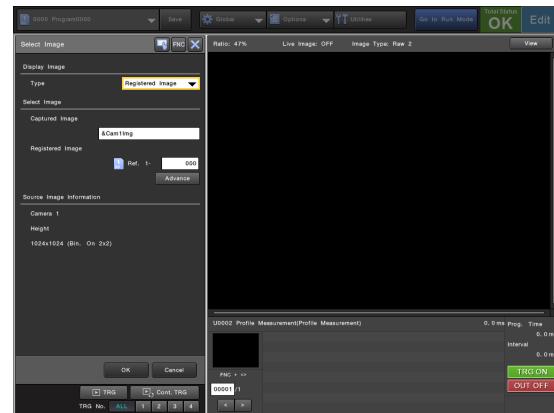
- The image cannot be registered if [Live Image] is enabled. Please stop live image update first before executing.
- When registering the height image only, the grayscale image will be deleted if a grayscale image is already registered for the corresponding registered image number. Note that the same applies when registering the grayscale image only.

Delete

When [Registered Image] is selected for [Type], you can delete the registered image specified under [Options].

Select Image

Specify the registered image and captured image to be used as reference for the measurements and settings.



Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** The registered image specified under [Select Image] is displayed.

Select Image

Captured Image

Set an image variable to be used as the captured image for the unit.

Registered Image

Specify the registered image number for the registered image to be used.

- The registered images of height images are managed as "ref (Camera No.)-(registered image number 0 to 499)". In addition, the number where 500 is added to the registered image number of the height image will be the registered image number of the corresponding grayscale image.
- The camera number is fixed to that of the camera of the image variable specified in the [Captured Image] field.

Profile Measurement

Advance

Set advanced options for the switching of registered images as necessary.

- Use numerical variable for registered image No.:** To use a variable to specify the registered image number to be switched to for the unit, check this box and then assign a numerical or numerical array type variable as a destination to be referenced. By using a variable for the registered image number and then issuing a variable reference value apply command (NU), the image is switched to the specified registered image in the variable and the image reference information is updated. For details, refer to the XG-X2000 Series Communications Control Manual.
- Process variable when changing programs:** Check this option to switch to the registered image specified with the Numerical variable (variable initial value) when the program is changed or the system is next powered up.

Point

Note that the registered image number does not switch in synchronization with a change in the variable value.

Source Image Information

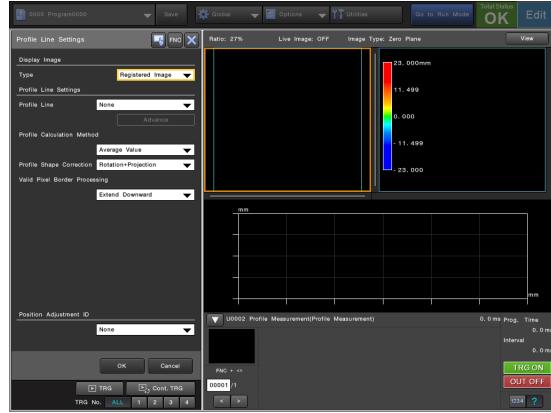
The camera number, image type, and resolution of the camera corresponding to the image variable specified for the captured image will be displayed.

Profile Line Settings

Specify the position for obtaining the profile on the height image.

Point

Editing the profile line settings will initialize the settings in "Measurement Item List" (Page 8-60).



Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified under [Select Image].

Profile Line Settings

Profile Line

Choose the method for specifying the profile line.

- Specify 2 Points:** Specifies two points on the image, the start and end points, to draw a profile line.
- Circle:** The profile line is drawn in a circumferential direction on the image.

Advance

Set the details of the profile line. The setting items vary depending on the selection in [Profile Line].

- When [Specify 2 Points] is selected
 - Point 1:** Specifies the starting point.
 - Point 2:** Specifies the end point.
 - Profile Width:** Specifies the width of the profile line.
- When [Circle] is selected
 - Center:** Specifies the center of the circle.
 - Radius:** Specifies the radius.
 - Start Angle:** Specifies the angle that will serve as the starting point of the profile line.
 - Profile Width:** Specifies the width of the profile line.

Point

The profile with the specified [Profile Width] is obtained according to the [Profile Calculation Method] setting.

Profile Calculation Method

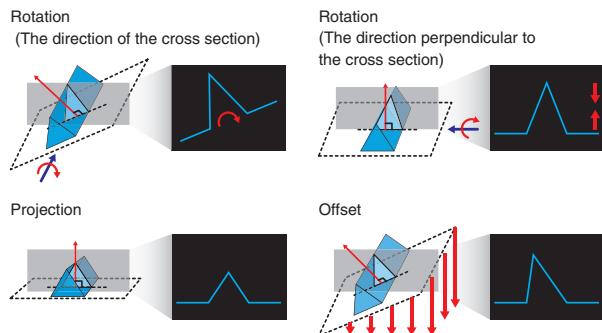
Specify the profile calculation method for obtaining the profile to be used for measurement, using the profile line specified on the height image and the profiles obtained from the [Profile Width] setting.

- **Average Value:** The average of the obtained profiles is used for the measurement.
- **Maximum Value:** The maximum pixel of the obtained profiles is combined to form the profile to use for the measurement.
- **Minimum Value:** The minimum pixel of the obtained profiles is combined to form the profile to use for the measurement.

Profile Shape Correction

The shape of the profile is corrected by rotating the profile line according to the inclination of the zero plane.

- **Rotation + Projection:** The shape of the profile will not be distorted, even when the zero plane is tilted in the cross-section direction or a direction perpendicular to the cross-section. The profile is rotated in the cross-section plane and then projected onto a cross-section that is perpendicular to the zero plane.
- **Rotation Only:** The shape of the profile will not be distorted, even when the zero plane is tilted in the direction of the cross-section. The profile is rotated in the cross-section plane in accordance with the inclination. Use this option to measure the profile by a cross-section parallel to the Z axis.
- **None:** Calculates the profile by subtracting from each individual point the corresponding height of the zero plane. The shape of the profile will be distorted if the zero plane is tilted.



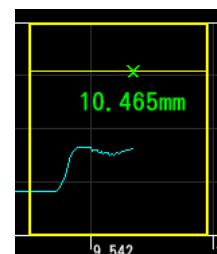
Valid Pixel Border Processing

Select the processing method of the profile at the border section between valid and invalid pixels.



Only influences the measured value of edges and inflection points.

- **Extend Upward:** Connects the upper limit with the valid pixels.



- **Extend Downward:** Connects the lower limit with the valid pixels.



- **None:** There will be no connection at the border section. Therefore edges and inflection points will not be detected.

Position Adjustment ID

To apply position adjustment to the profile line, select the position adjustment unit to be referenced.

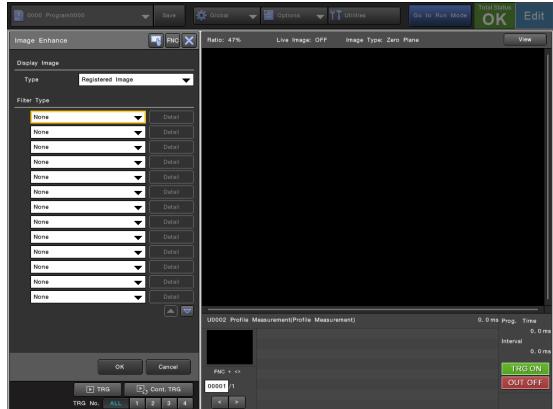


The position adjustment is applied to the profile line settings, zero plane region and zero plane mask regions.

Profile Measurement

Image Enhance

Specify the filter processing to apply to the image.



Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified under [Select Image].

Filter Type

Select the [Filter Type] field and then select the filter to apply.

- None:** Image enhancement is not used.
- Average:** This process smoothes and stabilizes the height variations that occur on the plane in a wave-like pattern. It also interpolates invalid pixels by applying the average value of the surrounding pixels. The filter application size (default: 3x3; or 5x5 for a bigger processing area) and the count (0 to 9, where 0 turns the filter off) can be configured.
- Median:** It has the effect of eliminating abnormal height values that occur in the form of spike-like noise by applying the median of the surrounding pixel heights to the center pixel. The filter application size (default: 3x3; or 5x5 for a bigger processing area) and the count (0 to 9, where 0 turns the filter off) can be configured.
- Gaussian:** This process reduces noise by applying heavier smoothing on pixels closer to the center. You can obtain a more natural blur compared to [Average], but the noise reduction effect will be weaker. The filter application size (default: 3x3; or 5x5 for a bigger processing area) and the count (0 to 9, where 0 turns the filter off) can be configured.

• **Smoothing:** This image enhancement is equivalent to [Average], but you can obtain a stronger smoothing effect by increasing the filter size. You can set the filter size (3 to 127) and the count (0 to 9, where 0 turns the filter off). In addition, by using [Border], you can select whether to perform smoothing at the boundary of the region by referring to height information outside the region or by considering them to be of the same height as the region boundary part.

• **Inv. Pixel Suppress.:** This option suppresses invalid pixels by interpolating invalid pixels without height data with the height data estimated from the surrounding valid pixels. Invalid pixel suppression does not affect the values of valid pixels around the invalid pixels. [Level] (1 (default) to 9), [Adj. Width] (Small (default), Large) and [Count] (0 to 1, where 0 turns the filter off) can be configured. The greater the level and the larger the adjustment width, the wider the range of invalid pixels that can be suppressed.

• **Spike Noise Cut:** Eliminates pixels (spike noise) whose heights spike out from the surroundings due to noise, etc. The processing direction and [Cut Size] (eliminates spike noise which is equal to or below the specified size width), [Cut Threshold] (eliminates spike points which stray from the specified height in relation to the surrounding as noise), and [Cut Target] can be specified. Specify the [Cut Size] from 2 - 30 (default setting value: 4), the [Cut Threshold] (mm) from 0.000 - 99.999 (default setting value: 0.050), and the [Cut Target] as Upper or Lower or Both (default setting value: Upper).

Point

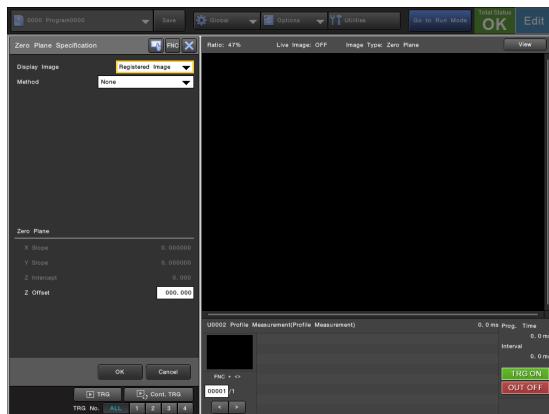
- When multiple filters are set, they are processed one by one from the top.
- Spike points which are eliminated via the spike noise cut filter become invalid pixels.
- Invalid pixels are pixels that do not contain height information as a result of failure to obtain the height during capture or due to unreliable measured values.

Reference

With a filter selected in the [Filter Type] field, if you move the 8-way key up and down while holding the No. 1 (FUNCTION) key on the console, you can change the filter application order.

Zero Plane

Use this setting if you wish to set a plane with a different height/slope than the reference plane as the reference for measurement.



- The zero plane is configured separately for each profile measurement unit.
- [Zero Plane Specification] corrects the height but not XY directions.
- If you have selected [Zero Plane Specification], [Zero Plane] can be specified as the display image type. The zero plane image will show the height distribution based on the zero plane.

Display Image

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified under [Select Image].

Method

Choose the method for specifying the Zero plane according to the measurement purpose and target.

Specifiable Zero Plane

	Changes According to the Captured Image	Does Not Change According to the Captured Image
Plane Parallel to Reference Plane	Region (Ave. Height)	None
Arbitrary Plane	Region (Best Fit), 3 Points (Real-Time)	-

* The zero plane can also be specified by referring to result data (From Result Data) or by specifying values (User Specified).

- None** (Default): Specify the reference plane as the zero plane.
- Region (Best Fit):** The least square plane calculated using the 3D information of the captured image within the specified region will be used as the zero plane.
- Region (Ave. Height):** The zero plane will be the plane that is parallel to the reference plane whose Z intercept is the average Z value of the captured image in the specified region.

- 3 Points (Real-Time):** The plane calculated using the 3D information of the captured image at the specified three points will be used as the zero plane.

- From Result Data:** Enter a plane type variable into the [Plane] field or directly specify and reference the zero planes, height extract planes, detected planes, etc. of other tools. Selecting [Input Assistant] opens a menu in which the result data of other units can be selected easily.



- If the reference unit itself refers to the result data of another unit, the setting will result in an error.
- When specifying variable reference of a plane type variable, specify the absolute measured value (AB) for the plane to be substituted into the variable. Planes that have been adjusted using position adjustment or scaling will not be converted properly.

- User Specified:** Specify the zero plane by specifying the values for the XY direction slopes and Z intercept in the [Zero Plane] field.

Zero Plane

Specify the zero plane in numeric values according to [Method].

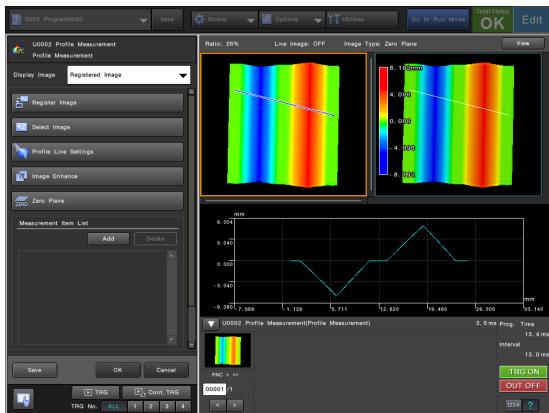
- X Slope:** Specifies the inclination amount (mm/pixel) in the Z direction for 1 pixel in the X direction.
- Y Slope:** Specifies the inclination amount (mm/pixel) in the Z direction for 1 pixel in the Y direction.
- Z Intercept:** Specifies the Z intercept of the zero plane.
- Z Offset:** Specifies the offset value in the Z-axis direction of the zero plane.



- [X Slope], [Y Slope], and [Z Intercept] can only be specified when [Method] is set to [User Specified].

Measurement Item List

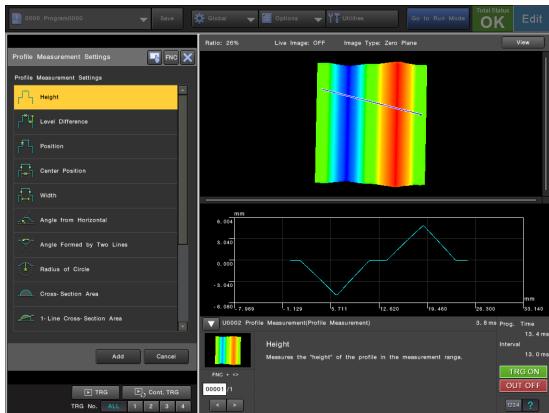
Set the profile measurement type for the obtained profile according to the measurement details.



Point Up to 32 profile measurement settings can be set.

Add

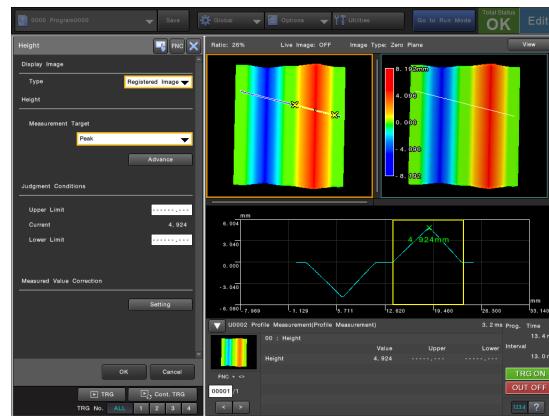
Add and configure [Profile Measurement Settings] (Page 8-49) according to the measurement details.



- Height (Page 8-60)
- Level Difference (Page 8-61)
- Position (Page 8-61)
- Center Position (Page 8-62)
- Width (Page 8-62)
- Angle from Horizontal (Page 8-63)
- Angle Formed by Two Lines (Page 8-63)
- Radius of Circle (Page 8-64)
- Cross-Section Area (Page 8-64)
- 1-Line Cross-Section Area (Page 8-65)
- 2-Line Cross-Section Area (Page 8-65)
- Points Distance (Page 8-66)
- Point/Line Distance (Page 8-66)
- Count (Page 8-67)
- Defect Detection (Page 8-67)

Height

Measures the "Height" of the profile in the measurement range.



• Display Image

- Type

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

• Height

- Measurement Target

Specify the measurement target (Page 8-52) for measuring the height.

- Advance

Select the method for specifying the measurement range and draw the region. Also, set the measurement target detection conditions according to the specified measurement target.

Average (Page 8-70)

Peak (Page 8-71)

Bottom (Page 8-71)

Inflection Point (Page 8-72)

Two Lines Intersection (Page 8-73)

Circle/Line Intersection (Page 8-73)

Center of Circle (Page 8-74)

Distance to Reference Line (Page 8-76)

• Judgment Conditions

Set the tolerance (upper limit and lower limit) for the measured height.

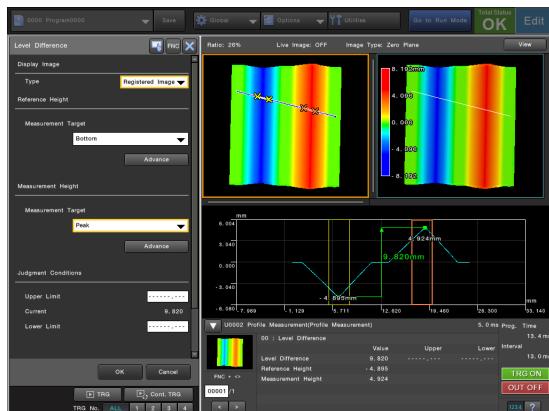
The unit of tolerance is mm.

• Measured Value Correction

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-78) for more details on the setting method.

Level Difference

Measures the level difference based on the "Height" of the profiles detected in two measurement ranges.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Reference Height/Measurement Height**

- **Measurement Target**

Specify the measurement target (Page 8-52) for measuring the reference height/measurement height.

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the measurement target detection conditions according to the specified measurement target.

Average (Page 8-70)

Peak (Page 8-71)

Bottom (Page 8-71)

Inflection Point (Page 8-72)

Two Lines Intersection (Page 8-73)

Circle/Line Intersection (Page 8-73)

Center of Circle (Page 8-74)

Distance to Reference Line (Page 8-76)

- **Judgment Conditions**

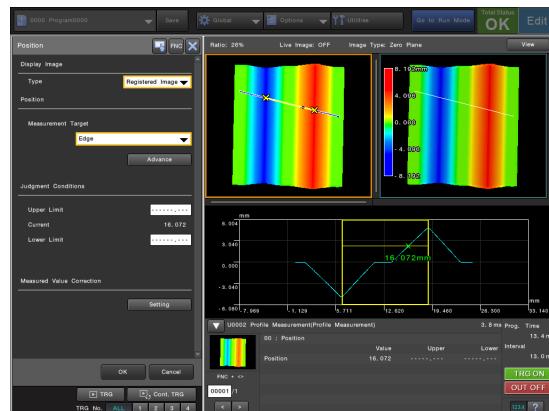
Set the tolerance (upper limit and lower limit) for the measured level difference. The unit of tolerance is mm.

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-78) for more details on the setting method.

Position

Measures the "Position" of the profile in the measurement range.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Position**

- **Measurement Target**

Specify the measurement target (Page 8-52) for measuring the position.

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the measurement target detection conditions according to the specified measurement target.

Edge (Page 8-69)

Peak (Page 8-71)

Bottom (Page 8-71)

Inflection Point (Page 8-72)

Two Lines Intersection (Page 8-73)

Circle/Line Intersection (Page 8-73)

Center of Circle (Page 8-74)

Distance to Reference Line (Page 8-76)

- **Judgment Conditions**

Set the tolerance (upper limit and lower limit) for the measured position. The unit of tolerance is mm.

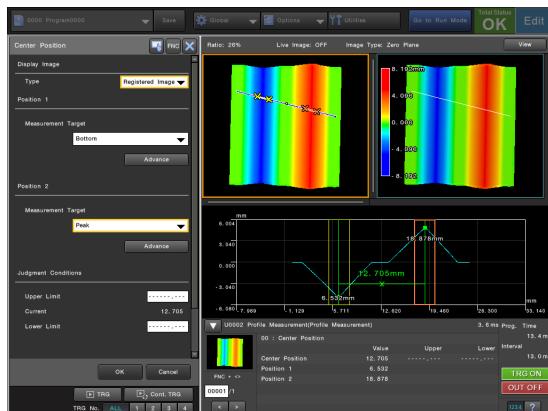
- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-78) for more details on the setting method.

Profile Measurement

Center Position

Measures the center position based on the "Position" of the profiles detected in two measurement ranges.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Position 1/Position 2**

- **Measurement Target**

Specify the measurement target (Page 8-52) for measuring the position.

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the measurement target detection conditions according to the specified measurement target.

Edge (Page 8-69)

Peak (Page 8-71)

Bottom (Page 8-71)

Inflection Point (Page 8-72)

Two Lines Intersection (Page 8-73)

Circle/Line Intersection (Page 8-73)

Center of Circle (Page 8-74)

Distance to Reference Line (Page 8-76)

- **Judgment Conditions**

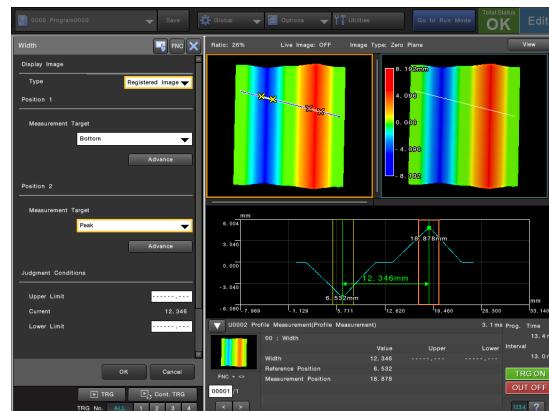
Set the tolerance (upper limit and lower limit) for the measured center position. The unit of tolerance is mm.

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-78) for more details on the setting method.

Width

Measures the width based on the "Position" of the profiles detected in two measurement ranges.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Position 1/Position 2**

- **Measurement Target**

Specify the measurement target (Page 8-52) for measuring the position.

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the measurement target detection conditions according to the specified measurement target.

Edge (Page 8-69)

Peak (Page 8-71)

Bottom (Page 8-71)

Inflection Point (Page 8-72)

Two Lines Intersection (Page 8-73)

Circle/Line Intersection (Page 8-73)

Center of Circle (Page 8-74)

Distance to Reference Line (Page 8-76)

- **Judgment Conditions**

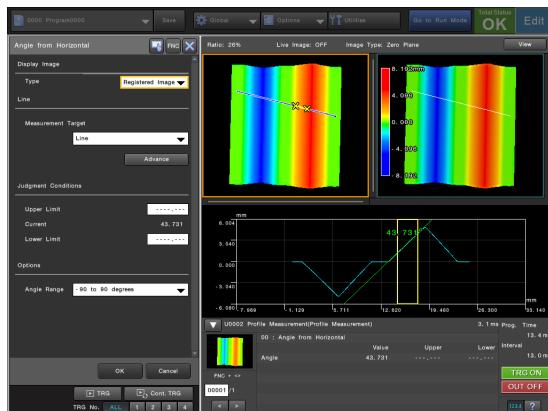
Set the tolerance (upper limit and lower limit) for the measured width. The unit of tolerance is mm.

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-78) for more details on the setting method.

Angle from Horizontal

Measures the “angle” between the horizontal and the line derived from the profile in the measurement range.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Line**

- **Measurement Target**

Fixed at [Line].

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the line (Page 8-75).

- **Judgment Conditions**

Set the tolerance (upper limit and lower limit) for the measured angle from horizontal. The unit of tolerance is °.

- **Options**

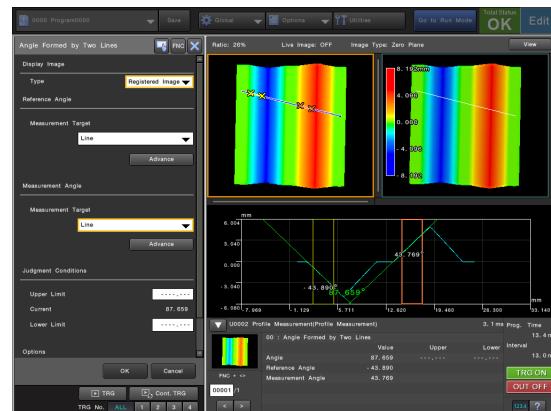
- **Angle Range:** Selects the display range for the detected angle.

-90 to 90 degrees

0 to 180 degrees

Angle Formed by Two Lines

Measures the “angle” formed by the line derived from the profile in one measurement range and the line derived from the profile in the other measurement range.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Reference Angle/Measurement Angle**

- **Measurement Target**

Fixed at [Line].

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the line (Page 8-75).

- **Judgment Conditions**

Set the tolerance (upper limit and lower limit) for the measured angle formed by two lines. The unit of tolerance is °.

- **Options**

- **Angle Range:** Selects the display range for the detected angle.

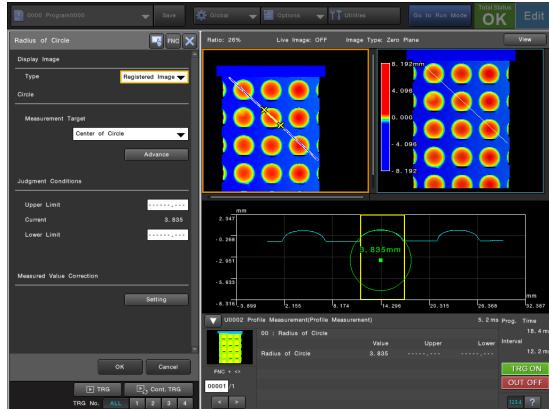
-90 to 90 degrees

0 to 180 degrees

Profile Measurement

Radius of Circle

Measures the "radius of the circle" derived from the profile in the measurement range.



• Display Image

- Type

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

• Circle

- Measurement Target

Fixed at [Center of Circle].

- Advance

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the center of the circle (Page 8-74).

• Judgment Conditions

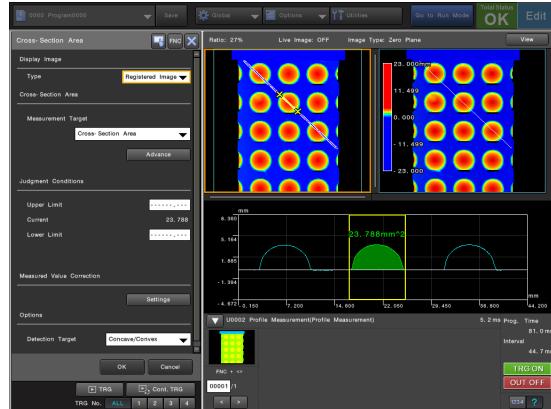
Set the tolerance (upper limit and lower limit) for the measured radius of the circle. The unit of tolerance is mm.

• Measured Value Correction

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-78) for more details on the setting method.

Cross-Section Area

Measures the area of the region enclosed by the zero plane and the profile in the measurement range.



• Display Image

- Type

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

• Cross-Section Area

- Measurement Target

Fixed at [Cross-Section Area].

- Advance

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the cross-section area (Page 8-75).

• Judgment Conditions

Set the tolerance (upper limit and lower limit) for the measured cross-section area. The unit of tolerance is mm².

• Measured Value Correction

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-78) for more details on the setting method.

• Options

Detection Target: Selects the detection target for the cross-section area.

Concave/Convex: Calculates the added area of the area of the region above the reference height and the area of the region below the reference height.

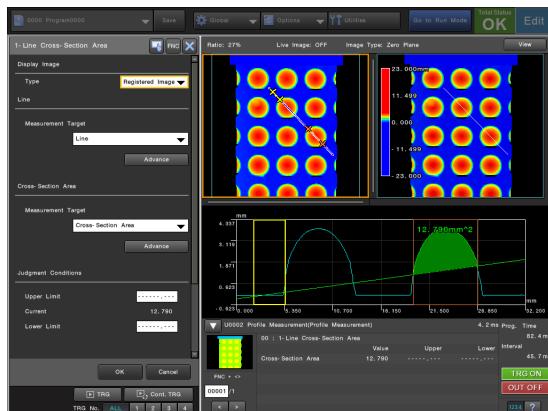
Concave Part: Calculates the area of the region below the reference height.

Convex Part: Calculates the area of the region above the reference height.

Integration: Calculates the added area with the area of the region above the reference height taken as a positive area and the area of the region below the reference height taken as a negative area.

1-Line Cross-Section Area

Measures the area of the region enclosed by one line and the profile in the measurement range.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Line**

- **Measurement Target**

Fixed at [Line].

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the line (Page 8-75).

- **Cross-Section Area**

- **Measurement Target**

Fixed at [Cross-Section Area].

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the cross-section area (Page 8-75).

- **Judgment Conditions**

Set the tolerance (upper limit and lower limit) for the measured cross-section area enclosed by 1 line. The unit of tolerance is mm².

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-78) for more details on the setting method.

- **Options**

- **Detection Target:** Selects the detection target for the cross-section area.

Concave/Convex: Calculates the added area of the area of the region above the reference height and the area of the region below the reference height.

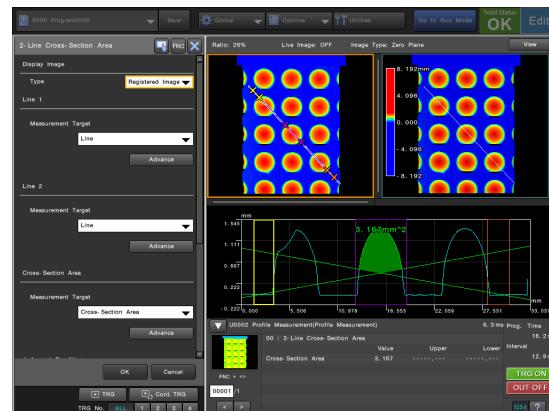
Concave Part: Calculates the area of the region below the reference height.

Convex Part: Calculates the area of the region above the reference height.

Integration: Calculates the added area with the area of the region above the reference height taken as a positive area and the area of the region below the reference height taken as a negative area.

2-Line Cross-Section Area

Measures the area of the region enclosed by two lines and the profile in the measurement range.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Line 1/Line 2**

- **Measurement Target**

Fixed at [Line].

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the line (Page 8-75).

- **Cross-Section Area**

- **Measurement Target**

Fixed at [Cross-Section Area].

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the cross-section area (Page 8-75).

- **Judgment Conditions**

Set the tolerance (upper limit and lower limit) for the measured cross-section area enclosed by two lines. The unit of tolerance is mm².

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-78) for more details on the setting method.

- **Options**

- **Detection Target:** Selects the detection target for the cross-section area.

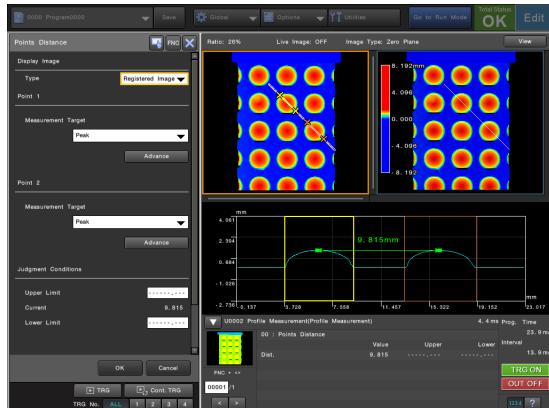
Concave Part: Calculates the area of the region below the reference height.

Convex Part: Calculates the area of the region above the reference height.

Profile Measurement

Points Distance

Measures the distance based on the "Point" detected on the profile in two measurement ranges.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Point 1/Point 2**

- **Measurement Target**

Specify the measurement target (Page 8-52) for measuring the point.

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the measurement target detection conditions according to the specified measurement target.

Edge (Page 8-69)

Peak (Page 8-71)

Bottom (Page 8-71)

Inflection Point (Page 8-72)

Two Lines Intersection (Page 8-73)

Circle/Line Intersection (Page 8-73)

Center of Circle (Page 8-74)

Distance to Reference Line (Page 8-76)

- **Judgment Conditions**

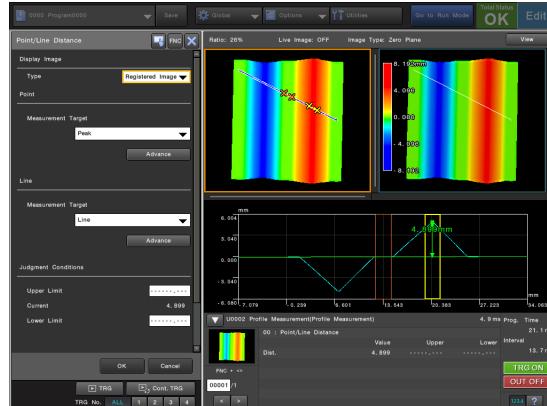
Set the tolerance (upper limit and lower limit) for the measured distance between the points. The unit of tolerance is mm.

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-78) for more details on the setting method.

Point/Line Distance

Measures the distance based on the "Point" detected on the profile in one measurement range and the "Line" detected from the profile in the other measurement range.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Point**

- **Measurement Target**

Specify the measurement target (Page 8-52) for measuring the point.

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the measurement target detection conditions according to the specified measurement target.

Edge (Page 8-69)

Peak (Page 8-71)

Bottom (Page 8-71)

Inflection Point (Page 8-72)

Two Lines Intersection (Page 8-73)

Circle/Line Intersection (Page 8-73)

Center of Circle (Page 8-74)

Distance to Reference Line (Page 8-76)

- **Line**

- **Measurement Target**

Fixed at [Line].

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the line (Page 8-75).

- **Judgment Conditions**

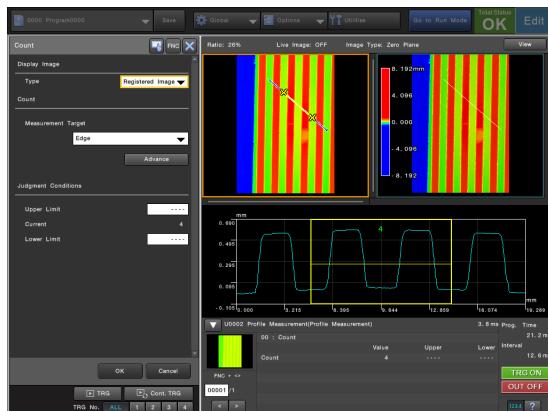
Set the tolerance (upper limit and lower limit) for the measured distance between the point and line. The unit of tolerance is mm.

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-78) for more details on the setting method.

Count

Measures the number of measurement targets found on the profile in the measurement range.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Count**

- **Measurement Target**

Specify the measurement target (Page 8-52) to be counted.

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the measurement target detection conditions according to the specified measurement target.

Edge (Page 8-69)

Inflection Point (Page 8-72)

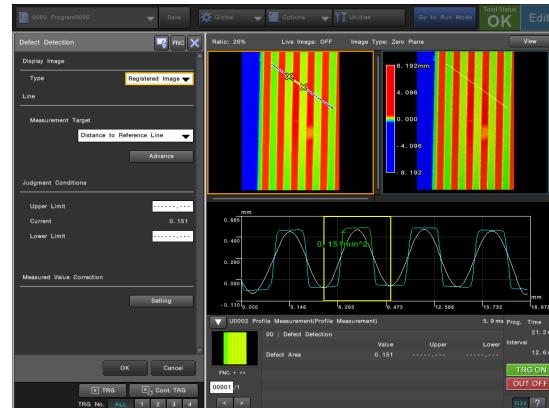
Distance to Reference Line (Page 8-76)

- **Judgment Conditions**

Set the tolerance (upper limit and lower limit) for the count.

Defect Detection

Determines the difference of the reference line and the profile inside the measurement range and measures the area of the determined defect regions.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Defect Detection**

- **Measurement Target**

Fixed at [Distance to Reference Line].

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the distance to reference line (Page 8-76).

- **Judgment Conditions**

Set the tolerance (upper limit and lower limit) for the measured defect area. The unit of tolerance is mm².

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-78) for more details on the setting method.

Profile Measurement

Delete

Deletes the profile measurement settings.

- Select the profile measurement setting to delete, and then select [Delete].**

The profile measurement setting is deleted.

Edit

Edit the measurement details of existing profile measurement settings.

- 1 Select the profile measurement setting to edit, and then select [Edit].**

The setting screen for the selected profile measurement setting appears.

- 2 Edit the measurement details.**

Refer to "Add" (Page 8-60) for more details on the setting method.

- 3 Select [OK].**

Copy

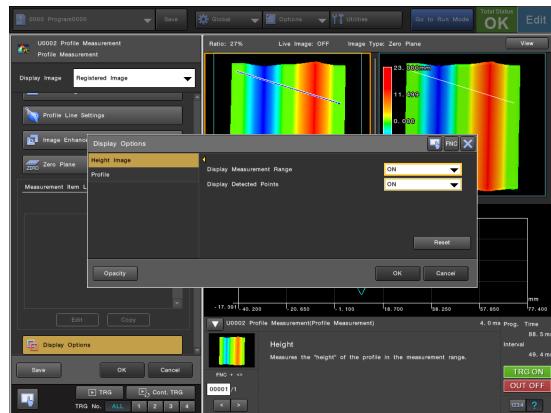
Copies existing profile measurement settings.

- Select the profile measurement setting to copy, and then select [Copy].**

The selected profile measurement setting is copied and added to the bottom of the list.

Display Options

Specify the measurement range and measurement results display settings.



Height Image

Specify whether to display/hide the measurement range and the detected point on the height image.

Profile

Display/hide the measurement results on the profile and specify the number of decimal places.



The specified number of decimal places is only reflected to the measurement results displayed on the profile.
It is not reflected to the measurement results displayed on the [Run Mode] screen or those displayed in the information display in [Setup Mode].

Reset

Restores the display options to their default settings.

Opacity

This function can be used to change the opacity of this dialog so that what is going on in the background can be seen.

Save

The present state is saved to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

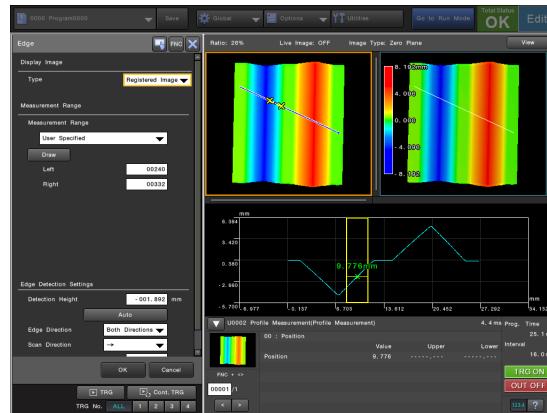


- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. For example, variable values or the default display, such as the screen, changed in the current program can be excluded when saving.

Setting the Measurement Target

Edge

Specify the measurement range and edge detection conditions to measure the edge within the region.



Display Image

• Type

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Measurement Range

Specify the range for measuring the edge.

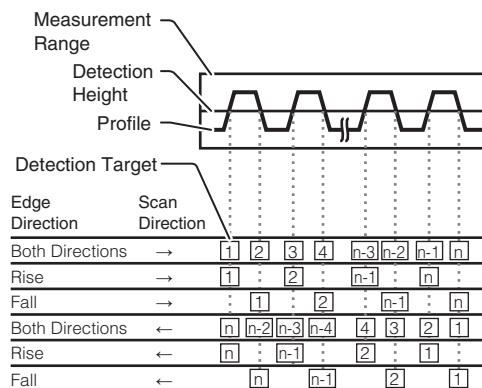
- **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
- **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
- **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-77) for more details on the setting method.

Profile Measurement

Edge Detection Settings

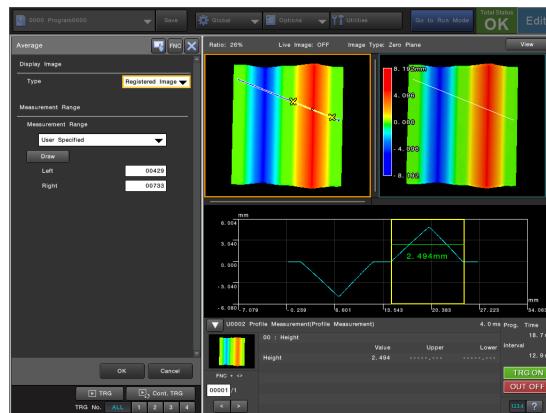
Specify the edge detection conditions.



- Detection Height:** Specifies the height where the profile traverses within the measurement range to be detected as an edge. When [Auto] is selected, the height for detecting the edge in the displayed profile is set automatically.
- Edge Direction:** Specifies the change direction of the profile to detect as an edge.
 - Both Directions:** Considers both the rise and fall as measurement targets.
 - Rise:** Considers a bottom to top direction of traversal as the target.
 - Fall:** Considers a top to bottom direction of traversal as the target.
- Scan Direction:** Specifies the direction for scanning for the edge within the measurement range.
 - : Does a scan from left to right of the displayed profile (from start point to end point of the profile line).
 - ←: Does a scan from right to left of the displayed profile (from end point to start point of the profile line).
- Detection Target:** From among the edge candidates that satisfy the conditions, the label that will be the target of the detection is specified by its number.

Average

Specify the measurement range to measure the average height value of the profile in the region.



Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified under [Select Image].

Measurement Range

- Measurement Range:** Specify the range for measuring the average.

- User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.

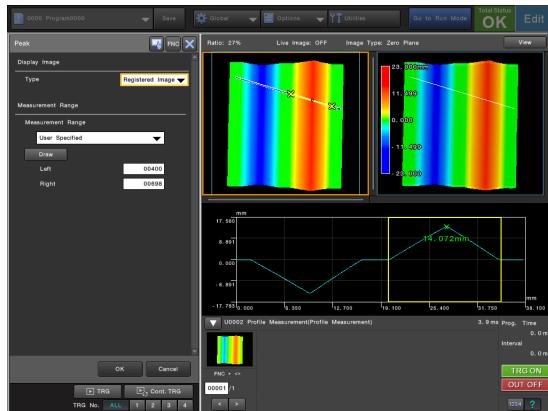
- Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.

- Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-77) for more details on the setting method.

Peak

Specify the measurement range to measure the maximum value of the profile in the region.



Display Image

- Type**

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

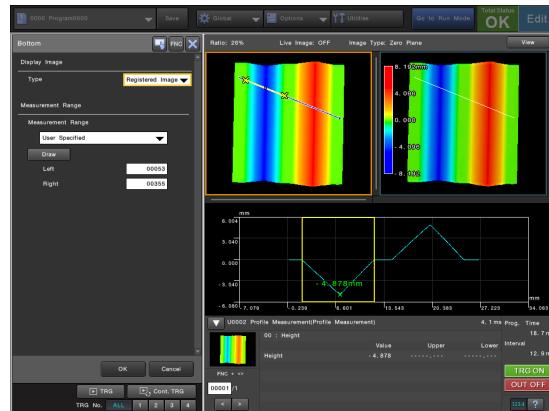
Measurement Range

- **Measurement Range:** Specify the range for measuring the peak.
 - **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
 - **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
 - **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-77) for more details on the setting method.

Bottom

Specify the measurement range to measure the minimum value of the profile in the region.



Display Image

- Type**

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Measurement Range

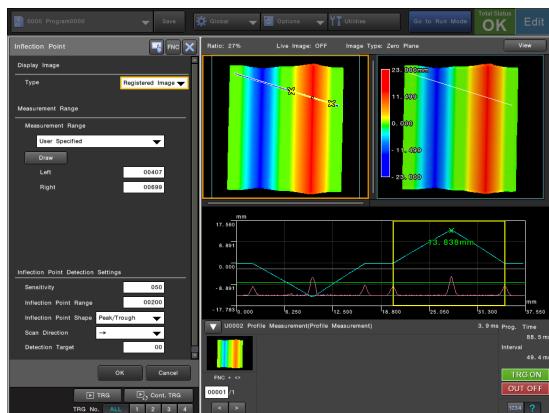
- **Measurement Range:** Specify the range for measuring the bottom.
 - **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
 - **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
 - **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-77) for more details on the setting method.

Profile Measurement

Inflection Point

Specify the measurement range and inflection point detection settings to measure the inflection point of the profile in the region.



Display Image

- Type**

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Measurement Range

- Measurement Range:** Specify the range for measuring the inflection point.

- **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
- **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
- **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-77) for more details on the setting method.

Inflection Point Detection Settings

Set the detection conditions for the inflection point.

- **Sensitivity:** Sensitivity is a threshold value for determining up to what level of profile slope change (bending degree) is to be detected as an inflection point.

While setting the sensitivity, the differentiated waveform of the profile data (the sensitivity profile) is displayed to emphasize the inflection point.

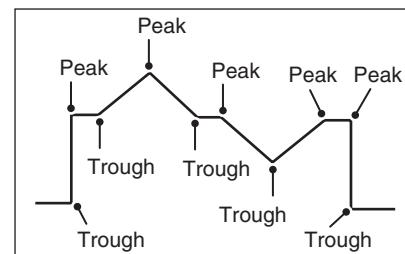
Set the sensitivity in the range between 1 to 100 such that the sensitivity profile of the point to detect exceeds the threshold value.

- **Inflection Point Range:** Sets the display range for the graph of the inflection point. If part of the graph display of the inflection point is cut off, a larger value should be set.



- **Inflection Point Shape:** Specifies the shape of the profile gradient.

- Peak/Trough: The profile slope change forms an inflection point from both the decreasing and increasing trends.
- Peak: This is the inflection point where the profile slope change is of a decreasing trend.
- Trough: This is the inflection point where the profile slope change is of an increasing trend.



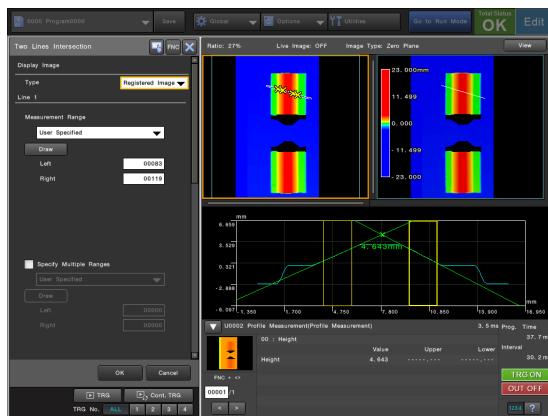
- **Scan Direction:** Specifies the direction for scanning for the inflection point within the measurement range.

- →: Does a scan from left to right of the displayed profile (from start point to end point of the profile line).
- ←: Does a scan from right to left of the displayed profile (from end point to start point of the profile line).

- **Detection Target:** From among the inflection point candidates that satisfy the conditions, the label that will be the target of the detection is specified by its number.

Two Lines Intersection

Specify two measurement ranges to measure the position of the point where the approximate lines calculated from the profile of each measurement range intersect.



Display Image

- Type**

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Line 1/Line 2

- Measurement Range:** Specifies the measurement range for detecting the approximate line.
 - **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
 - **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
 - **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-77) for more details on the setting method.

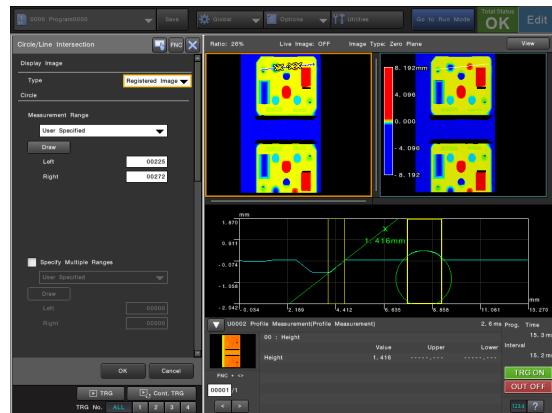
- Specify Multiple Ranges:** When this is enabled, another measurement target area is specified and an approximate line can be detected from those two areas. The method for specifying the measurement range is the same as above.

Options

- Deformation Correction:** Turning this option on reduces the noise influence during the detection of approximate lines.

Circle/Line Intersection

Specify two measurement ranges. Detect an approximate circle from the profile in one measurement range; and detect an approximate line from the profile in the other measurement range. Draw a perpendicular line from the center of the detected approximate circle to the approximate line, and measure the position/height of the point of intersection.



Display Image

- Type**

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Circle

- Measurement Range:** Specifies the measurement range for detecting the approximate circle.
 - **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
 - **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
 - **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-77) for more details on the setting method.

- Specify Multiple Ranges:** When this is enabled, another measurement target area is specified and an approximate circle can be detected from those two areas. The method for specifying the measurement range is the same as above.

Profile Measurement

Line

- **Measurement Range:** Specifies the measurement range for detecting the approximate line.
 - **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
 - **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
 - **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-77) for more details on the setting method.

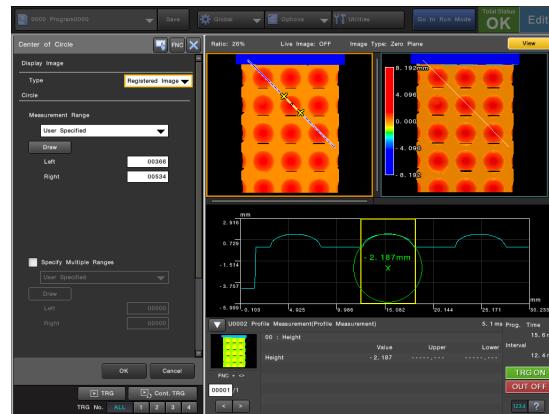
- **Specify Multiple Ranges:** When this is enabled, another measurement target area is specified and an approximate line can be detected from those two areas. The method for specifying the measurement range is the same as above.

Options

- **Deformation Correction:** Turning this option on reduces the noise influence during the detection of the approximate circle and line.

Center of Circle

Specify the measurement range to measure the center position of the approximate circle detected from the profile in the measurement range.



Display Image

Type

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Circle

- **Measurement Range:** Specifies the measurement range for detecting the approximate circle.

- **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.

- **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.

- **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-77) for more details on the setting method.

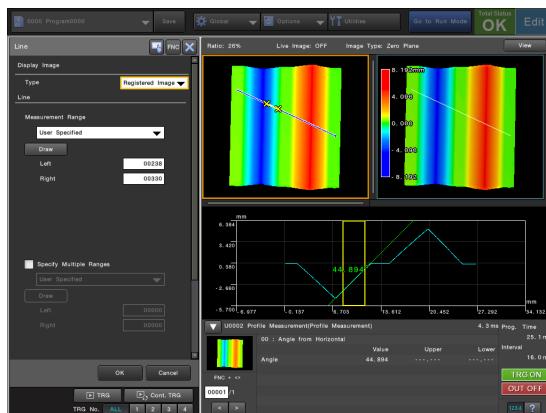
- **Specify Multiple Ranges:** When this is enabled, another measurement target area is specified and an approximate circle can be detected from those two areas. The method for specifying the measurement range is the same as above.

Options

- **Deformation Correction:** Turning this option on reduces the noise influence during the detection of the approximate circle.

Line

Specify the measurement range to detect an approximate line from the profile in the measurement range.



Display Image

- Type**

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Line

- **Measurement Range:** Specifies the measurement range for detecting the approximate line.

- **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
- **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
- **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-77) for more details on the setting method.

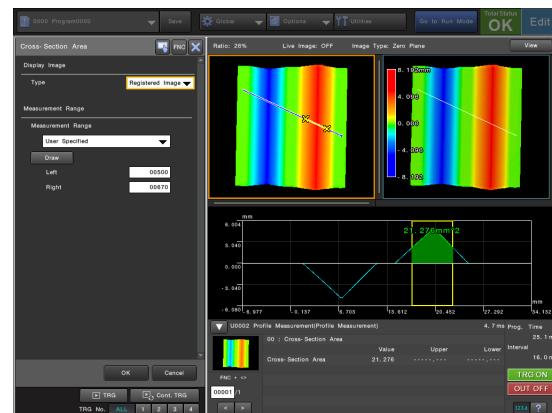
- **Specify Multiple Ranges:** When this is enabled, another measurement target area is specified and an approximate line can be detected from those two areas. The method for specifying the measurement range is the same as above.

Options

- **Deformation Correction:** Turning this option on reduces the noise influence during the detection of the approximate line.

Cross-Section Area

Specify the measurement range to measure the area of the region delimited by the profile in the measurement range and zero plane.



Display Image

- Type**

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Measurement Range

- **Measurement Range:** Specifies the measurement range for detecting the cross section area.

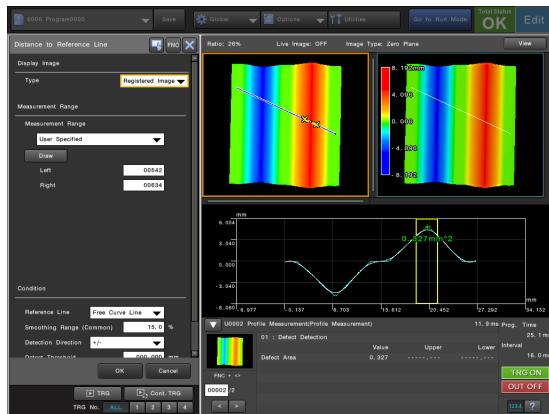
- **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
- **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
- **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-77) for more details on the setting method.

Profile Measurement

Distance to Reference Line

Specify the measurement range to detect a reference line from the profile in the measurement range, and measure the difference from the profile.



Display Image

- Type**

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Measurement Range

- Measurement Range:** Specifies the measurement range for detecting the reference line.

- **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
- **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
- **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-77) for more details on the setting method.

Condition

Specify the conditions for detecting the difference from the reference line.

- **Reference Line:** Specifies the reference line fitting the profile to measure.

- **Free Curve Line**

- **Line**

- **Circle**

- **Smoothing Range (Common):** Set this option when selecting "Free Curve Line" as the reference line.

Increase the smoothing range to make the free curve smoother to the profile of the measurement range. To make the free curve sharper, decrease it.

- **Detection Direction:** Specifies the direction to detect.

- **+/-:** Detects irregularities in both the + and - directions as a difference.
- **+**: Detects as a difference only the irregularities in the + direction.
- **-**: Detects as a difference only the irregularities in the - direction.

When the reference line is set to "Circle", "+" will be set to outside and "-" to inside the circle.

- **Detection Threshold:** Distances from the reference line, that exceed the specified value will be detected as defects (unit: mm).

- **Lowest Detected Width:** A defect whose width is smaller than the specified lower limit is not detected as a defect (unit: mm).

Reference When [Distance to Reference Line] is used for the position calculation, the position of the part of the section deemed as a defect that is furthest away from the reference line is calculated as the result.

Setting the Measurement Range

Set the measurement target range.

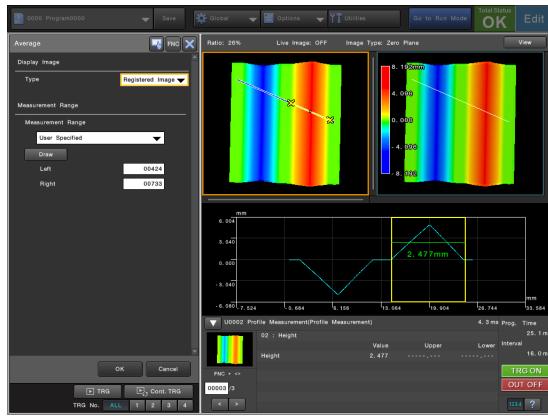
The measurement range can be set using the following methods.

- User Specified (Page 8-77)
- Refer to Position Meas. (1 pt.) (Page 8-77)
- Refer to Position Meas. (2 pts.) (Page 8-78)

User Specified

Specify the left and right end positions of the measurement range in numeric values.

Use this option when the measurement range is fixed.



Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-24) for more details.

Left

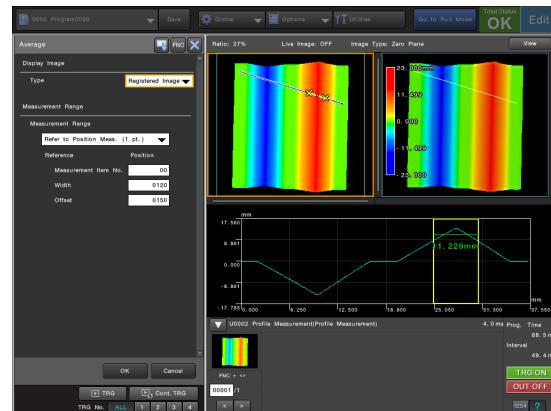
Specify the left end position of the measurement range.

Right

Specify the right end position of the measurement range.

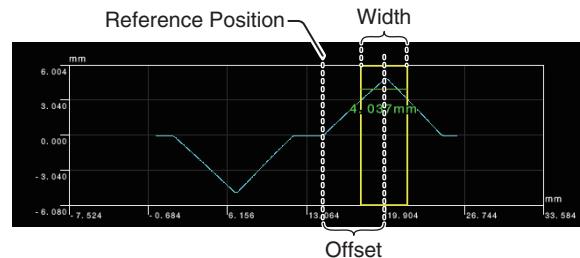
Refer to Position Meas. (1 pt.)

Specify the region by referencing the position (position or center position) measured in other profile measurement settings.



Reference

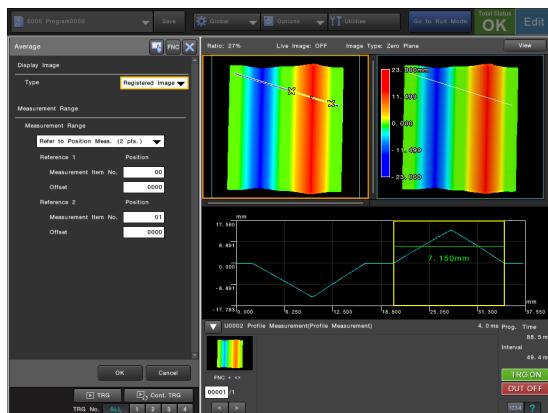
- **Measurement Item No.:** Specify the center position of the measurement range by specifying the measurement item number of the position or center position. The measurement range changes corresponding to the result of the position measurement.
- **Width:** Specifies the width of the measurement range with the referenced position in the center.
- **Offset:** Specifies an offset for the position of the measurement range.



Profile Measurement

Refer to Position Meas. (2 pts.)

Specify two positions measured in other profile measurements (position or center position) as the left and right end positions of the measurement range.



Reference 1

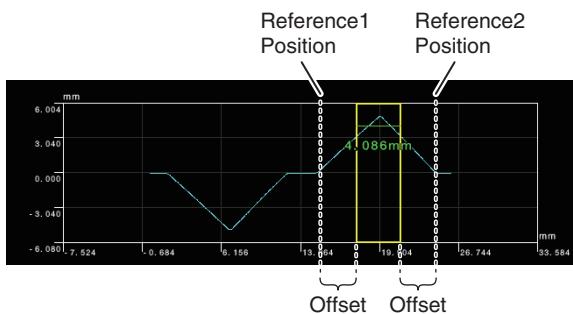
Specify the left end position of the measurement range.

- Measurement Item No.:** Specifies the measurement item number of the position or center position. The measurement range changes corresponding to the result of the position measurement.
- Offset:** Specifies an offset for the position of the measurement range.

Reference 2

Specify the right end position of the measurement range.

- Measurement Item No.:** Specifies the measurement item number of the position or center position. The measurement range changes corresponding to the result of the position measurement.
- Offset:** Specifies an offset for the position of the measurement range.



Correcting the Measured Value

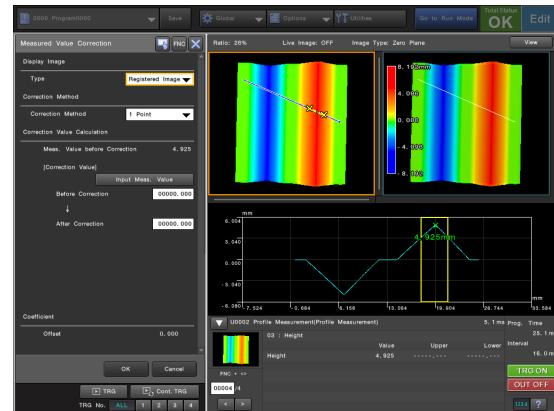
Correct the measured value to match the full-scale value. The following correction methods are available.

- 1 Point (Page 8-78)
- 2 Points (Page 8-79)

1 Point

A correction is performed based on one measured value. Set the post-correction measured value for the current measured value to calculate the offset for the measured value.

- 1 Select the image to display in [Display Image] and perform the measurement.



- 2 Select [1 Point] in [Correction Method].

- 3 Select [Input Meas. Value] to enter the current measured value into the [Before Correction] field.

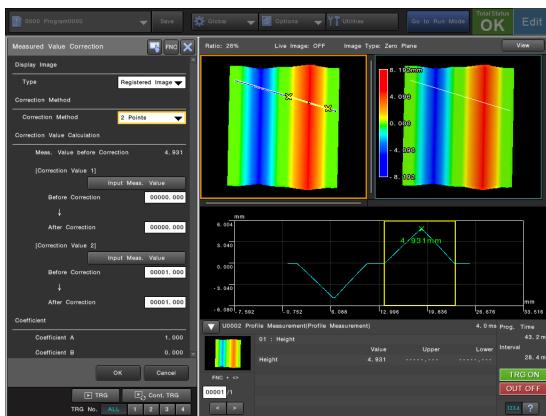
- 4 Enter the after correction measured value in [After Correction] field.

The offset for the measured value is calculated from the before correction and after correction values.

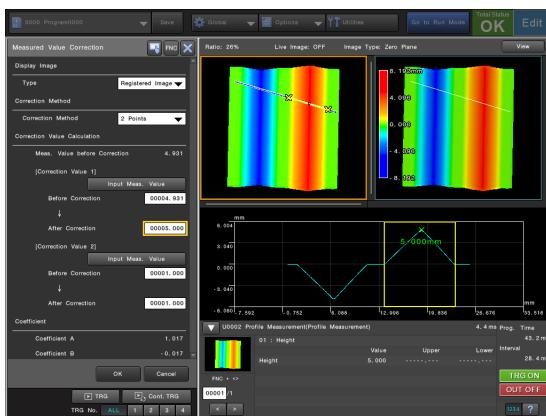
2 Points

Specify pre-correction and post-correction values for two measured values, and calculate the coefficients A and B from the results.

- 1 Select the image to display in [Display Image] and perform the measurement.**



- 2 Select [2 Points] in [Correction Method].**
- 3 Select [Input Meas. Value] to enter the current measured value into the [Before Correction] field for [Correction Value 1].**
- 4 Enter the after correction measured value in [After Correction] field for [Correction Value 1].**
- 5 Perform the measurement again.**



- 6 Select [Input Meas. Value] to enter the current measured value into the [Before Correction] field for [Correction Value 2].**
- 7 Enter the after correction measured value in [After Correction] field for [Correction Value 2].**

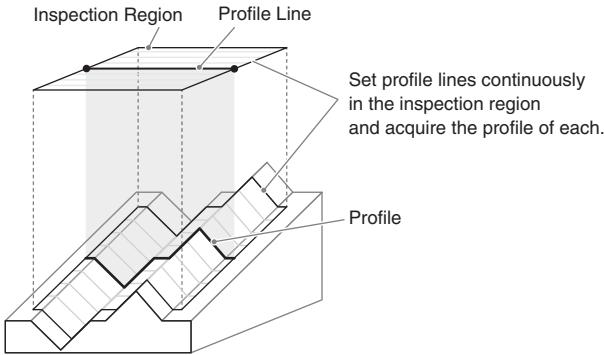
Coefficients A and B are calculated from the measured values corrected using [Correction Value 1] and [Correction Value 2].

Continuous Profile Measurement

Continuous Profile Measurement

Continuous profile measurement is performed by drawing multiple profile lines in succession at regular intervals in the region that is set on the height image.

A profile is obtained from each profile line and profile measurement (Page 8-49) is performed. Not only is measurement performed for each profile, it is also possible to judge the Continuous Profile Measurement as NG when the series of profile measurements include NG results of the specified count.



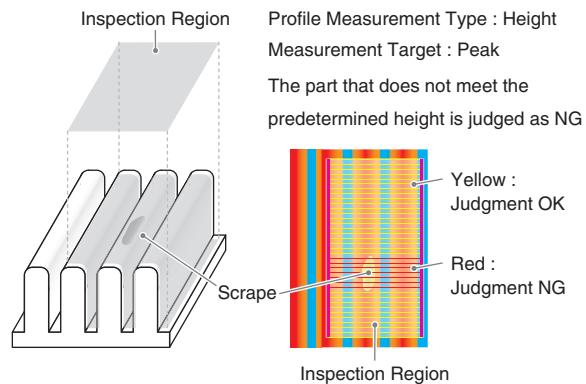
The continuous profile measurement unit cannot be used with the XG-X2800LJ.

Image of the Measurement

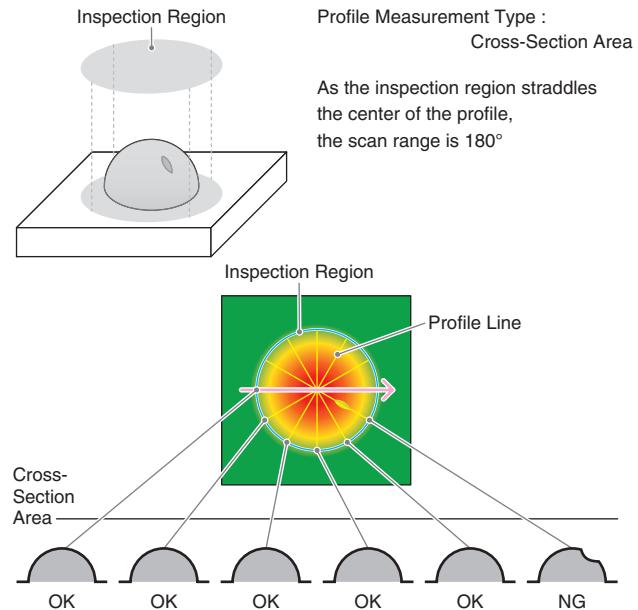
In the continuous profile measurement, an inspection region is specified for the height image to specify multiple profile lines.

The profile measurement performed for each of the obtained profiles is the same as in "Profile Measurement" (Page 8-49).

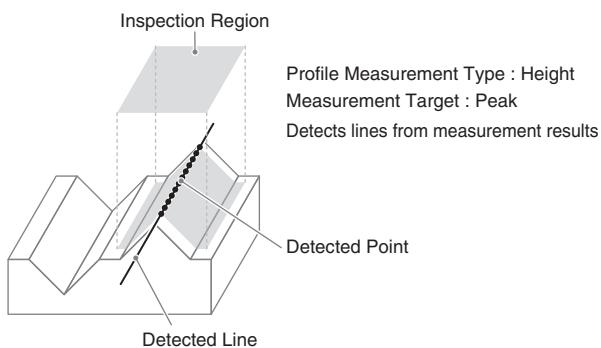
Continuous profile measurement of [Rectangle] or [Rotated Rectangle] inspection regions



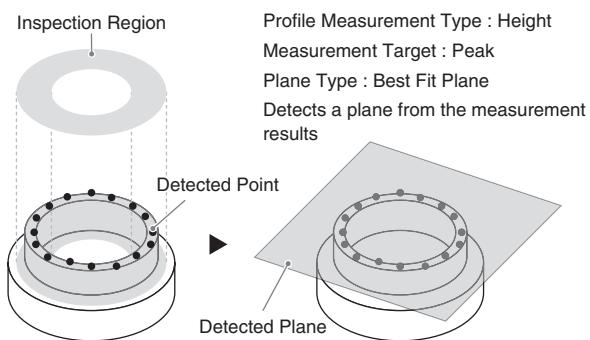
Continuous profile measurement of [Circle] inspection regions



Line Best Fit Detection

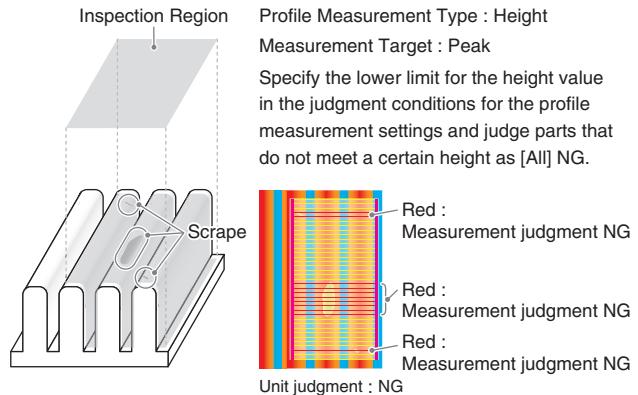


Plane Best Fit Detection

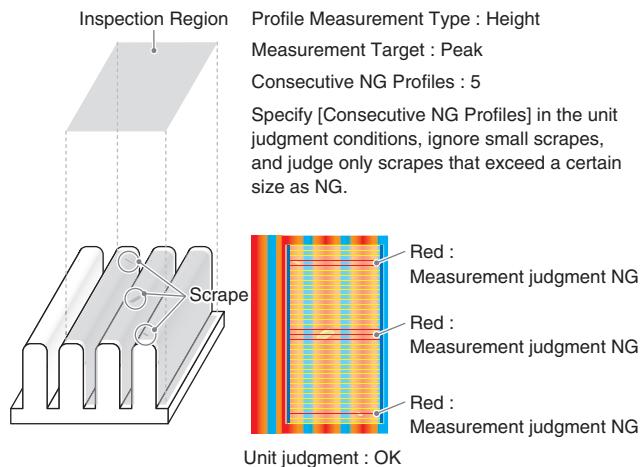


Measurement Sample

When Judging Using the Profile Measurement Result

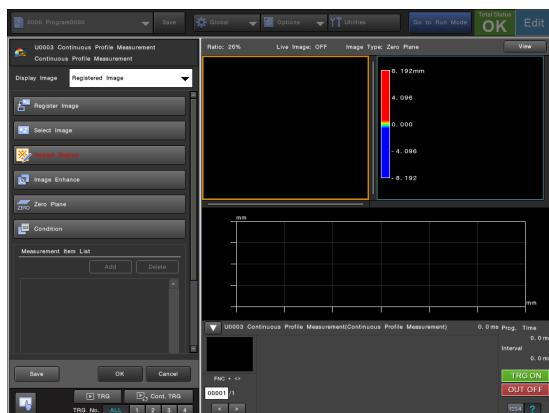


When Judging Using the Judgment Condition “Consecutive NG Profiles”



Top Menu

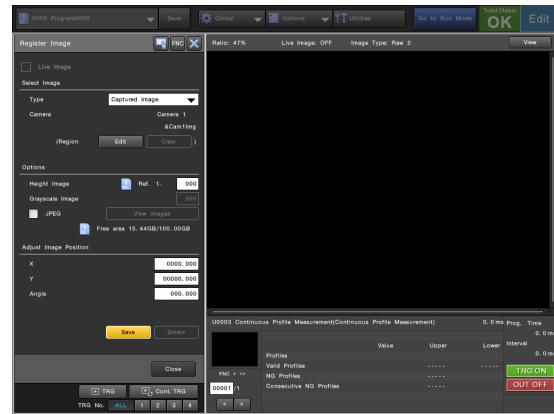
The top menu of the Continuous Profile Measurement unit consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 8-82)	Register the image to be used as reference for measurement and setting as the Registered Image.
Select Image (Page 8-84)	Specify the registered image and captured image to be used as reference for the measurements and settings.
Inspect Region (Page 8-85)	Specify the region for obtaining the profile on the height image.
Image Enhance (Page 8-86)	Specify the filter processing to apply to the image.
Zero Plane (Page 8-87)	Use this setting if you wish to set a plane with a different height/slope than the reference plane as the reference for measurement.
Condition (Page 8-88)	Specify the method for specifying the profile line in the inspection region, profile result display settings, and line/plane best fit detection settings.
Measurement Item List (Page 8-90)	Set the profile measurement type (height, level difference, position, etc.) for the obtained profile according to the measurement details.
Limits (Page 8-99)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 8-99)	Specify the measurement range and measurement results display settings.
Save (Page 8-100)	The present state is saved to the program file.

Register Image

An image can be saved to the controller to be used as a template for measurements and settings. It is recommended to adjust lighting and other conditions completely before registering an image.



Live Image (only when using 3D cameras)

Check this box to display the latest images through a continuous feed.



- [Live Image] is not available when the LJ-V series head is being used.
- [Live Image] is only available while the unit is being edited.
- When [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings], this cannot be changed.
- When configured to not wait for triggers in [Trigger Settings], this check is always cleared and cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is on, the live image is applied even if the capture unit is not running if the unit being edited is the capture unit that was recently run.
- [Live Image] cannot be used if image capture using an area camera is enabled.
- The image variable used for the captured image of the measurement unit should be the same as the destination image variable used for the capture unit being executed (waiting for a trigger). When the image capture buffer is set to enabled, the destination image variable of the capture unit executed most recently will be the subject of comparison.

Select Image

Type

Select an image to register.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** The registered image specified under [Options] is displayed.

Region

To register a portion of the image, select [Edit] and specify the area you wish to register.

Options

Height Image

Specify the registered image number "(camera No.)-(specified No.)" to register the image. The height image will be registered to the specified number (0 to 499).

-  **Point** The saved file name is "ref(camera number)_(specified No.)" (for full screen image registration) or "ref (camera No.)_(specified No.)_XXX_YYY" (for partial image registration).

Grayscale Image

The grayscale image is registered as a registered image of a number which is the sum of 500 and the number specified for [Height Image].

JPEG

Check this option to save the registered image in JPEG format. When this box is not checked, the image will be saved in BMP format as either a 24-bit color bitmap image (when a color camera, 3D camera or LJ-V series head is used) or an 8-bit grayscale bitmap image (when a monochrome camera is used).

-  **Point**
- Using image compression may result in some image deterioration, thus measurement results from a compressed image may be different from those when non-compressed image is used.
 - Using image compression on the height image will prevent you from obtaining correct height data due to image deterioration caused by the compression.

View Images

You can view all registered images in a list.

Adjust Image Position

Adjust the position of the image being captured.

X

X (horizontal) adjustment between -8191.000 and 8191.000 pixels.

Y

Y (vertical) adjustment between -16383.000 and 16383.000 pixels.

Angle

Adjust the position to the θ angle (rotation) around the center of the image between -999.999° and 999.999°.



Point

- When [Captured Image] is selected as the [Type] and a [Position Adjustment ID] is selected in [Inspect Region] (Page 8-85), [Pos. Adjust. value] can be selected in addition to [Number Input]. This option is useful because even when the image capture position deviates, the current image is automatically adjusted using the adjustment value based on the reference unit. However, note that when [Pos. Adjust. value] is selected in the state where a proper adjustment value cannot be measured for the current image, the position used for registration may be incorrect.
- Position adjustment may cause missing peripheries (black areas) due to image movement or jagged edges (jaggies) due to rotation in the registered image, or expansion of invalid pixels with no height data.

Save

Save the displayed image as a registered image under the conditions specified in the [Register Image] screen.



Point

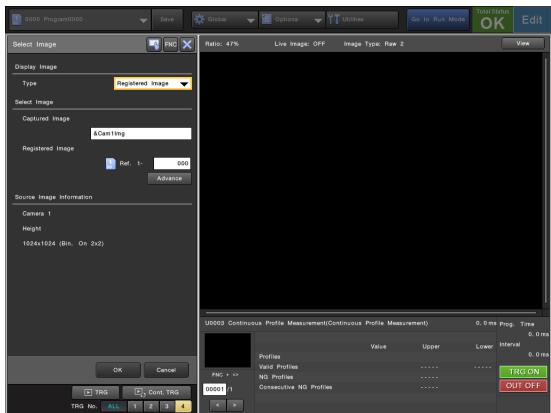
- The image cannot be registered if [Live Image] is enabled. Please stop live image update first before executing.
- When registering the height image only, the grayscale image will be deleted if a grayscale image is already registered for the corresponding registered image number. Note that the same applies when registering the grayscale image only.

Delete

When [Registered Image] is selected for [Type], you can delete the registered image specified under [Options].

Select Image

Specify the registered image and captured image to be used as reference for the measurements and settings.



Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** The registered image specified under [Select Image] is displayed.

Select Image

Captured Image

Set an image variable to be used as the captured image for the unit.

Registered Image

Specify the registered image number for the registered image to be used.

- The registered images of height images are managed as "ref (Camera No.)-(registered image number 0 to 499)". In addition, the number where 500 is added to the registered image number of the height image will be the registered image number of the corresponding grayscale image.
- The camera number is fixed to that of the camera of the image variable specified in the [Captured Image] field.

Advance

Set advanced options for the switching of registered images as necessary.

- Use numerical variable for registered image No.:** To use a variable to specify the registered image number to be switched to for the unit, check this box and then assign a numerical or numerical array type variable as a destination to be referenced. By using a variable for the registered image number and then issuing a variable reference value apply command (NU), the image is switched to the specified registered image in the variable and the image reference information is updated. For details, refer to the XG-X2000 Series Communications Control Manual.

- Process variable when changing programs:** Check this option to switch to the registered image specified with the Numerical variable (variable initial value) when the program is changed or the system is next powered up.



Note that the registered image number does not switch in synchronization with a change in the variable value.

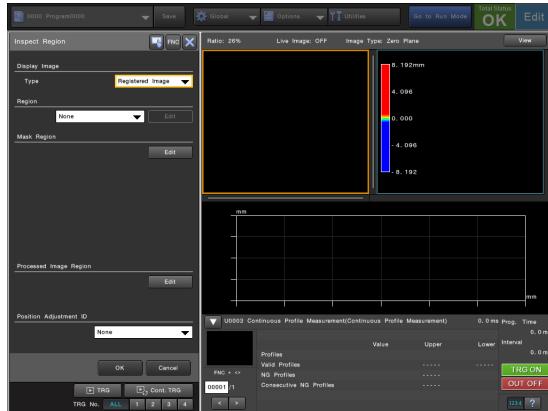
Source Image Information

The camera number, image type, and resolution of the camera corresponding to the image variable specified for the captured image will be displayed.

Inspect Region

Specify the region for obtaining the profile on the height image.

- Point** Changing the Region setting to [None] will initialize the settings in "Measurement Item List" (Page 8-90).



Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified under [Select Image].

Region

Specify the inspection region for drawing the profile lines. Select a shape for the inspection region and then draw the region, or select [Edit] and specify the region with numerical values.

Refer to "Drawing a Region" (Page 2-474) for more details on drawing a region.

- Point** [Profile No.] (0 to X) in the edit menu indicates the position of the profile within the region. When a number is specified, the profile position on the 2D screen and the profile on the profile screen are displayed in link accordingly.



Specify the Profile No.

The 2D and profile screens are displayed in link with the specified no.

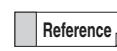
Mask Region

A mask region is an area which can be defined in the inspection region and will be excluded from the inspection. Up to four mask regions can be set per inspection region. A mask region is typically used for hiding an area that does not require inspection.

Select a shape for the mask region and then draw the region, or select [Edit] and specify the region with numerical values.

Processed Image Region

To use a processed region based on a resultant image variable, select [ON] and then select [Detail] for configuration.



Refer to "Generating a Region from an Image (Processed Image Region)" (Page 2-482) for more details on processed image region.

Image

Specify the resultant image variable used as reference for the processed image region.

Area

Select the areas to set as the inspection region from the image data in the resultant image variable by selecting either [Black] (Level 0) or [White] (Level 255, default).

Preview

When this box is checked, the specified resultant image variable is displayed. When the checkmark is removed, the display returns to its normal state.

Position Adjustment ID

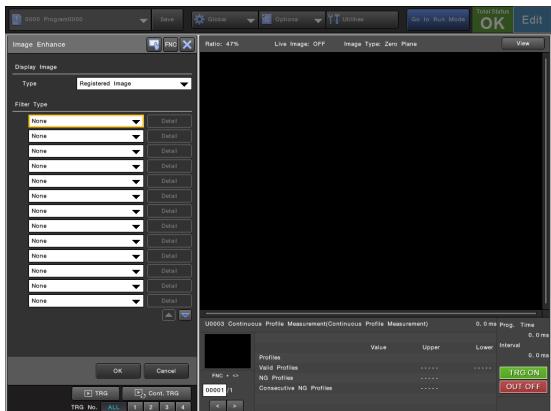
To apply position adjustment to the region, select the position adjustment unit to be referenced.

- Point**

The position adjustment is applied to the inspection, mask, processed image, zero plane, and zero plane mask regions.

Image Enhance

Specify the filter processing to apply to the image.



Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified under [Select Image].

Filter Type

Select the [Filter Type] field and then select the filter to apply.

- None:** Image enhancement is not used.
- Average:** This process smoothes and stabilizes the height variations that occur on the plane in a wave-like pattern. It also interpolates invalid pixels by applying the average value of the surrounding pixels. The filter application size (default: 3x3; or 5x5 for a bigger processing area) and the count (0 to 9, where 0 turns the filter off) can be configured.
- Median:** It has the effect of eliminating abnormal height values that occur in the form of spike-like noise by applying the median of the surrounding pixel heights to the center pixel. The filter application size (default: 3x3; or 5x5 for a bigger processing area) and the count (0 to 9, where 0 turns the filter off) can be configured.
- Gaussian:** This process reduces noise by applying heavier smoothing on pixels closer to the center. You can obtain a more natural blur compared to [Average], but the noise reduction effect will be weaker. The filter application size (default: 3x3; or 5x5 for a bigger processing area) and the count (0 to 9, where 0 turns the filter off) can be configured.

• **Smoothing:** This image enhancement is equivalent to [Average], but you can obtain a stronger smoothing effect by increasing the filter size. You can set the filter size (3 to 127) and the count (0 to 9, where 0 turns the filter off). In addition, by using [Border], you can select whether to perform smoothing at the boundary of the region by referring to height information outside the region or by considering them to be of the same height as the region boundary part.

• **Inv. Pixel Suppress.:** This option suppresses invalid pixels by interpolating invalid pixels without height data with the height data estimated from the surrounding valid pixels. Invalid pixel suppression does not affect the values of valid pixels around the invalid pixels. [Level] (1 (default) to 9), [Adj. Width] (Small (default), Large) and [Count] (0 to 1, where 0 turns the filter off) can be configured. The greater the level and the larger the adjustment width, the wider the range of invalid pixels that can be suppressed.

• **Spike Noise Cut:** Eliminates pixels (spike noise) whose heights spike out from the surroundings due to noise, etc. The processing direction and [Cut Size] (eliminates spike noise which is equal to or below the specified size width), [Cut Threshold] (eliminates spike points which stray from the specified height in relation to the surrounding as noise), and [Cut Target] can be specified. Specify the [Cut Size] from 2 - 30 (default setting value: 4), the [Cut Threshold] (mm) from 0.000 - 99.999 (default setting value: 0.050), and the [Cut Target] as Upper or Lower or Both (default setting value: Upper).

Point

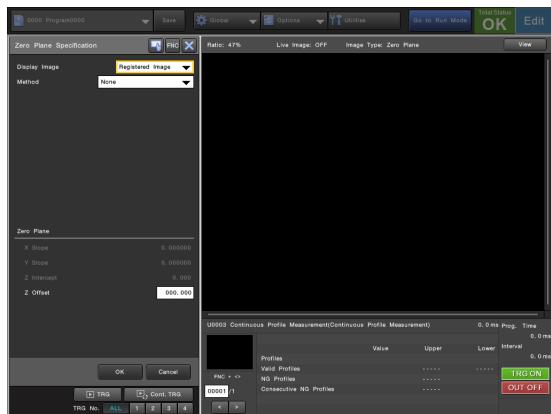
- When multiple filters are set, they are processed one by one from the top.
- Spike points which are eliminated via the spike noise cut filter become invalid pixels.
- Invalid pixels are pixels that do not contain height information as a result of failure to obtain the height during capture or due to unreliable measured values.

Reference

With a filter selected in the [Filter Type] field, if you move the 8-way key up and down while holding the No. 1 (FUNCTION) key on the console, you can change the filter application order.

Zero Plane

Use this setting if you wish to set a plane with a different height/slope than the reference plane as the reference for measurement.



- The zero plane is configured separately for each Continuous Profile Measurement unit.
- [Zero Plane Specification] corrects the height but not XY directions.
- If you have selected [Zero Plane Specification], [Zero Plane] can be specified as the display image type. The zero plane image will show the height distribution based on the zero plane.

Display Image

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified under [Select Image].

Method

Choose the method for specifying the Zero plane according to the measurement purpose and target.

Specifiable Zero Plane

	Changes According to the Captured Image	Does Not Change According to the Captured Image
Plane Parallel to Reference Plane	Region (Ave. Height)	None
Arbitrary Plane	Region (Best Fit), 3 Points (Real-Time)	-

* The zero plane can also be specified by referring to result data (From Result Data) or by specifying values (User Specified).

- None** (Default): Specify the reference plane as the zero plane.
- Region (Best Fit):** The least square plane calculated using the 3D information of the captured image within the specified region will be used as the zero plane.
- Region (Ave. Height):** The zero plane will be the plane that is parallel to the reference plane whose Z intercept is the average Z value of the captured image in the specified region.

- 3 Points (Real-Time):** The plane calculated using the 3D information of the captured image at the specified three points will be used as the zero plane.

- From Result Data:** Enter a plane type variable into the [Plane] field or directly specify and reference the zero planes, height extract planes, detected planes, etc. of other tools. Selecting [Input Assistant] opens a menu in which the result data of other units can be selected easily.



- If the reference unit itself refers to the result data of another unit, the setting will result in an error.
- When specifying variable reference of a plane type variable, specify the absolute measured value (AB) for the plane to be substituted into the variable. Planes that have been adjusted using position adjustment or scaling will not be converted properly.

- User Specified:** Specify the zero plane by specifying the values for the XY direction slopes and Z intercept in the [Zero Plane] field.

Zero Plane

Specify the zero plane in numeric values according to [Method].

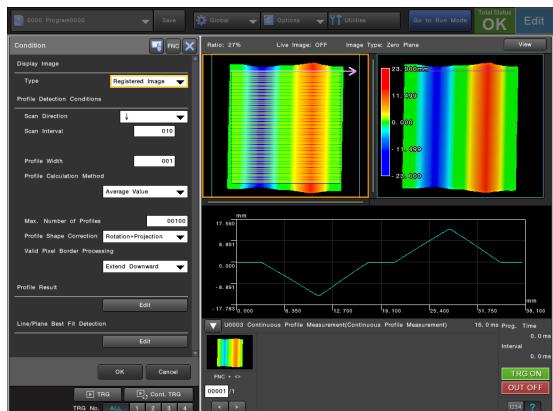
- X Slope:** Specifies the inclination amount (mm/pixel) in the Z direction for 1 pixel in the X direction.
- Y Slope:** Specifies the inclination amount (mm/pixel) in the Z direction for 1 pixel in the Y direction.
- Z Intercept:** Specifies the Z intercept of the zero plane.
- Z Offset:** Specifies the offset value in the Z-axis direction of the zero plane.



[X Slope], [Y Slope], and [Z Intercept] can only be specified when [Method] is set to [User Specified].

Condition

Specify the method for specifying the profile line in the inspection region, profile result display settings, and line/plane best fit detection settings.



Display Image

Type

Switch the image displayed on the screen.

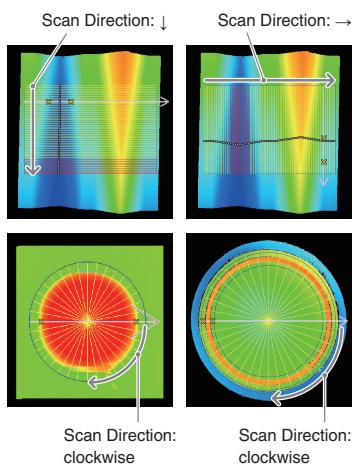
- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified under [Select Image].

Profile Detection Conditions

Scan Direction

Specify the direction of moving for the profile line in the inspection region. Items that can be selected vary depending on the shape of the inspection region.

- When the inspection region is [Rectangle]
 - ↓: Moves from the top to the bottom of the inspection region.
 - : Moves from the left to the right of the inspection region.
- When the inspection region is [Rotated Rectangle]
 - ↓: Moves in relation to the rotation direction of the inspection region.
- When the inspection region is [Circle] or [Ring]
 - clockwise: Moves in clockwise direction in the inspection region.



Scan Interval

Specify the scan interval of the profile line.

The smaller the scan interval, the longer the processing time while the more number of profiles can be measured within the same range.



The unit for the scan interval is "mm" when the inspection region is [Rectangle] / [Rotated Rectangle], and "°" when the inspection region is [Circle] or [Ring].

Scan Range (Only When the Inspection Region is [Circle] or [Ring])

Specify the scan range of the profile through a circular angle.

- 180°: Does a semicircle scan.
- 360°: Does a full circular scan. Select this option to use only one radius measurement item instead of two separate ones. Doubles the number of scans.

Profile Width

Specify the width of the profile line.



- The profile with the specified [Profile Width] is obtained according to the [Profile Calculation Method] setting.
- If a value smaller than 10 pixels is specified as the profile width, the profile lines are not displayed on the height image. This is to avoid the height image from being hidden by the profile lines drawn densely on the height image. The minimum profile display interval can be specified in [Display Options] - [Height Image] - [Interval for Display Enabling].

Profile Calculation Method

Specify the profile calculation method for obtaining the profile to be used for measurement, using the profile line specified on the height image and the profiles obtained from the [Profile Width] setting.

- Average Value:** The average of the obtained profiles is used for the measurement.
- Maximum Value:** The maximum pixel of the obtained profiles is combined to form the profile to use for the measurement.
- Minimum Value:** The minimum pixel of the obtained profiles is combined to form the profile to use for the measurement.

Start Angle (Only when the Inspection Region is [Circle] or [Ring])

Specify the amount of offset (angle) from the starting edge of the inspection region for the first profile.

If there is no detection target near the boundaries of the inspection region, the first profile can be placed at an optimum position without changing the inspection region.

Max. Number of Profiles

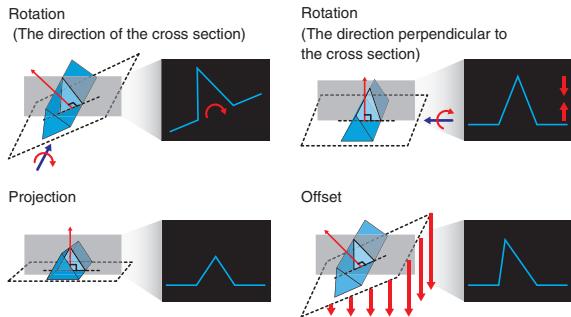
Specify the maximum number of profiles that can be measured. Specify [Max. Number of Profiles] to a larger value than the number of [Profiles].

Point The number of [Profiles] changes in relation to the inspection region and the scan interval.

Profile Shape Correction

The shape of the profile is corrected by rotating the profile line according to the inclination of the zero plane.

- Rotation + Projection:** The shape of the profile will not be distorted, even when the zero plane is tilted in the cross-section direction or a direction perpendicular to the cross-section. The profile is rotated in the cross-section plane and then projected onto a cross-section that is perpendicular to the zero plane.
- Rotation Only:** The shape of the profile will not be distorted, even when the zero plane is tilted in the direction of the cross-section. The profile is rotated in the cross-section plane in accordance with the inclination. Use this option to measure the profile by a cross-section parallel to the Z axis.
- None:** Calculates the profile by subtracting from each individual point the corresponding height of the zero plane. The shape of the profile will be distorted if the zero plane is tilted.



Valid Pixel Border Processing

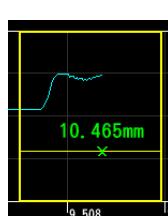
Select the processing method of the profile at the border section between valid and invalid pixels.

Point Only influences the measured value of edges and inflection points.

- Extend Upward:** Connects the upper limit with the valid pixels.



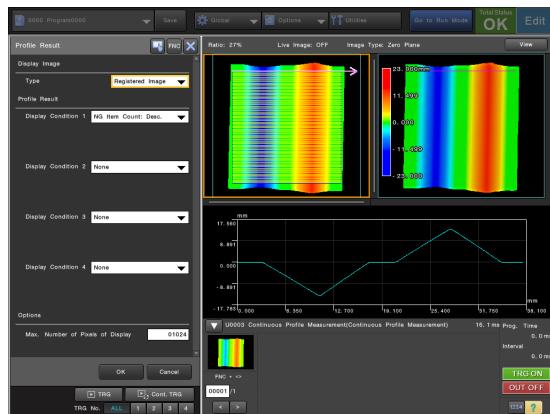
- Extend Downward:** Connects the lower limit with the valid pixels.



- None:** There will be no connection at the border section. Therefore edges and inflection points will not be detected.

Profile Result

Specify up to four display conditions for the profile to be displayed on the screen. The screen display can be switched easily by specifying the display conditions beforehand. Up to four profiles can be displayed using one condition.



Display Image

Type

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image.

Display Condition 1 to Display Condition 4

None

- NG Item Count: Desc.:** Shows the top 4 profiles of the profiles sorted by their NG item count in descending order.
- Measured Value: Desc.:** Shows the top 4 profiles of the profiles sorted by the measured value of the specified measurement item in descending order.

- Measured Value: Asc.:** Shows the bottom 4 profiles of the profiles sorted by the measured value of the specified measurement item in ascending order.

- Equal Division: Desc.:** Shows, starting with the profile with the highest profile number, four profiles equally spaced in the region in descending order.

- Equal Division: Asc.:** Shows, starting with the profile with the lowest profile number, four profiles equally spaced in the region in ascending order.

Measurement Item No.

If [Measured Value: Asc.] or [Measured Value: Desc.] is selected, specify the number of the target profile measurement.

Options

Max. Number of Pixels of Display

Specifies the display range of the profile by the number of pixels. Less program memory will be used by decreasing this value. However, some parts of the profile can not be depicted, when the value is set to a value smaller than the width of the measured profile. To avoid this, set the value to be larger than the width of the measured profile.



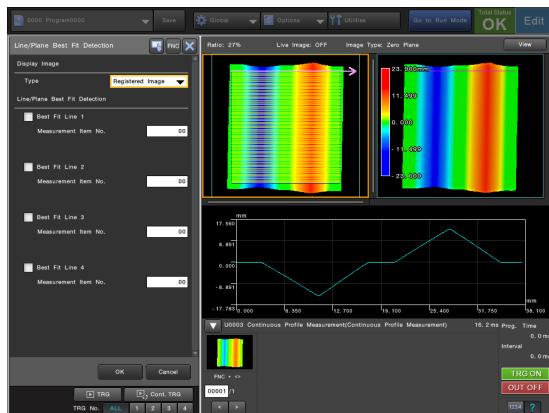
The program memory consumption is affected heavily by whether the display conditions are set and the maximum number of pixels of result display.

Line/Plane Best Fit Detection

Based on the measurement result of each profile obtained by setting [Profile Detection Conditions], a line can be detected if the inspection region is [Rectangle] or [Rotated Rect.]; and a plane can be detected if the region is [Circle] or [Ring].

Reference Detected lines and planes are displayed on the 3D display.

They can be referenced in 3D Geometry and Calculation units.



When the inspection region is [Rectangle] or [Rotated Rect.]

- Best Fit Line 1 to Best Fit Line 4:** Check this option to detect lines. The detected lines are least-squares lines.
- Measurement Item No.:** Specifies the measurement item number of the profile measurement settings used for measuring the value used for line detection.

When the inspection region is [Circle] or [Ring]

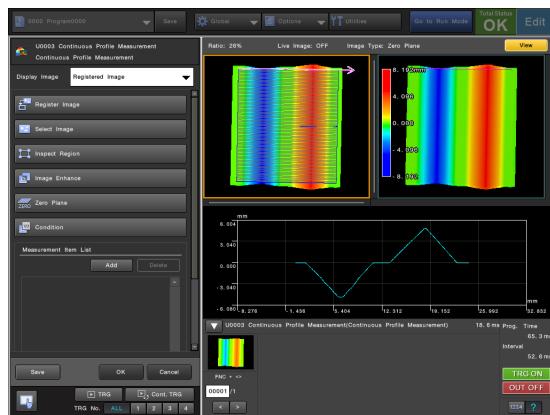
- Plane Type:** Specifies the type of the plane to detect.

Point When detecting a plane, [Scan Range] in [Profile Detection Conditions] changes to [360°].

- **None:** Does not detect a plane.
- **Best Fit Plane:** Detects the plane of least-squares from the detected points.
- **Tangential Plane (Top):** Detects the plane connecting to the detected points from above.
- **Tangential Plane (Bottom):** Detects the plane connecting to the detected points from underneath.
- Measurement Item No.:** Specifies the measurement item number of the profile measurement settings used for measuring the value used for plane detection.

Measurement Item List

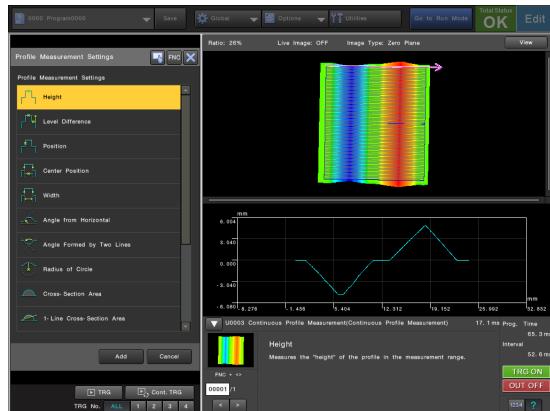
Set the profile measurement type for the obtained profile according to the measurement details.



Point Up to 32 profile measurement settings can be set.

Add

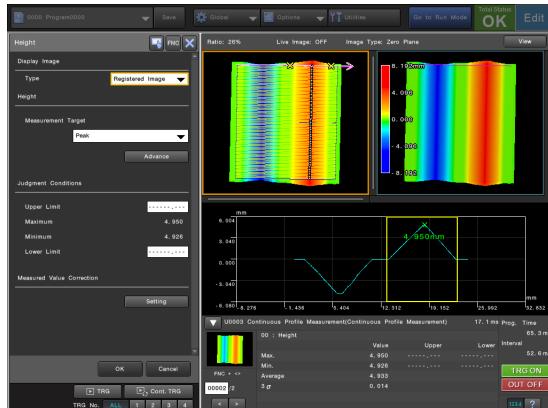
Add and configure [Profile Measurement Settings] (Page 8-49) according to the measurement details.



- Height (Page 8-91)
- Level Difference (Page 8-91)
- Position (Page 8-92)
- Center Position (Page 8-92)
- Width (Page 8-93)
- Angle from Horizontal (Page 8-93)
- Angle Formed by Two Lines (Page 8-94)
- Radius of Circle (Page 8-94)
- Cross-Section Area (Page 8-95)
- 1-Line Cross-Section Area (Page 8-95)
- 2-Line Cross-Section Area (Page 8-96)
- Points Distance (Page 8-96)
- Point/Line Distance (Page 8-97)
- Count (Page 8-97)
- Defect Detection (Page 8-97)

Height

Measures the "Height" of the profile in the measurement range.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Height**

- **Measurement Target**

Specify the measurement target (Page 8-52) for measuring the height.

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the measurement target detection conditions according to the specified measurement target.

Average (Page 8-101)

Peak (Page 8-102)

Bottom (Page 8-102)

Inflection Point (Page 8-103)

Two Lines Intersection (Page 8-104)

Circle/Line Intersection (Page 8-104)

Center of Circle (Page 8-105)

Distance to Reference Line (Page 8-107)

- **Judgment Conditions**

Set the tolerance (upper limit and lower limit) for the measured height.

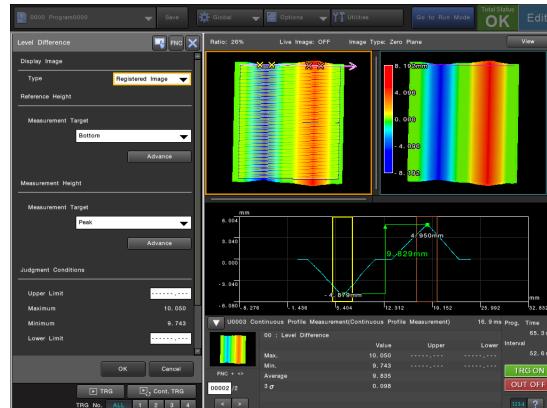
The unit of tolerance is mm.

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-109) for more details on the setting method.

Level Difference

Measures the level difference based on the "Height" of the profiles detected in two measurement ranges.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Reference Height/Measurement Height**

- **Measurement Target**

Specify the measurement target (Page 8-52) for measuring the reference height/measurement height.

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the measurement target detection conditions according to the specified measurement target.

Average (Page 8-101)

Peak (Page 8-102)

Bottom (Page 8-102)

Inflection Point (Page 8-103)

Two Lines Intersection (Page 8-104)

Circle/Line Intersection (Page 8-104)

Center of Circle (Page 8-105)

Distance to Reference Line (Page 8-107)

- **Judgment Conditions**

Set the tolerance (upper limit and lower limit) for the measured level difference. The unit of tolerance is mm.

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-109) for more details on the setting method.

Continuous Profile Measurement

Position

Measures the “Position” of the profile in the measurement range.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Position**

- **Measurement Target**

Specify the measurement target (Page 8-52) for measuring the position.

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the measurement target detection conditions according to the specified measurement target.

Edge (Page 8-100)

Peak (Page 8-102)

Bottom (Page 8-102)

Inflection Point (Page 8-103)

Two Lines Intersection (Page 8-104)

Circle/Line Intersection (Page 8-104)

Center of Circle (Page 8-105)

Distance to Reference Line (Page 8-107)

- **Judgment Conditions**

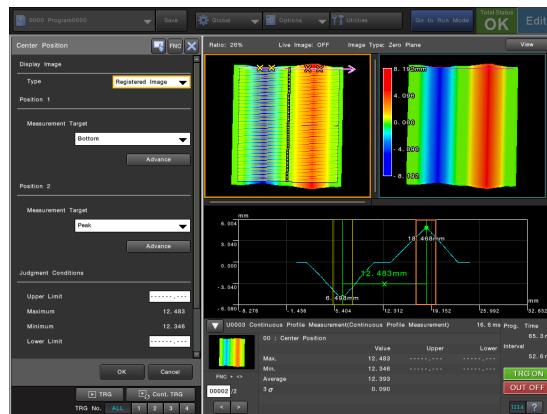
Set the tolerance (upper limit and lower limit) for the measured position. The unit of tolerance is mm.

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-109) for more details on the setting method.

Center Position

Measures the center position based on the “Position” of the profiles detected in two measurement ranges.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Position 1/Position 2**

- **Measurement Target**

Specify the measurement target (Page 8-52) for measuring the position.

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the measurement target detection conditions according to the specified measurement target.

Edge (Page 8-100)

Peak (Page 8-102)

Bottom (Page 8-102)

Inflection Point (Page 8-103)

Two Lines Intersection (Page 8-104)

Circle/Line Intersection (Page 8-104)

Center of Circle (Page 8-105)

Distance to Reference Line (Page 8-107)

- **Judgment Conditions**

Set the tolerance (upper limit and lower limit) for the measured center position. The unit of tolerance is mm.

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-109) for more details on the setting method.

Width

Measures the width based on the “Position” of the profiles detected in two measurement ranges.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Position 1/Position 2**

- **Measurement Target**

Specify the measurement target (Page 8-52) for measuring the position.

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the measurement target detection conditions according to the specified measurement target.

Edge (Page 8-100)

Peak (Page 8-102)

Bottom (Page 8-102)

Inflection Point (Page 8-103)

Two Lines Intersection (Page 8-104)

Circle/Line Intersection (Page 8-104)

Center of Circle (Page 8-105)

Distance to Reference Line (Page 8-107)

- **Judgment Conditions**

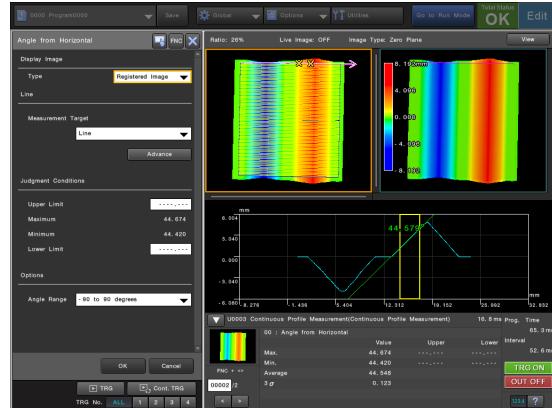
Set the tolerance (upper limit and lower limit) for the measured width. The unit of tolerance is mm.

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-109) for more details on the setting method.

Angle from Horizontal

Measures the “angle” between the horizontal and the line derived from the profile in the measurement range.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Line**

- **Measurement Target**

Fixed at [Line].

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the line (Page 8-106).

- **Judgment Conditions**

Set the tolerance (upper limit and lower limit) for the measured angle from horizontal. The unit of tolerance is °.

- **Options**

- **Angle Range:** Selects the display range for the detected angle.

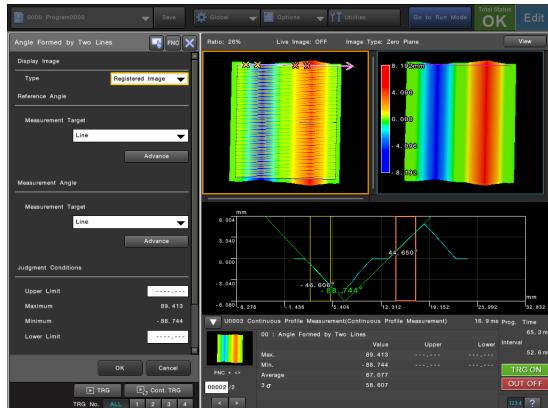
-90 to 90 degrees

0 to 180 degrees

Continuous Profile Measurement

Angle Formed by Two Lines

Measures the “angle” formed by the line derived from the profile in one measurement range and the line derived from the profile in the other measurement range.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Reference Angle/Measurement Angle**

- **Measurement Target**

Fixed at [Line].

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the line (Page 8-106).

- **Judgment Conditions**

Set the tolerance (upper limit and lower limit) for the measured angle formed by two lines. The unit of tolerance is °.

- **Options**

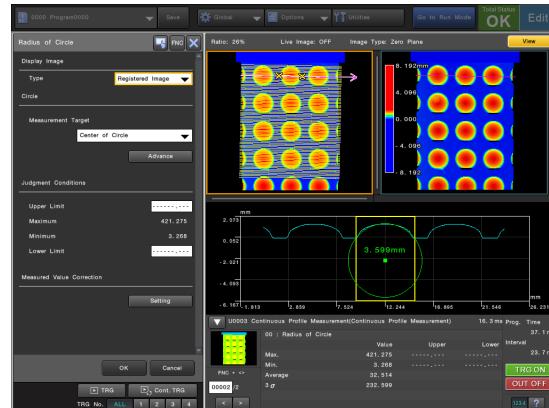
- **Angle Range:** Selects the display range for the detected angle.

-90 to 90 degrees

0 to 180 degrees

Radius of Circle

Measures the “radius of the circle” derived from the profile in the measurement range.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Circle**

- **Measurement Target**

Fixed at [Center of Circle].

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the center of the circle (Page 8-105).

- **Judgment Conditions**

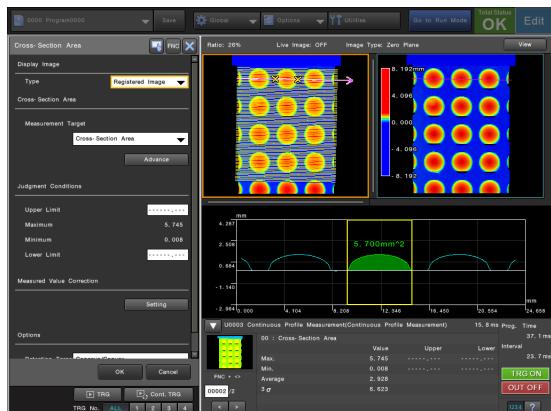
Set the tolerance (upper limit and lower limit) for the measured radius of the circle. The unit of tolerance is mm.

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-109) for more details on the setting method.

Cross-Section Area

Measures the area of the region enclosed by the zero plane and the profile in the measurement range.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Cross-Section Area**

- **Measurement Target**

Fixed at [Cross-Section Area].

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the cross-section area (Page 8-106).

- **Judgment Conditions**

Set the tolerance (upper limit and lower limit) for the measured cross-section area. The unit of tolerance is mm².

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-109) for more details on the setting method.

- **Options**

- **Detection Target:** Selects the detection target for the cross-section area.

Concave/Convex: Calculates the added area of the area of the region above the reference height and the area of the region below the reference height.

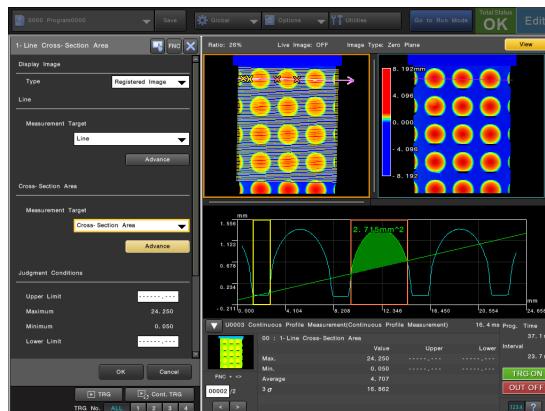
Concave Part: Calculates the area of the region below the reference height.

Convex Part: Calculates the area of the region above the reference height.

Integration: Calculates the added area with the area of the region above the reference height taken as a positive area and the area of the region below the reference height taken as a negative area.

1-Line Cross-Section Area

Measures the area of the region enclosed by one line and the profile in the measurement range.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Line**

- **Measurement Target**

Fixed at [Line].

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the line (Page 8-106).

- **Cross-Section Area**

- **Measurement Target**

Fixed at [Cross-Section Area].

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the cross-section area (Page 8-106).

- **Judgment Conditions**

Set the tolerance (upper limit and lower limit) for the measured cross-section area enclosed by 1 line. The unit of tolerance is mm².

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-109) for more details on the setting method.

- **Options**

- **Detection Target:** Selects the detection target for the cross-section area.

Concave/Convex: Calculates the added area of the area of the region above the reference height and the area of the region below the reference height.

Concave Part: Calculates the area of the region below the reference height.

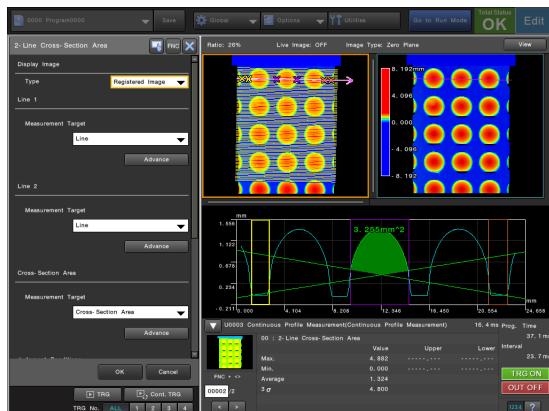
Convex Part: Calculates the area of the region above the reference height.

Integration: Calculates the added area with the area of the region above the reference height taken as a positive area and the area of the region below the reference height taken as a negative area.

Continuous Profile Measurement

2-Line Cross-Section Area

Measures the area of the region enclosed by two lines and the profile in the measurement range.



• Display Image

- Type

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

• Line 1/Line 2

- Measurement Target

Fixed at [Line].

- Advance

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the line (Page 8-106).

• Cross-Section Area

- Measurement Target

Fixed at [Cross-Section Area].

- Advance

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the cross-section area (Page 8-106).

• Judgment Conditions

Set the tolerance (upper limit and lower limit) for the measured cross-section area enclosed by two lines. The unit of tolerance is mm².

• Measured Value Correction

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-109) for more details on the setting method.

• Options

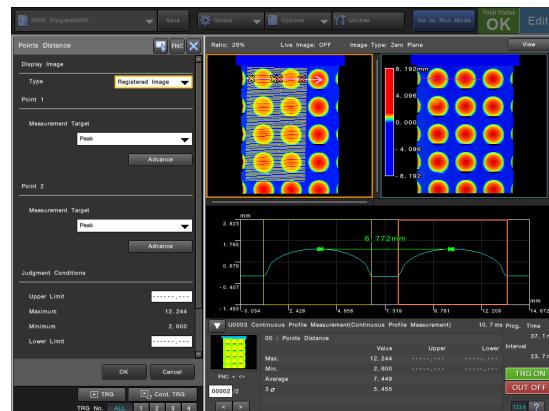
- Detection Target: Selects the detection target for the cross-section area.

Concave Part: Calculates the area of the region below the reference height.

Convex Part: Calculates the area of the region above the reference height.

Points Distance

Measures the distance based on the "Point" detected on the profile in two measurement ranges.



• Display Image

- Type

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

• Point 1/Point 2

- Measurement Target

Specify the measurement target (Page 8-52) for measuring the point.

- Advance

Select the method for specifying the measurement range and draw the region. Also, set the measurement target detection conditions according to the specified measurement target.

Edge (Page 8-100)

Peak (Page 8-102)

Bottom (Page 8-102)

Inflection Point (Page 8-103)

Two Lines Intersection (Page 8-104)

Circle/Line Intersection (Page 8-104)

Center of Circle (Page 8-105)

Distance to Reference Line (Page 8-107)

• Judgment Conditions

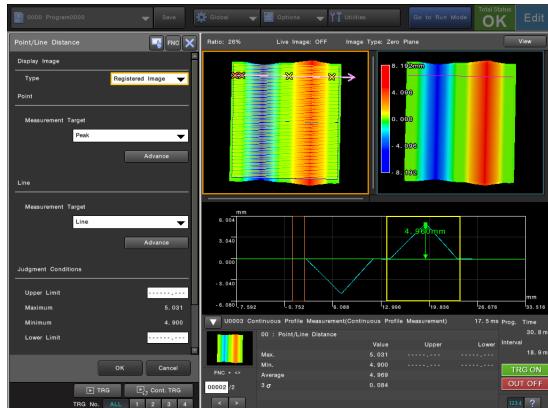
Set the tolerance (upper limit and lower limit) for the measured distance between the points. The unit of tolerance is mm.

• Measured Value Correction

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-109) for more details on the setting method.

Point/Line Distance

Measures the distance based on the "Point" detected on the profile in one measurement range and the "Line" detected from the profile in the other measurement range.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Point**

- **Measurement Target**

Specify the measurement target (Page 8-52) for measuring the point.

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the measurement target detection conditions according to the specified measurement target.

Edge (Page 8-100)

Peak (Page 8-102)

Bottom (Page 8-102)

Inflection Point (Page 8-103)

Two Lines Intersection (Page 8-104)

Circle/Line Intersection (Page 8-104)

Center of Circle (Page 8-105)

Distance to Reference Line (Page 8-107)

- **Line**

- **Measurement Target**

Fixed at [Line].

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the line (Page 8-106).

- **Judgment Conditions**

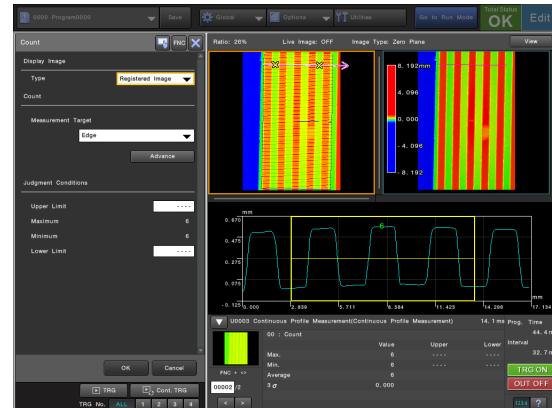
Set the tolerance (upper limit and lower limit) for the measured distance between the point and line. The unit of tolerance is mm.

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-109) for more details on the setting method.

Count

Measures the number of measurement targets found on the profile in the measurement range.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Count**

- **Measurement Target**

Specify the measurement target (Page 8-52) to be counted.

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the measurement target detection conditions according to the specified measurement target.

Edge (Page 8-100)

Inflection Point (Page 8-103)

Distance to Reference Line (Page 8-107)

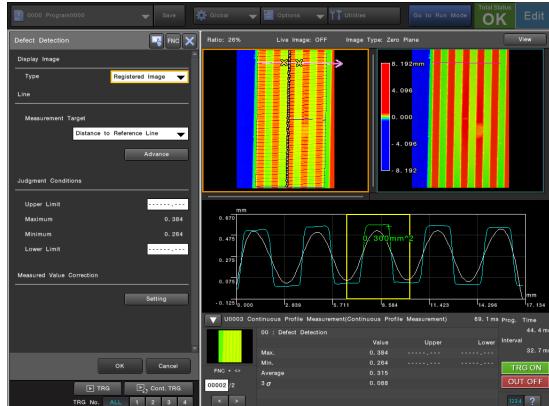
- **Judgment Conditions**

Set the tolerance (upper limit and lower limit) for the count.

Continuous Profile Measurement

Defect Detection

Determines the difference of the reference line and the profile inside the measurement range and measures the area of the determined defect regions.



- **Display Image**

- **Type**

Switch the image displayed on the screen.

Captured Image: Displays the latest image from the specified camera (image variable).

Registered Image: Displays the registered image specified under [Select Image].

- **Defect Detection**

- **Measurement Target**

Fixed at [Distance to Reference Line].

- **Advance**

Select the method for specifying the measurement range and draw the region. Also, set the detection conditions for the distance to reference line (Page 8-107).

- **Judgment Conditions**

Set the tolerance (upper limit and lower limit) for the measured defect area. The unit of tolerance is mm².

- **Measured Value Correction**

Select [Setting] and correct the measured value to match the full-scale value. Refer to "Correcting the Measured Value" (Page 8-109) for more details on the setting method.

Delete

Deletes the profile measurement settings.

Select the profile measurement setting to delete, and then select [Delete].

The profile measurement setting is deleted.

Edit

Edit the measurement details of existing profile measurement settings.

1 Select the profile measurement setting to edit, and then select [Edit].

The setting screen for the selected profile measurement setting appears.

2 Edit the measurement details.

Refer to "Add" (Page 8-90) for more details on the setting method.

3 Select [OK].

Copy

Copies existing profile measurement settings.

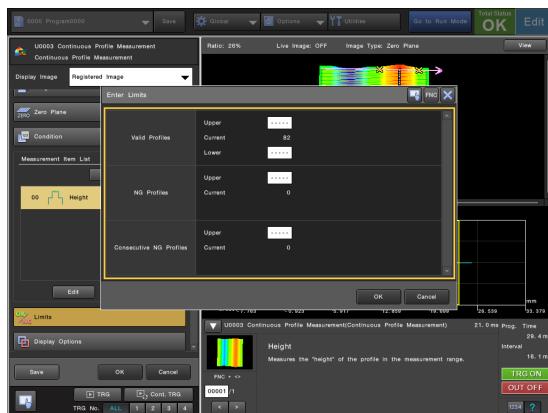
Select the profile measurement setting to copy, and then select [Copy].

The selected profile measurement setting is copied and added to the bottom of the list.

Limits

Set the tolerance (upper and lower limits) for the measured value.

When the measurement result is outside of the specified tolerance range, it is judged as [NG]. When the result is within the tolerance range, it is judged as [OK].



Select [Direct Input] and enter a value to set the desired tolerance.



- [----] indicates an empty state where no tolerance is set. In this state, judgment will not be performed after the measurement.
- To reset the tolerance setting to an empty state, select [Clear]. Select the tolerances you wish to configure and enter the tolerances.

Valid Profiles

The profiles for which one or more measurement items have been detected are judged as valid profiles; and upper/lower limits are set for the number of valid profiles.

Set this option in cases such as when an inspection is to be regarded as not correctly done when there is only a small number of valid profiles.

NG Profiles

Set the upper limit for the number of profiles judged as "NG" in individual profile measurements. If multiple profile measurements have been configured, the profile is judged as "NG" when there is one or more "NG" judgments.

When the upper limit is exceeded, the judgment of the continuous profile measurement unit becomes "NG".

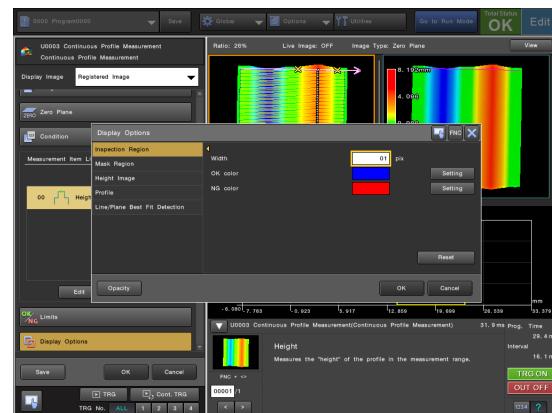
Consecutive NG Profiles

Set the upper limit for the number of profiles judged as "NG" consecutively in individual profile measurements.

When the upper limit is exceeded, the judgment of the continuous profile measurement unit becomes "NG".

Display Options

Specify the display settings for things such as the measurement range and measurement results.



Inspection Region

Specify the line thickness and display color of the inspection region.

Mask Region

Specify the line thickness and display color of the mask region.

Height Image

Specify options such as the showing/hiding of the measurement range, scan interval, and detected points on the height image, the display color, etc.

Profile

Show/hide the measurement results on the profile and specify the number of decimal places.



- The specified number of decimal places is only reflected to the measurement results displayed on the profile.
It is not reflected to the measurement results displayed on the [Run Mode] screen or those displayed in the information display in [Setup Mode].

Line/Plane Best Fit Detection

Specify options such as showing/hiding the line/plane on the 3D image, the line thickness, display color, etc. when detecting lines/planes.

Reset

Restores the display options to their default settings.

Opacity

This function can be used to change the opacity of this dialog so that what is going on in the background can be seen.

Save

The present state is saved to the program file.

The settings for all the units are saved in the current program file in SD Card 1 or SD Card 2.

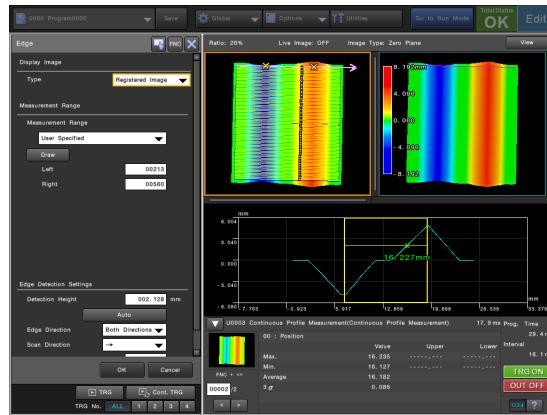
Point

- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. For example, variable values or the default display, such as the screen, changed in the current program can be excluded when saving.

Setting the Measurement Target

Edge

Specify the measurement range and edge detection conditions to measure the edge within the region.



Display Image

Type

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Measurement Range

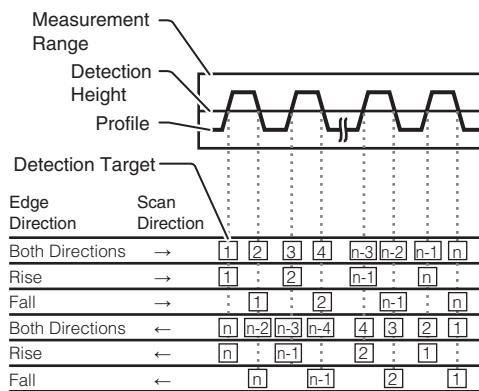
Specify the range for measuring the edge.

- **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
- **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
- **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-108) for more details on the setting method.

Edge Detection Settings

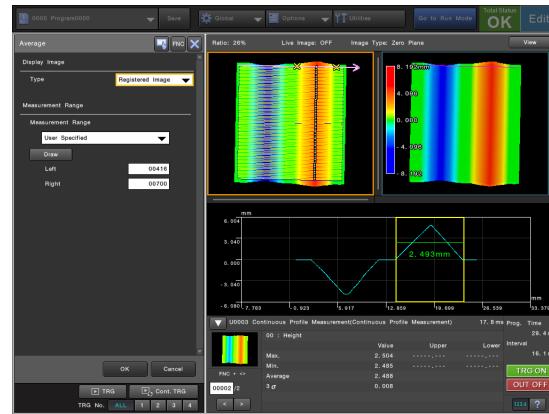
Specify the edge detection conditions.



- Detection Height:** Specifies the height where the profile traverses within the measurement range to be detected as an edge. When [Auto] is selected, the height for detecting the edge in the displayed profile is set automatically.
- Edge Direction:** Specifies the change direction of the profile to detect as an edge.
 - Both Directions:** Considers both the rise and fall as measurement targets.
 - Rise:** Considers a bottom to top direction of traversal as the target.
 - Fall:** Considers a top to bottom direction of traversal as the target.
- Scan Direction:** Specifies the direction for scanning for the edge within the measurement range.
 - : Does a scan from left to right of the displayed profile (from start point to end point of the profile line).
 - ←: Does a scan from right to left of the displayed profile (from end point to start point of the profile line).
- Detection Target:** From among the edge candidates that satisfy the conditions, the label that will be the target of the detection is specified by its number.

Average

Specify the measurement range to measure the average height value of the profile in the region.



Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified under [Select Image].

Measurement Range

Specify the range for measuring the average.

- User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
- Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
- Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-108) for more details on the setting method.

Continuous Profile Measurement

Peak

Specify the measurement range to measure the maximum value of the profile in the region.



Display Image

- Type**

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Measurement Range

Specify the range for measuring the peak.

- **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
- **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
- **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-108) for more details on the setting method.

Bottom

Specify the measurement range to measure the minimum value of the profile in the region.



Display Image

- Type**

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Measurement Range

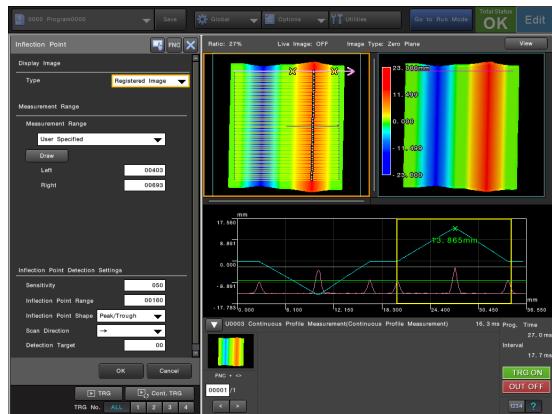
Specify the range for measuring the bottom.

- **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
- **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
- **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-108) for more details on the setting method.

Inflection Point

Specify the measurement range and inflection point detection settings to measure the inflection point of the profile in the region.



Display Image

- Type**

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Measurement Range

Specify the range for measuring the inflection point.

- User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
- Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
- Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-108) for more details on the setting method.

Inflection Point Detection Settings

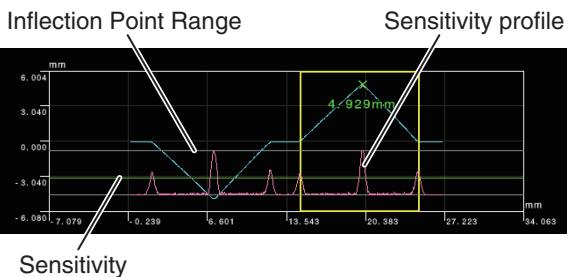
Set the detection conditions for the inflection point.

- Sensitivity:** Sensitivity is a threshold value for determining up to what level of profile slope change (bending degree) is to be detected as an inflection point.

When setting the sensitivity, the differentiated waveform of the profile data (the sensitivity profile) is displayed to emphasize the inflection point.

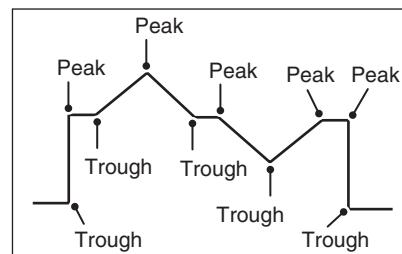
Set the sensitivity in the range between 1 to 100 such that the sensitivity profile of the point to detect exceeds the threshold value.

- Inflection Point Range:** Sets the display range for the graph of the inflection point. If part of the graph of the inflection point is cut off, a larger value should be set.



- Inflection Point Shape:** Specifies the shape of the profile gradient.

- **Peak/Trough:** The profile slope change forms an inflection point from both the decreasing and increasing trends.
- **Peak:** This is the inflection point where the profile slope change is of a decreasing trend.
- **Trough:** This is the inflection point where the profile slope change is of an increasing trend.



- Scan Direction:** Specifies the direction for scanning for the inflection point within the measurement range.

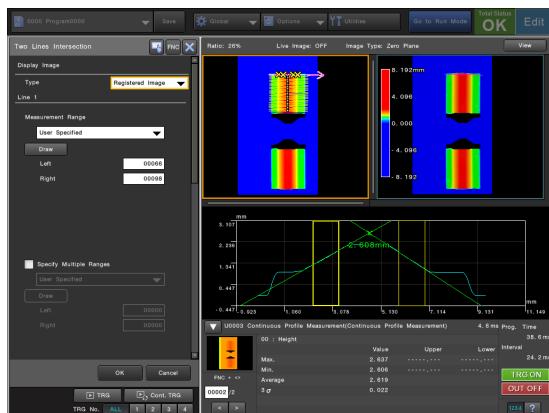
- →: Does a scan from left to right of the displayed profile (from start point to end point of the profile line).
- ←: Does a scan from right to left of the displayed profile (from end point to start point of the profile line).

- Detection Target:** From among the inflection point candidates that satisfy the conditions, the label that will be the target of the detection is specified by its number.

Continuous Profile Measurement

Two Lines Intersection

Specify two measurement ranges to measure the position of the point where the approximate lines calculated from the profile of each measurement range intersect.



Display Image

- Type**

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Line 1/Line 2

- Measurement Range:** Specifies the measurement range for detecting the approximate line.

- **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
- **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
- **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-108) for more details on the setting method.

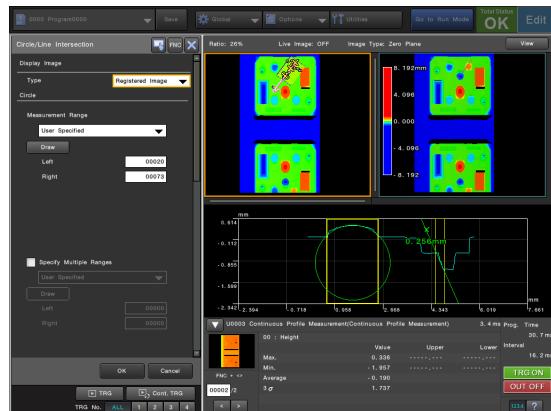
- Specify Multiple Ranges:** When this is enabled, another measurement target area is specified and an approximate line can be detected from those two areas. The method for specifying the measurement range is the same as above.

Options

- Deformation Correction:** Turning this option on reduces the noise influence during the detection of approximate lines.

Circle/Line Intersection

Specify two measurement ranges. Detect an approximate circle from the profile in one measurement range; and detect an approximate line from the profile in the other measurement range. Draw a perpendicular line from the center of the detected approximate circle to the approximate line, and measure the position/height of the point of intersection.



Display Image

- Type**

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Circle

- Measurement Range:** Specifies the measurement range for detecting the approximate circle.

- **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
- **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
- **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-108) for more details on the setting method.

- Specify Multiple Ranges:** When this is enabled, another measurement target area is specified and an approximate circle can be detected from those two areas. The method for specifying the measurement range is the same as above.

Line

- **Measurement Range:** Specifies the measurement range for detecting the approximate line.
 - **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
 - **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
 - **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-108) for more details on the setting method.

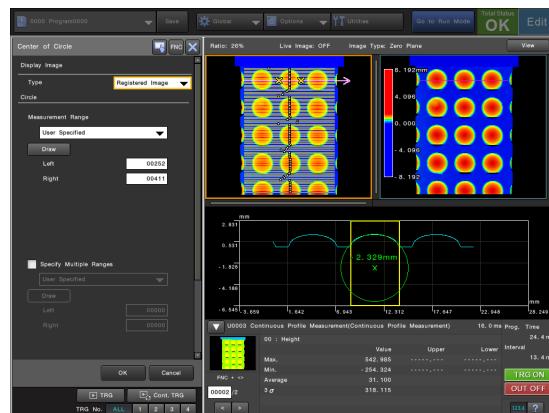
- **Specify Multiple Ranges:** When this is enabled, another measurement target area is specified and an approximate line can be detected from those two areas. The method for specifying the measurement range is the same as above.

Options

- **Deformation Correction:** Turning this option on reduces the noise influence during the detection of the approximate circle and line.

Center of Circle

Specify the measurement range to measure the center position of the approximate circle detected from the profile in the measurement range.



Display Image

Type

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Circle

- **Measurement Range:** Specifies the measurement range for detecting the approximate circle.
 - **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
 - **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
 - **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.
- Refer to "Setting the Measurement Range" (Page 8-108) for more details on the setting method.
- **Specify Multiple Ranges:** When this is enabled, another measurement target area is specified and an approximate circle can be detected from those two areas. The method for specifying the measurement range is the same as above.

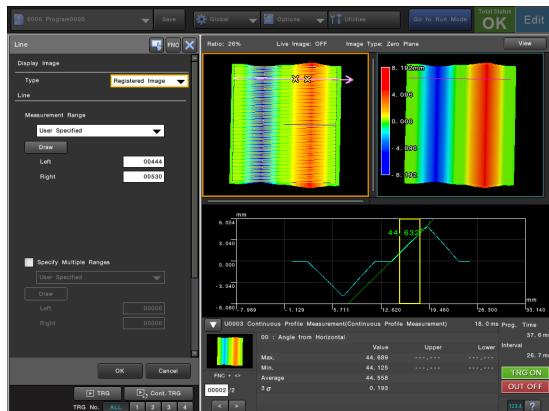
Options

- **Deformation Correction:** Turning this option on reduces the noise influence during the detection of the approximate circle.

Continuous Profile Measurement

Line

Specify the measurement range to detect an approximate line from the profile in the measurement range.



Display Image

- Type**

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Line

- Measurement Range:** Specifies the measurement range for detecting the approximate line.

- **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
- **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
- **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-108) for more details on the setting method.

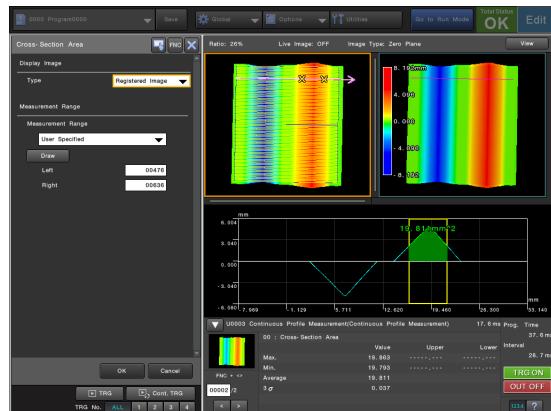
- Specify Multiple Ranges:** When this is enabled, another measurement target area is specified and an approximate line can be detected from those two areas. The method for specifying the measurement range is the same as above.

Options

- Deformation Correction:** Turning this option on reduces the noise influence during the detection of the approximate line.

Cross-Section Area

Specify the measurement range to measure the area of the region delimited by the profile in the measurement range and zero plane.



Display Image

- Type**

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Measurement Range

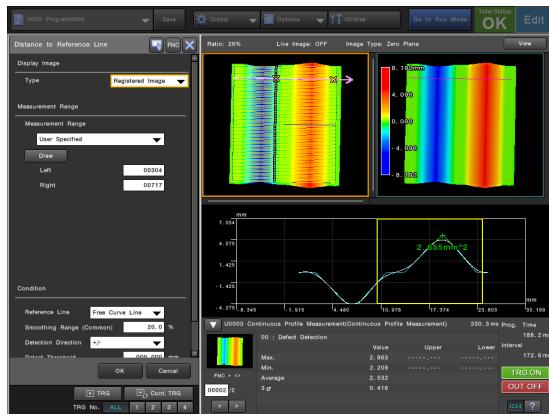
- Measurement Range:** Specifies the measurement range for detecting the cross section area.

- **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
- **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
- **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-108) for more details on the setting method.

Distance to Reference Line

Specify the measurement range to detect a reference line from the profile in the measurement range, and measure the difference from the profile.



Display Image

- Type**

Switch the image displayed on the screen.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** Displays the registered image specified under [Select Image].

Measurement Range

- Measurement Range:** Specifies the measurement range for detecting the reference line.

- **User Specified:** Specifies the right/left end of the measurement range in numeric values. The measurement range does not change.
- **Refer to Position Meas. (1 pt.):** Specifies the region by referencing the position measured in other profile measurements.
- **Refer to Position Meas. (2 pts.):** Specifies the region based on two positions measured in other profile measurements.

Refer to "Setting the Measurement Range" (Page 8-108) for more details on the setting method.

Condition

Specify the conditions for detecting the difference from the reference line.

- **Reference Line:** Specifies the reference line fitting the profile to measure.

- **Free Curve Line**

- **Line**

- **Circle**

- **Smoothing Range (Common):** Set this option when selecting "Free Curve Line" as the reference line.

Increase the smoothing range to make the free curve smoother to the profile of the measurement target. To make the free curve sharper, decrease it.

- **Detection Direction:** Specifies the direction to detect.

- **+/-:** Detects irregularities in both the + and - directions as a difference.
- **+**: Detects as a difference only the irregularities in the + direction.
- **-**: Detects as a difference only the irregularities in the - direction.

When the reference line is set to "Circle", "+" will be set to outside and "-" to inside the circle.

- **Detection Threshold:** Distances from the reference line, that exceed the specified value will be detected as defects (unit: mm).

- **Lowest Detected Width:** A defect whose width is smaller than the specified lower limit is not detected as a defect (unit: mm).



When [Distance to Reference Line] is used for the position calculation, the position of the part of the section deemed as a defect that is furthest away from the reference line is calculated as the result.

Setting the Measurement Range

Set the measurement target range.

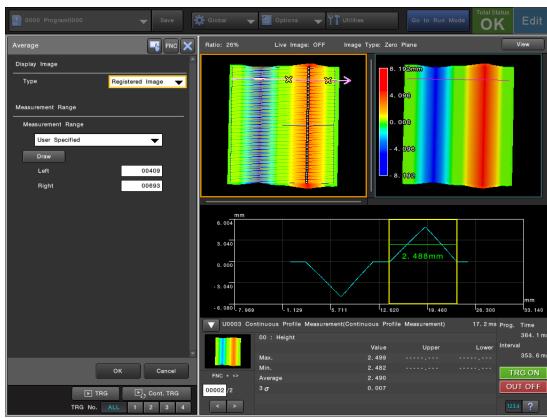
The measurement range can be set using the following methods.

- User Specified (Page 8-108)
- Refer to Position Meas. (1 pt.) (Page 8-108)
- Refer to Position Meas. (2 pts.) (Page 8-109)

User Specified

Specify the left and right end positions of the measurement range in numeric values.

Use this option when the measurement range is fixed.



Draw

Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-30) for more details.

Left

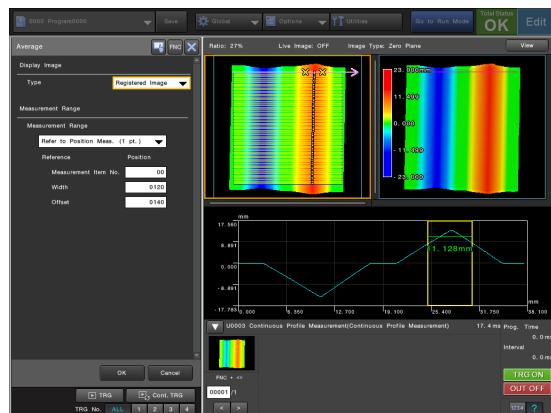
Specify the left end position of the measurement range.

Right

Specify the right end position of the measurement range.

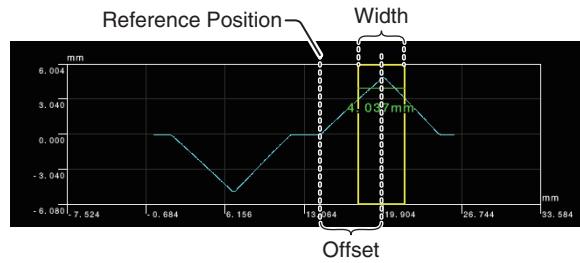
Refer to Position Meas. (1 pt.)

Specify the region by referencing the position (position or center position) measured in other profile measurement settings.



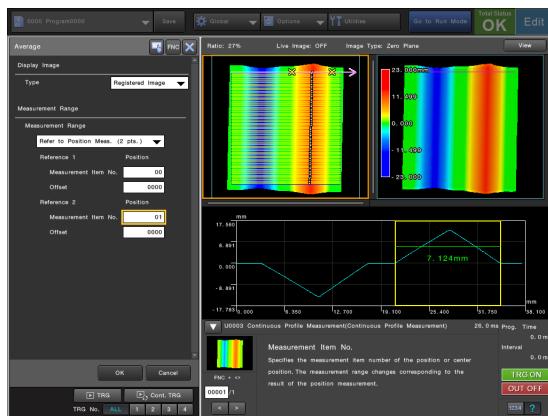
Reference

- **Measurement Item No.:** Specify the center position of the measurement range by specifying the measurement item number of the position or center position. The measurement range changes corresponding to the result of the position measurement.
- **Width:** Specifies the width of the measurement range with the referenced position in the center.
- **Offset:** Specifies an offset for the position of the measurement range.



Refer to Position Meas. (2 pts.)

Specify two positions measured in other profile measurements (position or center position) as the left and right end positions of the measurement range.



Reference 1

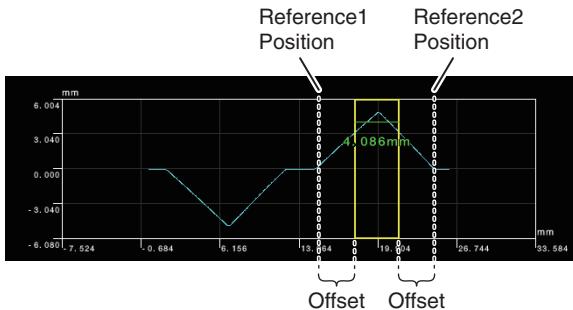
Specify the left end position of the measurement range.

- Measurement Item No.:** Specifies the measurement item number of the position or center position. The measurement range changes corresponding to the result of the position measurement.
- Offset:** Specifies an offset for the position of the measurement range.

Reference 2

Specify the right end position of the measurement range.

- Measurement Item No.:** Specifies the measurement item number of the position or center position. The measurement range changes corresponding to the result of the position measurement.
- Offset:** Specifies an offset for the position of the measurement range.



Correcting the Measured Value

Correct the measured value to match the full-scale value. The following correction methods are available.

- 1 Point (Page 8-109)
- 2 Points (Page 8-110)

1 Point

A correction is performed based on one measured value. Set the post-correction measured value for the current measured value to calculate the offset for the measured value.

- 1 Select the image to display in [Display Image] and perform the measurement.



- 2 Select [1 Point] in [Correction Method].

- 3 Select [Input Meas. Value] to enter the current measured value into the [Before Correction] field.

- 4 Enter the after correction measured value in [After Correction] field.

The offset for the measured value is calculated from the before correction and after correction values.

2 Points

Specify pre-correction and post-correction values for two measured values, and calculate the coefficients A and B from the results.

- Select the image to display in [Display Image] and perform the measurement.**



- Select [2 Points] in [Correction Method].**
- Select [Input Meas. Value] to enter the current measured value into the [Before Correction] field for [Correction Value 1].**
- Enter the after correction measured value in [After Correction] field for [Correction Value 1].**
- Perform the measurement again or switch the profile.**



- Select [Input Meas. Value] to enter the current measured value into the [Before Correction] field for [Correction Value 2].**
- Enter the after correction measured value in [After Correction] field for [Correction Value 2].**

Coefficients A and B are calculated from the measured values corrected using [Correction Value 1] and [Correction Value 2].

3D Geometry

3D Geometry

Using the 3D Geometry unit, it is possible to calculate distances, angles, lines, planes, spheres, etc. based on the 3D information of figures such as arbitrary points and planes specified on the height image.

Points and planes measured in other tools can also be used for the 3D information to be used for the calculations.



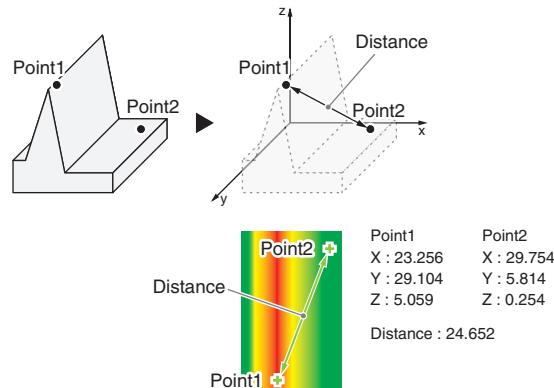
The 3D geometry unit cannot be used on XG-X2800LJ.

Calculation Image

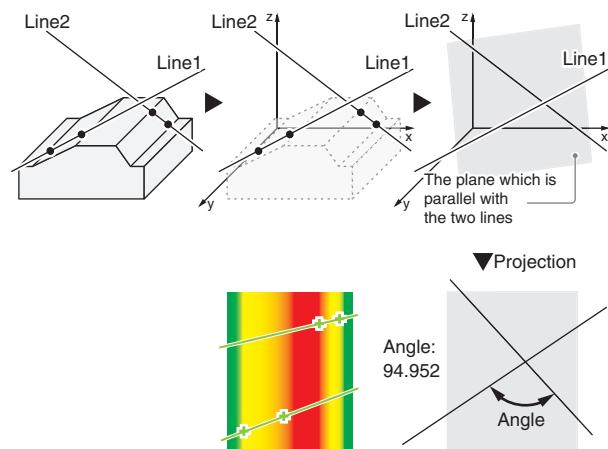
The following can be calculated in 3D geometry:

- Distance: Calculates the distance between the input elements.
- Angle: Calculates the angle between the input elements.
- Point: Calculates the intersection point, midpoint, etc. between the input elements.
- Line: Calculates a line from the input elements.
- Plane: Calculates a plane from the input elements.
- Sphere: Calculates a sphere from the input element.

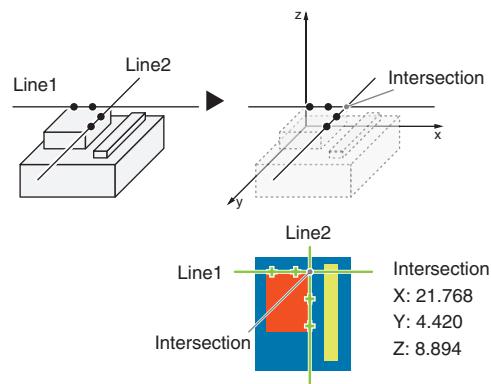
Distance: Points Distance



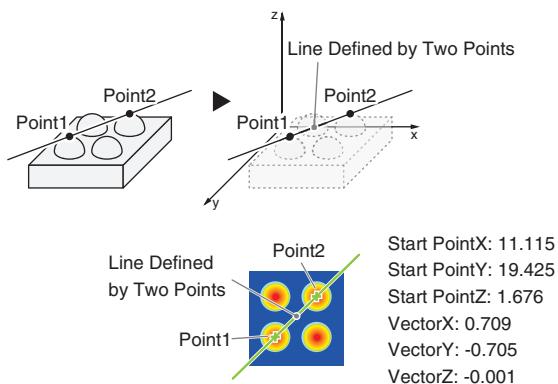
Angle: Angle Between Two Lines



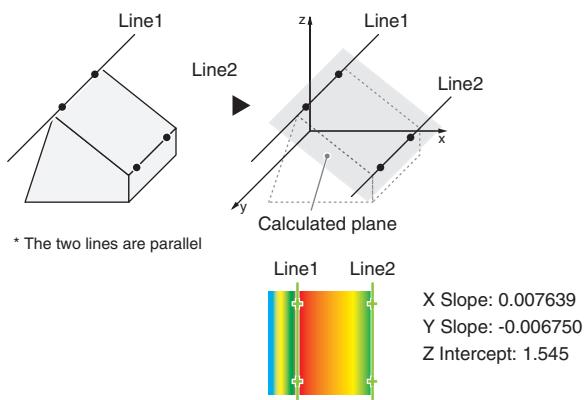
Point: Intersection of Two Lines



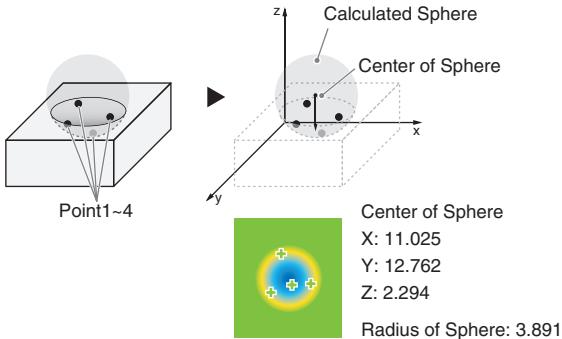
Line: Line Defined by Two Points



Plane: Plane Determined by Two Lines

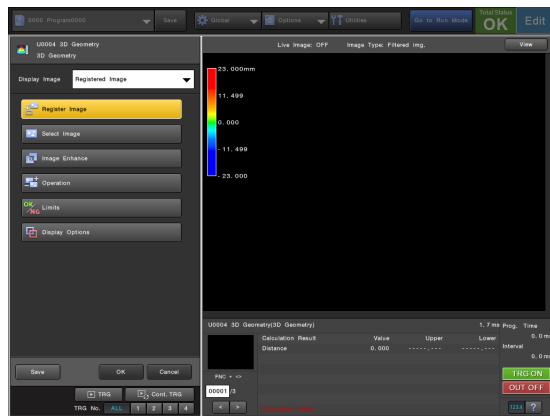


Sphere: Sphere



Top Menu

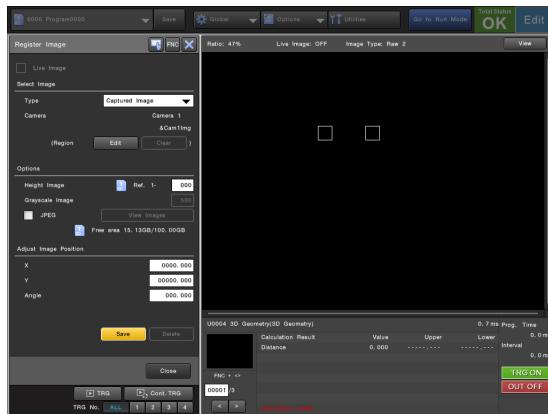
The top menu of the 3D Geometry unit consists of the following options. Configure settings under each option as required for the inspection.



Register Image (Page 8-113)	Register the image to be used as reference for measurement and setting as the Registered Image.
Select Image (Page 8-114)	Specify the registered image and captured image to be used as reference for the measurements and settings.
Image Enhance (Page 8-115)	Specify the filter processing to apply to the image.
Operation (Page 8-116)	Set the calculation details according to the calculation target type and measurement method.
Limits (Page 8-119)	Set the tolerance (upper and lower limits) for the measured value.
Display Options (Page 8-119)	Specify the figures and measurement results display settings.
Save (Page 8-120)	The present state is saved to the program file.

Register Image

An image can be saved to the controller to be used as a template for measurements and settings. It is recommended to adjust lighting and other conditions completely before registering an image.



Live Image (only when using 3D cameras)

Check this box to display the latest images through a continuous feed.



- [Live Image] is not available when the LJ-V series head is being used.
- [Live Image] is only available while the unit is being edited.
- When [Run Mode Screen Update Setting] is set to [Live Image] in [Trigger Settings], this cannot be changed.
- When configured to not wait for triggers in [Trigger Settings], this check is always cleared and cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is on, the live image is applied even if the capture unit is not running if the unit being edited is the capture unit that was recently run.
- [Live Image] cannot be used if image capture using an area camera is enabled.
- The image variable used for the captured image of the measurement unit should be the same as the destination image variable used for the capture unit being executed (waiting for a trigger). When the image capture buffer is set to enabled, the destination image variable of the capture unit executed most recently will be the subject of comparison.

Select Image

Type

Select an image to register.

- **Captured Image:** Displays the latest image from the specified camera (image variable).
- **Registered Image:** The registered image specified under [Options] is displayed.

Region

To register a portion of the image, select [Edit] and specify the area you wish to register.

Options

Height Image

Specify the registered image number "(camera No.)-(specified No.)" to register the image. The height image will be registered to the specified number (0 to 499).



The saved file name is "ref(camera number)_(specified No.)" (for full screen image registration) or "ref (camera No.)_(specified No.)_XXX_YYY" (for partial image registration).

Grayscale Image

The grayscale image is registered as a registered image of a number which is the sum of 500 and the number specified for [Height Image].

JPEG

Check this option to save the registered image in JPEG format. When this box is not checked, the image will be saved in BMP format as either a 24-bit color bitmap image (when a color camera, 3D camera or LJ-V series head is used) or an 8-bit grayscale bitmap image (when a monochrome camera is used).



- Using image compression may result in some image deterioration, thus measurement results from a compressed image may be different from those when non-compressed image is used.
- Using image compression on the height image will prevent you from obtaining correct height data due to image deterioration caused by the compression.

View Images

You can view all registered images in a list.

Adjust Image Position

Adjust the position of the image being captured.

X

X (horizontal) adjustment between -8191.000 and 8191.000 pixels.

Y

Y (vertical) adjustment between -16383.000 and 16383.000 pixels.

Angle

Adjust the position to the θ angle (rotation) around the center of the image between -999.999° and 999.999°.

Point

- When [Captured Image] is selected as the [Type] and a [Position Adjustment ID] is selected in [Operation] (Page 8-116), [Pos. Adjust. value] can be selected in addition to [Number Input]. This option is useful because even when the image capture position deviates, the current image is automatically adjusted using the adjustment value based on the reference unit. However, note that when [Pos. Adjust. value] is selected in the state where a proper adjustment value cannot be measured for the current image, the position used for registration may be incorrect.
- Position adjustment may cause missing peripheries (black areas) due to image movement or jagged edges (jaggies) due to rotation in the registered image, or expansion of invalid pixels with no height data.

Save

Save the displayed image as a registered image under the conditions specified in the [Register Image] screen.

Point

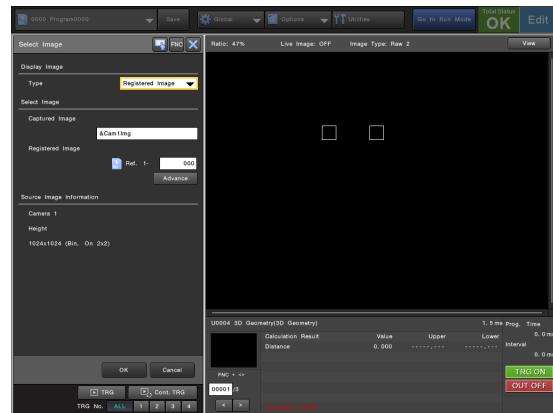
- The image cannot be registered if [Live Image] is enabled. Please stop live image update first before executing.
- When registering the height image only, the grayscale image will be deleted if a grayscale image is already registered for the corresponding registered image number. Note that the same applies when registering the grayscale image only.

Delete

When [Registered Image] is selected for [Type], you can delete the registered image specified under [Options].

Select Image

Specify the registered image and captured image to be used as reference for the measurements and settings.



Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** The registered image specified under [Select Image] is displayed.

Select Image

Captured Image

Set an image variable to be used as the captured image for the unit.

Registered Image

Specify the registered image number for the registered image to be used.

- The registered images of height images are managed as "ref (Camera No.)-(registered image number 0 to 499)". In addition, the number where 500 is added to the registered image number of the height image will be the registered image number of the corresponding grayscale image.
- The camera number is fixed to that of the camera of the image variable specified in the [Captured Image] field.

Advance

Set advanced options for the switching of registered images as necessary.

- Use numerical variable for registered image No.:** To use a variable to specify the registered image number to be switched to for the unit, check this box and then assign a numerical or numerical array type variable as a destination to be referenced. By using a variable for the registered image number and then issuing a variable reference value apply command (NU), the image is switched to the specified registered image in the variable and the image reference information is updated. For details, refer to the XG-X2000 Series Communications Control Manual.
- Process variable when changing programs:** Check this option to switch to the registered image specified with the Numerical variable (variable initial value) when the program is changed or the system is next powered up.



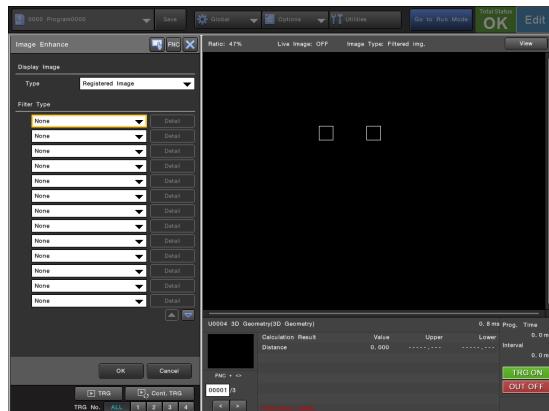
Note that the registered image number does not switch in synchronization with a change in the variable value.

Source Image Information

The camera number, image type, and resolution of the camera corresponding to the image variable specified for the captured image will be displayed.

Image Enhance

Specify the filter processing to apply to the image.



Display Image

Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified under [Select Image].

Filter Type

Select the [Filter Type] field and then select the filter to apply.

- None:** Image enhancement is not used.
- Average:** This process smoothes and stabilizes the height variations that occur on the plane in a wave-like pattern. It also interpolates invalid pixels by applying the average value of the surrounding pixels. The filter application size (default: 3x3; or 5x5 for a bigger processing area) and the count (0 to 9, where 0 turns the filter off) can be configured.
- Median:** It has the effect of eliminating abnormal height values that occur in the form of spike-like noise by applying the median of the surrounding pixel heights to the center pixel. The filter application size (default: 3x3; or 5x5 for a bigger processing area) and the count (0 to 9, where 0 turns the filter off) can be configured.
- Gaussian:** This process reduces noise by applying heavier smoothing on pixels closer to the center. You can obtain a more natural blur compared to [Average], but the noise reduction effect will be weaker. The filter application size (default: 3x3; or 5x5 for a bigger processing area) and the count (0 to 9, where 0 turns the filter off) can be configured.

3D Geometry

- Smoothing:** This image enhancement is equivalent to [Average], but you can obtain a stronger smoothing effect by increasing the filter size. You can set the filter size (3 to 127) and the count (0 to 9, where 0 turns the filter off). In addition, by using [Border], you can select whether to perform smoothing at the boundary of the region by referring to height information outside the region or by considering them to be of the same height as the region boundary part.
- Inv. Pixel Suppress.:** This option suppresses invalid pixels by interpolating invalid pixels without height data with the height data estimated from the surrounding valid pixels. Invalid pixel suppression does not affect the values of valid pixels around the invalid pixels. [Level] (1 (default) to 9), [Adj. Width] (Small (default), Large) and [Count] (0 to 1, where 0 turns the filter off) can be configured. The greater the level and the larger the adjustment width, the wider the range of invalid pixels that can be suppressed.
- Spike Noise Cut:** Eliminates pixels (spike noise) whose heights spike out from the surroundings due to noise, etc. The processing direction and [Cut Size] (eliminates spike noise which is equal to or below the specified size width), [Cut Threshold] (eliminates spike points which stray from the specified height in relation to the surrounding as noise), and [Cut Target] can be specified. Specify the [Cut Size] from 2 - 30 (default setting value: 4), the [Cut Threshold] (mm) from 0.000 - 99.999 (default setting value: 0.050), and the [Cut Target] as Upper or Lower or Both (default setting value: Upper).

Point

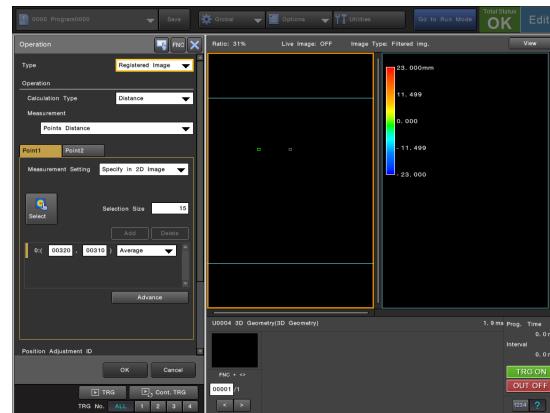
- When multiple filters are set, they are processed one by one from the top.
- Spike points which are eliminated via the spike noise cut filter become invalid pixels.
- Invalid pixels are pixels that do not contain height information as a result of failure to obtain the height during capture or due to unreliable measured values.

Reference

With a filter selected in the [Filter Type] field, if you move the 8-way key up and down while holding the No. 1 (FUNCTION) key on the console, you can change the filter application order.

Operation

Specify the calculation target type and measurement method, and then set the calculation details.



Type

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** Displays the registered image specified under [Select Image].

Operation

Calculation Type

Select the target to be measured.

- Distance:** Calculates the distance between the input elements.
- Angle:** Calculates the angle between the input elements.
- Point:** Calculates the intersection point, midpoint, etc. between the input elements.
- Line:** Calculates a line from the input elements.
- Plane:** Calculates a plane from the input elements.
- Sphere:** Calculates a sphere from the input element.

Measurement

Select the method for measuring the target in the 3D Geometry unit.

For more details about the behavior, see "Measurement method" (Page 8-120).

Combinations of calculation target type/measurement method and input elements are as described below.

Calculation Type/ Measurement Method	Input Element 1				Input Element 2		
	Point	Line	Plane	Sphere	Point	Line	Plane
Distance	Points Distance (Page 8-121)	<input type="radio"/>			<input type="radio"/>		
	Point/Line Distance (Page 8-121)	<input type="radio"/>				<input type="radio"/>	
	Point/Plane Distance (Page 8-122)	<input type="radio"/>					<input type="radio"/>
	Lines Distance (Page 8-122)		<input type="radio"/>			<input type="radio"/>	
	Line/Plane Distance (Page 8-123)		<input type="radio"/> *				<input type="radio"/>
	Planes Distance (Page 8-124)			<input type="radio"/>			<input type="radio"/> *
Angle	Angle Between Two Lines (Page 8-125)		<input type="radio"/>			<input type="radio"/>	
	Angle Between Line and Plane (Page 8-127)		<input type="radio"/>				<input type="radio"/>
	Angle Between Two Planes (Page 8-128)			<input type="radio"/>			<input type="radio"/>
	Point (Page 8-129)	<input type="radio"/>					
Point	Intersection of Two Lines (Page 8-129)		<input type="radio"/>			<input type="radio"/>	
	Intersection of Line/Plane (Page 8-130)		<input type="radio"/>				<input type="radio"/>
	Midpoint of Points (Page 8-131)	<input type="radio"/>			<input type="radio"/>		
	Point Between Point and Line (Page 8-131)	<input type="radio"/>				<input type="radio"/>	
	Point Between Point and Plane (Page 8-132)	<input type="radio"/>					<input type="radio"/>
	Intersection of Point/Line (Page 8-133)	<input type="radio"/>				<input type="radio"/>	
	Intersection of Point/Plane (Page 8-134)	<input type="radio"/>					<input type="radio"/>
	Line (Page 8-134)		<input type="radio"/>				
Line	Line Defined by Two Points (Page 8-135)	<input type="radio"/>			<input type="radio"/>		
	Center Line Between Point and Line (Page 8-135)	<input type="radio"/>				<input type="radio"/>	
	Line Projection onto Plane (Page 8-136)	<input type="radio"/>				<input type="radio"/>	
	Line Between Planes (Page 8-137)		<input type="radio"/>			<input type="radio"/>	

Calculation Type/ Measurement Method	Input Element 1			Input Element 2			
	Point	Line	Plane	Sphere	Point	Line	Plane
Plane	Plane (Page 8-137)			<input type="radio"/>			
	Center Plane Between Two Points (Page 8-138)	<input type="radio"/>				<input type="radio"/>	
	Center Plane Between Point and Plane (Page 8-139)	<input type="radio"/>					<input type="radio"/>
	Plane Determined by Point and Line (Page 8-140)	<input type="radio"/>					<input type="radio"/>
	Plane Determined by Two Lines (Page 8-140)		<input type="radio"/>				<input type="radio"/>
	Sphere (Page 8-142)				<input type="radio"/>		

* The method for specifying the input element 1 of [Line/Plane Distance] and input element 2 of [Planes Distance] is fixed to [Specify in 2D Image].

Measurement Setting

Choose the method for specifying the input element.

- Specify in 2D Image:** Specifies the input element on the height image directly.
- From Result Data:** Specifies the input element by referencing the result data of other units.
- User Specified:** Specifies the input element in numeric values.

The Measurement Setting setting details vary depending on the input element.

Refer to the following for more details on each setting method.

- "Point Measurement Setting" (Page 8-142)
- "Line Measurement Setting" (Page 8-145)
- "Plane Measurement Setting" (Page 8-148)
- "Sphere Measurement Setting" (Page 8-151)

Position Adjustment ID

To apply position adjustment to the specified calculation target type, select the position adjustment unit to be referenced.

Options

Options may be available depending on the specified calculation target type/measurement method.

For more details on the settings, refer to "Measurement method" (Page 8-120).

Measured Value Correction (Only when the Calculation Type is [Distance] or [Sphere])

Select [Settings] and correct the measured value to match the full-scale value.

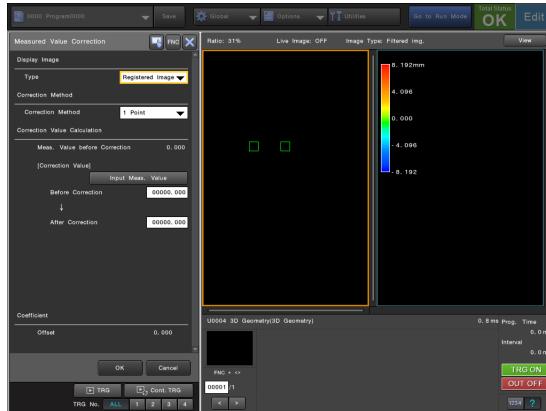
The following correction methods are available.

- 1 Point (Page 8-118)
- 2 Points (Page 8-118)

1 Point

A correction is performed based on one measured value. Set the post-correction measured value for the current measured value to calculate the offset for the measured value.

1 Select the image to display in [Display Image] and perform the measurement.



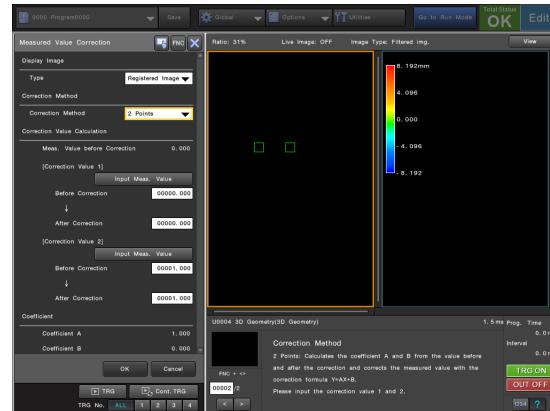
- 2 Select [1 Point] in [Correction Method].
- 3 Select [Input Meas. Value] to enter the current measured value into the [Before Correction] field.
- 4 Enter the after correction measured value in [After Correction] field.

The offset for the measured value is calculated from the before correction and after correction values.

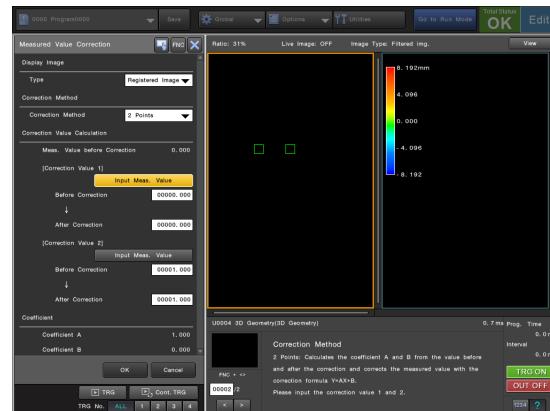
2 Points

Specify pre-correction and post-correction values for two measured values, and calculate the coefficients A and B from the results.

1 Select the image to display in [Display Image] and perform the measurement.



- 2 Select [2 Points] in [Correction Method].
- 3 Select [Input Meas. Value] to enter the current measured value into the [Before Correction] field for [Correction Value 1].
- 4 Enter the after correction measured value in [After Correction] field for [Correction Value 1].
- 5 Perform the measurement again.



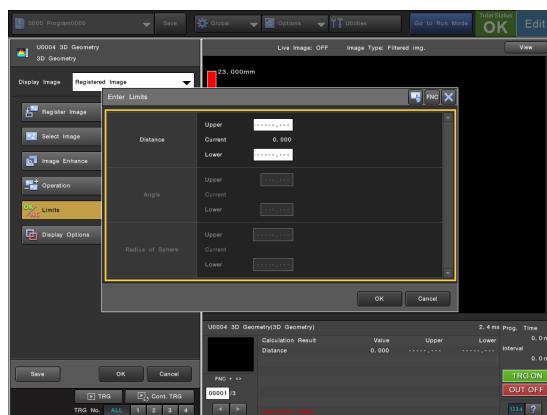
- 6 Select [Input Meas. Value] to enter the current measured value into the [Before Correction] field for [Correction Value 2].
- 7 Enter the after correction measured value in [After Correction] field for [Correction Value 2].

Coefficients A and B are calculated from the measured values corrected using [Correction Value 1] and [Correction Value 2].

Limits

Set the tolerance (upper and lower limits) for the measured value.

When the measurement result is outside of the specified tolerance range, it is judged as [NG]. When the result is within the tolerance range, it is judged as [OK].



Select [Direct Input] and enter a value to set the desired tolerance.



- [----] indicates an empty state where no tolerance is set. In this state, judgment will not be performed after the measurement.
- To reset the tolerance setting to an empty state, select [Clear]. Select the tolerances you wish to configure and enter the tolerances.

Distance

This can only be configured when the calculation target type for measuring distance has been specified.

Set the tolerance for the measured distance.

The unit of tolerance is mm.

Angle

This can only be configured when the calculation target type for measuring angle has been specified.

Set the tolerance for the measured angle.

The unit of tolerance is °.

Radius of Sphere

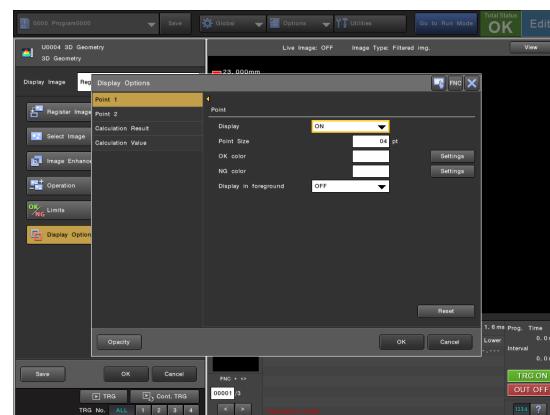
This can only be configured when the calculation target type for measuring sphere has been specified.

Set the tolerance for the measured radius of sphere.

The unit of tolerance is mm.

Display Options

Specify the display settings for things such as figures and measurement results.



Point 1/Point 2

Displayed when a measurement method based on points is selected.

It specifies options such as showing/hiding the point, point size/color, displaying in foreground, etc.

Line 1/Line 2

Displayed when a measurement method based on lines is selected.

It specifies options such as showing/hiding the line, line thickness/color, displaying in foreground, etc.

Plane 1/Plane 2

Displayed when a measurement method based on planes is selected.

It specifies options such as showing/hiding the plane, plane color, displaying in foreground, etc.

Sphere

Displayed when [Sphere] is selected as the measurement method.

It specifies options such as showing/hiding the sphere surface/sphere center, display color, displaying in foreground, etc.

Calculation Result (Arrowheads)

It specifies options such as showing/hiding the calculation result arrows, arrow color, displaying in foreground, etc.

Calculation Result (Point)

It specifies options such as showing/hiding the calculation result points, point size, point color, displaying in foreground, etc.

Calculation Result (Line)

It specifies options such as showing/hiding the calculation result lines, line thickness, line color, displaying in foreground, etc.

Calculation Result (Plane)

It specifies options such as showing/hiding the calculation result planes, plane color, displaying in foreground, etc.

Calculation Value

It specifies options such as showing/hiding the calculation value, character size/color, etc.

Reset

Restores the display options to their default settings.

Opacity

This function can be used to change the opacity of this dialog so that what is going on in the background can be seen.

Save

The present state is saved to the program file.

The settings for all units are saved to the currently used program setting file in SD Card 1 or SD Card 2.



Point

- If the device is turned off before any settings are saved, all of those changes will be deleted.
- Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
- Items specified not to be saved are excluded from the saving operation. For example, variable values or the default display, such as the screen, changed in the current program can be excluded when saving.

Measurement method

This section explains the calculation methods for the calculation target types available in this unit.

Distance

- Points Distance (Page 8-121)
- Point/Line Distance (Page 8-121)
- Point/Plane Distance (Page 8-122)
- Lines Distance (Page 8-122)
- Line/Plane Distance (Page 8-123)
- Planes Distance (Page 8-124)

Angle

- Angle Between Two Lines (Page 8-125)
- Angle Between Line and Plane (Page 8-127)
- Angle Between Two Planes (Page 8-128)

Point

- Point (Page 8-129)
- Intersection of Two Lines (Page 8-129)
- Intersection of Line/Plane (Page 8-130)
- Midpoint of Points (Page 8-131)
- Point Between Point and Line (Page 8-131)
- Point Between Point and Plane (Page 8-132)
- Intersection of Point/Line (Page 8-133)
- Intersection of Point/Plane (Page 8-134)

Line

- Line (Page 8-134)
- Line Defined by Two Points (Page 8-135)
- Center Line Between Point and Line (Page 8-135)
- Line Projection onto Plane (Page 8-136)
- Line Between Planes (Page 8-137)

Plane

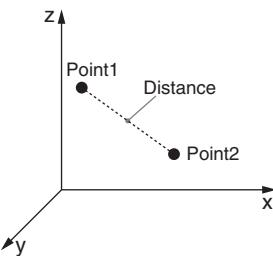
- Plane (Page 8-137)
- Center Plane Between Two Points (Page 8-138)
- Center Plane Between Point and Plane (Page 8-139)
- Plane Determined by Point and Line (Page 8-140)
- Plane Determined by Two Lines (Page 8-140)

Sphere

- Sphere (Page 8-142)

Points Distance

Specify two points (Point 1/Point 2) and calculate the distance between the points.



Setting Item

- Point 1/Point 2**

Specify a point (Page 8-142).

- Measured Value Correction**

Correct the measured value to match the full-scale value (Page 8-118).

Main Calculation Results

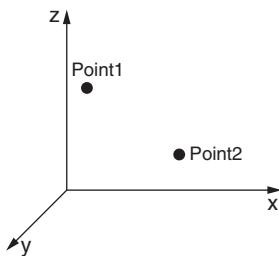
- Distance (mm)
- 3D Coordinates of Point 1 (X/Y/Z)
- 3D Coordinates of Point 2 (X/Y/Z)

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

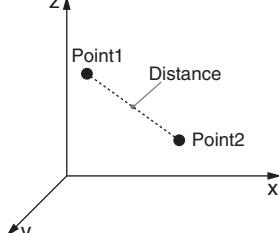
Calculation Image

The processing flow for [Points Distance] is as described below.

- 1). Specify Point 1 and Point 2.

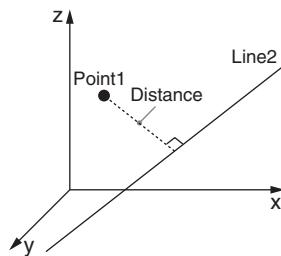


- 2). Measure the distance between the two points.



Point/Line Distance

Specify a point (Point 1) and line (Line 2) and calculate the distance of the perpendicular line drawn from the point to the line.



Setting Item

- Point 1**

Specify a point (Page 8-142).

- Line 2**

Specify a line (Page 8-145).

- Measured Value Correction**

Correct the measured value to match the full-scale value (Page 8-118).

Main Calculation Results

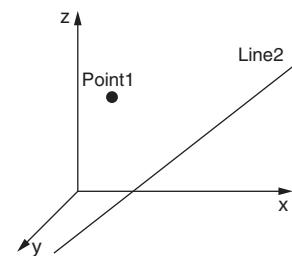
- Distance (mm)
- 3D Coordinates of Point 1 (X/Y/Z)
- 3D Coordinates of Starting Point of Line 2 (X/Y/Z)
- Vector of Line 2 (X/Y/Z)

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

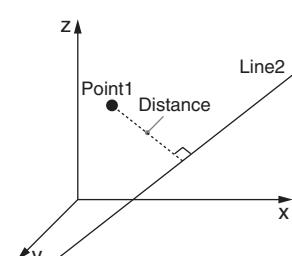
Calculation Image

The processing flow for [Point/Line Distance] is as described below.

- 1). Specify Point 1 and Line 2.



- 2). Draw a perpendicular line from Point 1 to Line 2 and measure the distance.

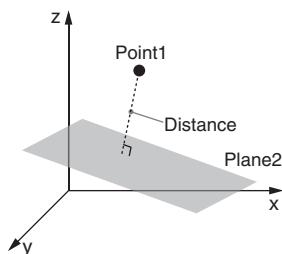


Point/Plane Distance

Specify a point (Point 1) and plane (Plane 2) and calculate the distance of the perpendicular line drawn from the point to the plane.



The plane to be calculated is determined by specifying multiple points and using the least-squares method on the specified group of points.



Setting Item

- **Point 1**
Specify a point (Page 8-142).
- **Plane 2**
Specify a plane (Page 8-148).
- **Measured Value Correction**
Correct the measured value to match the full-scale value (Page 8-118).

Main Calculation Results

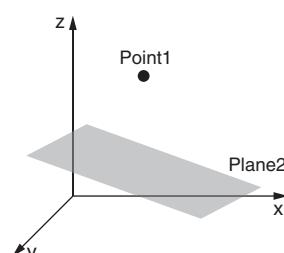
- Distance (mm)
- 3D Coordinates of Point 1 (X/Y/Z)
- Plane Formula of Plane 2 (XYZ)
- X Slope of Plane 2
- Y Slope of Plane 2
- Z Intercept of Plane 2

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

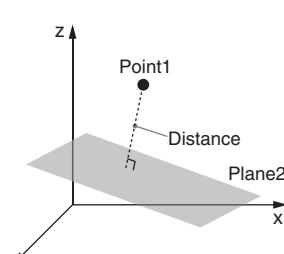
Calculation Image

The processing flow for [Point/Plane Distance] is as described below.

1). Specify Point 1 and Plane 2.

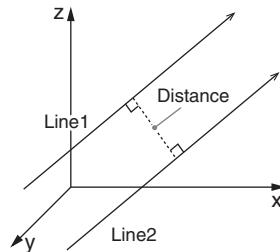


2). Draw a perpendicular line from Point 1 to Plane 2 and measure the distance.



Lines Distance

Specify two lines (Line 1/Line 2) and calculate the length of the common perpendicular line of the two lines. It can also be calculated by parallelizing the two lines according to the settings.



Setting Item

- **Line 1/Line 2**
Specify a line (Page 8-145).
- **Option**
Parallelize Lines: When enabled, the average of the vector of the two lines will be taken to adjust the direction of the lines.
- **Measured Value Correction**
Correct the measured value to match the full-scale value (Page 8-118).

Main Calculation Results

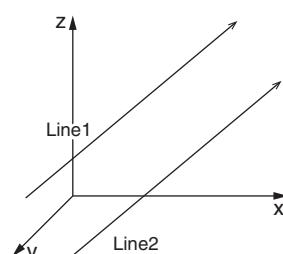
- Distance (mm)
- 3D Coordinates of Starting Point of Line 1 (X/Y/Z)
- Vector of Line 1 (X/Y/Z)
- 3D Coordinates of Starting Point of Line 2 (X/Y/Z)
- Vector of Line 2 (X/Y/Z)

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

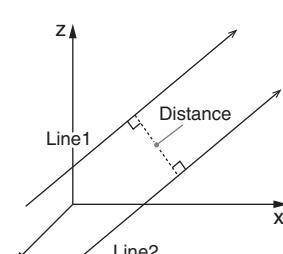
Calculation Image

The processing flow for [Lines Distance] is as described below.

1). Specify Line 1 and Line 2.

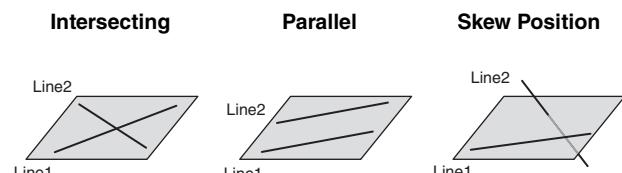


2). Calculates the length of the common perpendicular line.



Option**• Parallelize Lines**

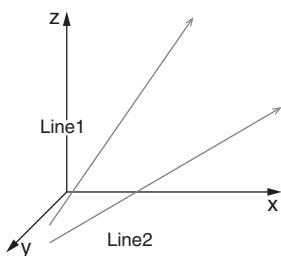
In 3D space, the positional relationship of two lines is one of the three patterns shown below.



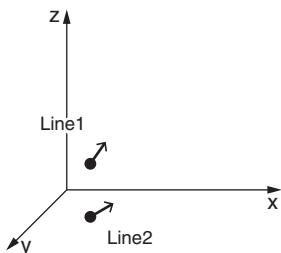
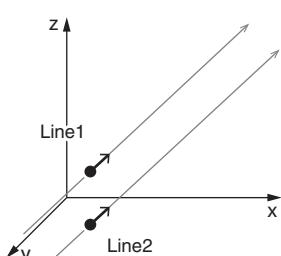
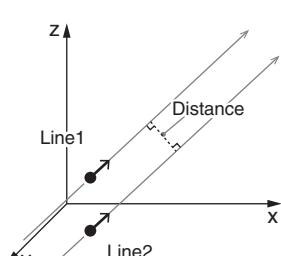
If the positional relationship is "Intersecting", the distance is calculated as 0.

If the two lines are not perfectly parallel, it is also possible to calculate the distance by parallelizing the lines.

The processing flow in the case when the lines are parallelized is as described below.

1). Specify Line 1 and Line 2.**2). Align the length without moving the start point.**

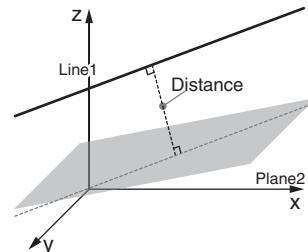
Line 1 or Line 2 is inverted if they are deviated by 180 degrees or greater.

**3). Take the average of the vector of Line 1 and Line 2 and align their direction.****4). Calculates the length of the common perpendicular line.****Line/Plane Distance**

Specify a line (Line 1) and plane (Plane 2) and calculate the distance of the perpendicular line drawn from the line to the plane.



The line to specify is determined by specifying multiple points and using the least-squares method on the specified group of points. The calculated line is fixed parallel to the plane.

**Setting Item****• Line 1**

Specify a line (Page 8-145).



The measurement setting is fixed to [Specify in 2D Image].

• Plane 2

Specify a plane (Page 8-148).

• Measured Value Correction

Correct the measured value to match the full-scale value (Page 8-118).

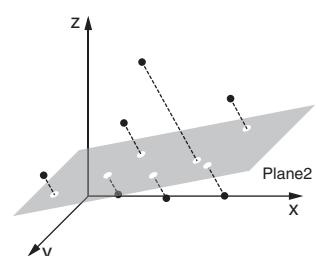
Main Calculation Results

- Distance (mm)
- 3D Coordinates of Starting Point of Line 1 (X/Y/Z)
- Vector of Line 1 (X/Y/Z)
- Plane Formula of Plane 2 (XYZ)
- X Slope of Plane 2
- Y Slope of Plane 2
- Z Intercept of Plane 2

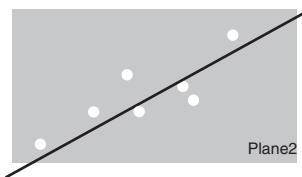
For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

Calculation Image

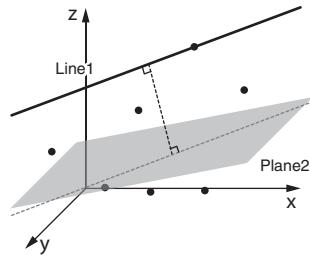
The processing flow for [Line/Plane Distance] is as described below.

1). Specify multiple points for calculating Line 1.**2). Specify Plane 2.****3). The specified points are projected onto the plane.**

- 4). The line is calculated by using the least-squares method on the projected group of points on the plane.



- 5). The calculated line is moved by parallel displacement to the position of the specified start point.



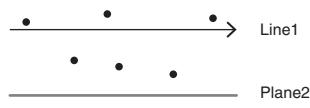
Start Point

- **Least-Squares Method:**

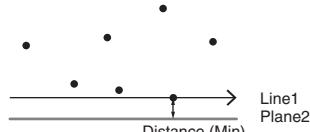
Sets the point calculated from the Z coordinate of all the points using the least squares method as the start point.



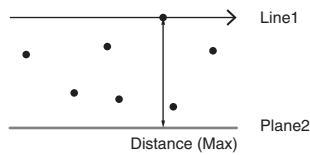
- **Average:** Sets the average point of the Z coordinate of all the points as the start point.



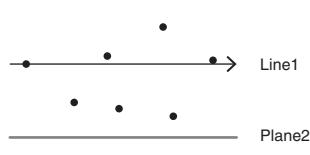
- **Minimum Distance:** Sets the point with the minimum distance from the plane (of the Z coordinate of all the points) as the start point.



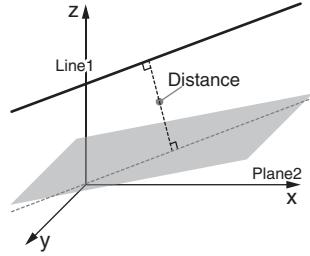
- **Maximum Distance:** Sets the point with the maximum distance from the plane (of the Z coordinate of all the points) as the start point.



- **Median:** Sets the median value of the Z coordinate of all the points as the start point.



- 6). The distance of the perpendicular line drawn from the start point to the plane is calculated.

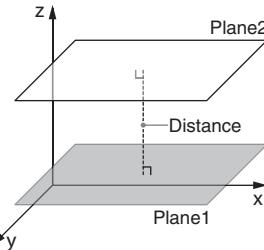


Planes Distance

Specify two planes (Plane 1/Plane 2) and calculate the distance between the planes.



Plane 2 is determined by specifying multiple points and using the least-squares method on the specified group of points. The calculated Plane 2 is fixed parallel to Plane 1.



Setting Item

- **Plane 1/Plane 2**

Specify a plane (Page 8-148).



The measurement setting for Plane 2 is fixed to [Specify in 2D Image].

- **Measured Value Correction**

Correct the measured value to match the full-scale value (Page 8-118).

Main Calculation Results

- Distance (mm)
- Plane Formula of Plane 1 (XYZ)
- X Slope of Plane 1
- Y Slope of Plane 1
- Z Intercept of Plane 1
- Plane Formula of Plane 2 (XYZ)
- X Slope of Plane 2
- Y Slope of Plane 2
- Z Intercept of Plane 2

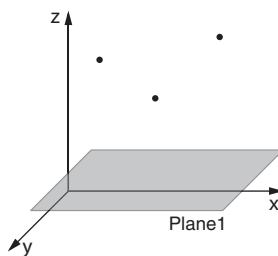
For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

Calculation Image

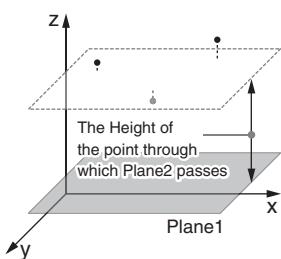
The processing flow for [Planes Distance] is as described below.

- 1). Specify Plane 1.

- 2). Specify multiple points for calculating Plane 2.



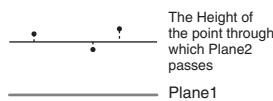
- 3). Calculate the point which Plane 2 passes through from the specified group of points.



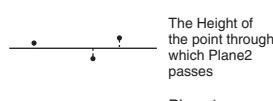
Point Which Plane 2 Passes Through

- Least-Squares Method:**

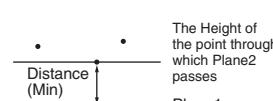
Sets the point calculated from the Z coordinate of all the points using the least squares method as the point which Plane 2 passes through.



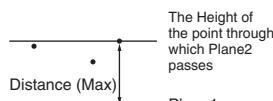
- Average:** Sets the average point of the Z coordinate of all the points as the point which Plane 2 passes through.



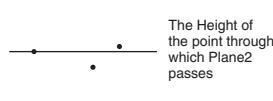
- Minimum Distance:** Sets the point with the minimum distance from Plane 1 (of the Z coordinate of all the points) as the point which Plane 2 passes through.



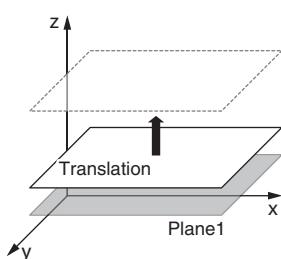
- Maximum Distance:** Sets the point with the maximum distance from Plane 1 (of the Z coordinate of all the points) as the point which Plane 2 passes through.



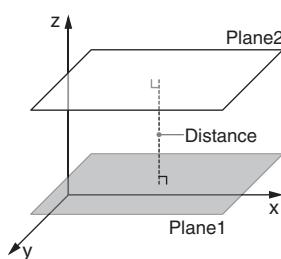
- Median:** Sets the median value of the Z coordinate of all the points as the point which Plane 2 passes through.



- 4). Move Plane 1 by parallel displacement to the calculated point and set it as Plane 2.



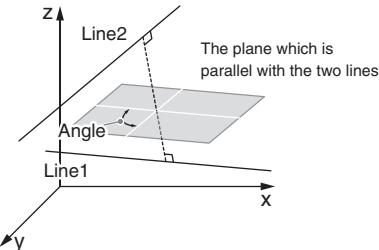
- 5). Calculate the distance from Plane 2 to Plane 1.



Angle Between Two Lines

Specify two lines (Line 1/Line 2). Project the two lines on to the plane which is parallel with the two lines and calculate the angle formed by the projected lines.

The angle can also be calculated by parallelizing the two lines on the same plane according to the settings.



Setting Item

- Line 1/Line 2**

Specify a Line (Page 8-145).

- Options**

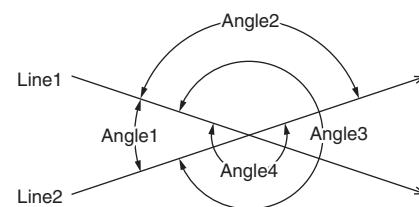
- **Angle Type:** Specifies the type of the angle to be displayed.

- Angle 1:** Calculated angle

- Angle 2:** 180 degrees - Angle 1

- Angle 3:** 360 degrees - Angle 1

- Angle 4:** 360 degrees - Angle 2



- **Invert Angle Display:** When enabled, the angle display position will be inverted.

- **Leveling Lines:** When enabled, the angle is calculated by deeming the specified two lines as being on the same plane.

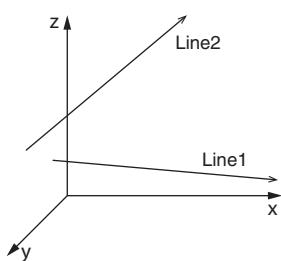
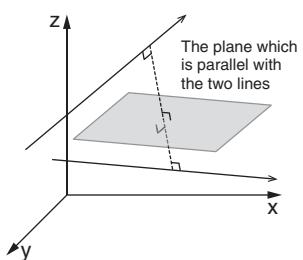
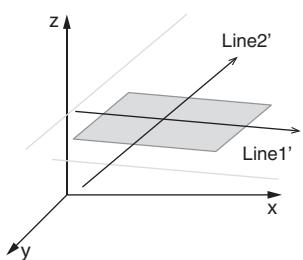
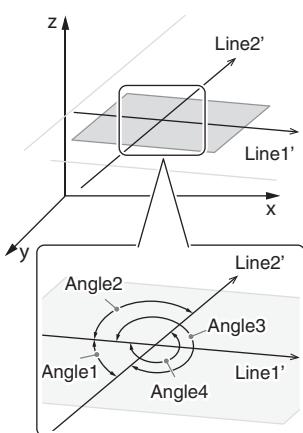
Main Calculation Results

- Angle ($^{\circ}$)
- 3D Coordinates of Starting Point of Line 1 (X/Y/Z)
- Vector of Line 1 (X/Y/Z)
- 3D Coordinates of Starting Point of Line 2 (X/Y/Z)
- Vector of Line 2 (X/Y/Z)

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

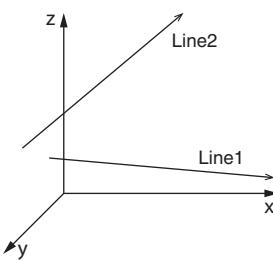
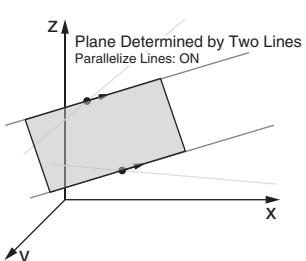
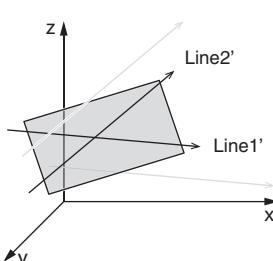
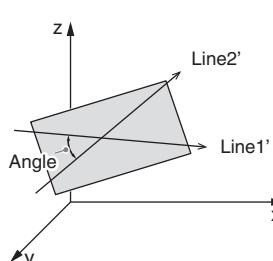
Calculation Image

The processing flow for [Angle Between Two Lines] is as described below.

1). Specify Line 1 and Line 2.**2). Calculate the plane that is parallel to the two lines.****3). Project the two lines on to the calculated plane****4). Calculate the angle formed by the two projected lines.****Option****• Leveling Lines**

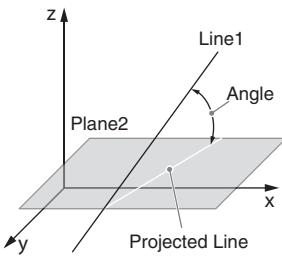
Project the specified lines on to the [Plane Determined by Two Lines] (Parallelize Lines: Enabled) and calculate the angle.

The processing flow when [Leveling Lines] is enabled is as described below.

1). Specify Line 1 and Line 2.**2). Calculate [Plane Determined by Two Lines] (Parallelize Lines: Enabled) (Page 8-140).****3). Project the two lines (Line1'/Line2') on to the calculated plane****4). Calculate the angle formed by the two projected lines**

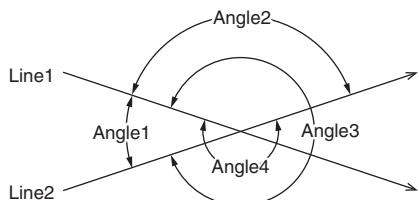
Angle Between Line and Plane

Specify a line (Line 1) and a plane (Plane 2). Project the specified line on to the plane and calculate the angle formed by the projected line and the original line using the same method as [Angle Between Two Lines].



Setting Item

- **Line 1**
Specify a line (Page 8-145).
- **Plane 2**
Specify a plane (Page 8-148).
- **Options**
 - **Angle Type:** Specifies the type of the angle to be displayed.
 - Angle 1:** Calculated angle
 - Angle 2:** 180 degrees - Angle 1
 - Angle 3:** 360 degrees - Angle 1
 - Angle 4:** 360 degrees - Angle 2



- **Invert Angle Display:** When enabled, the angle display position will be inverted.

Main Calculation Results

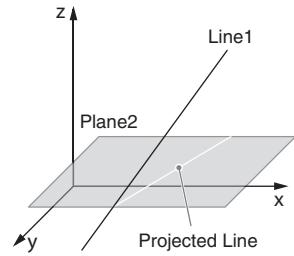
- Angle (°)
- 3D Coordinates of Starting Point of Line 1 (X/Y/Z)
- Vector of Line 1 (X/Y/Z)
- Plane Formula of Plane 2 (XYZ)
- X Slope of Plane 2
- Y Slope of Plane 2
- Z Intercept of Plane 2

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

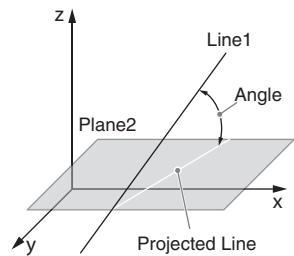
Calculation Image

The processing flow for [Angle Between Line and Plane] is as described below.

- 1). **Specify Line 1 and Plane 2.**
- 2). **Project Line 1 on Plane 2.**

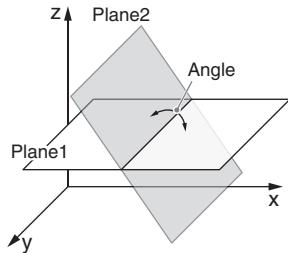


- 3). **Calculate the angle formed by Line 1 and the projected line by means of "Angle Between Two Lines" (Page 8-125).**



Angle Between Two Planes

Specify two planes (Plane 1/Plane 2) and calculate the angle formed by the normal ($Z>0$) of each of the planes using the same method as [Angle Between Two Lines].



Setting Item

- Plane 1/Plane 2**

Specify a plane (Page 8-148).

- Options**

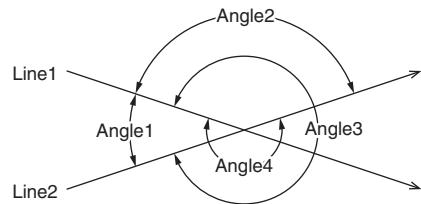
- **Angle Type:** Specifies the type of the angle to be displayed.

Angle 1: Calculated angle

Angle 2: 180 degrees - Angle 1

Angle 3: 360 degrees - Angle 1

Angle 4: 360 degrees - Angle 2



- **Invert Angle Display:** When enabled, the angle display position will be inverted.

Main Calculation Results

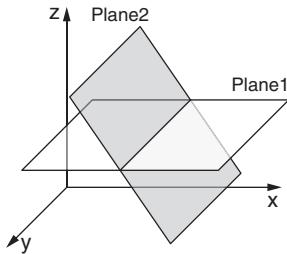
- Angle ($^{\circ}$)
- Plane Formula of Plane 1 (XYZ)
- X Slope of Plane 1
- Y Slope of Plane 1
- Z Intercept of Plane 1
- Plane Formula of Plane 2 (XYZ)
- X Slope of Plane 2
- Y Slope of Plane 2
- Z Intercept of Plane 2

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

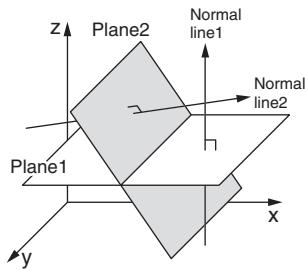
Calculation Image

The processing flow for [Angle Between Two Planes] is as described below.

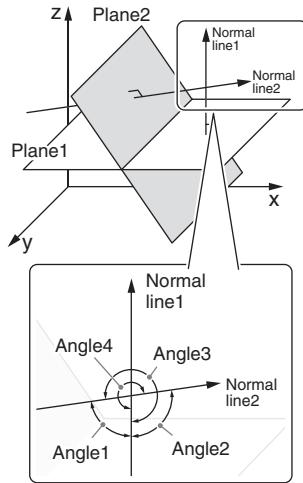
- 1). **Specify Plane 1 and Plane 2.**



- 2). **Calculate the normal line ($Z>0$ direction) of Plane 1 and Plane 2.**

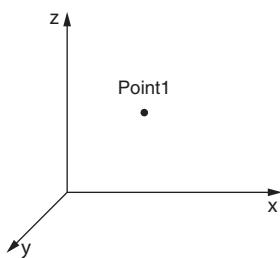


- 3). **Calculate the angle formed by the two calculated normal lines by means of "Angle Between Two Lines" (Page 8-125).**



Point

Specify a point (Point 1) and calculate its 3D coordinates.



Setting Item

- Point 1**

Specify a point (Page 8-142).

Main Calculation Results

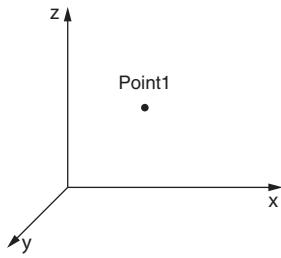
- 3D Coordinates of Point 1 (X/Y/Z)

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

Calculation Image

The processing flow for [Point] is as described below.

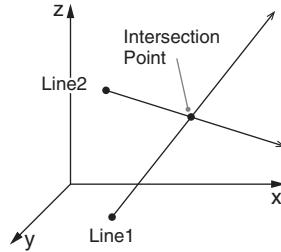
- 1). Specify a point.



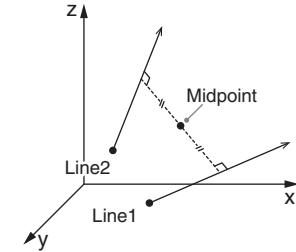
Intersection of Two Lines

Specify two lines (Line 1/Line 2) and calculate the 3D coordinates of the point where the lines intersect. If the lines do not intersect, the 3D coordinates of the midpoint of the two lines are calculated.

when the lines intersect



when the lines do not intersect



Setting Item

- Line 1/Line 2**

Specify a line (Page 8-145).

Main Calculation Results

- 3D Coordinates of Intersection Point (X/Y/Z)
- 3D Coordinates of Starting Point of Line 1 (X/Y/Z)
- Vector of Line 1 (X/Y/Z)
- 3D Coordinates of Starting Point of Line 2 (X/Y/Z)
- Vector of Line 2 (X/Y/Z)

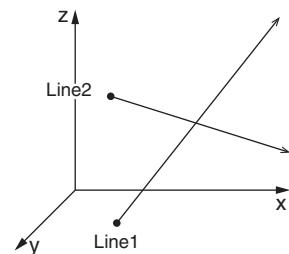
For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

Calculation Image (When the two lines intersect)

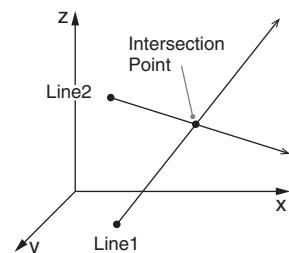
Calculate the 3D coordinates of the intersection point of the two lines.

The processing flow for [Intersection of Two Lines] when the two lines intersect is as described below.

- 1). Specify Line 1/Line 2.

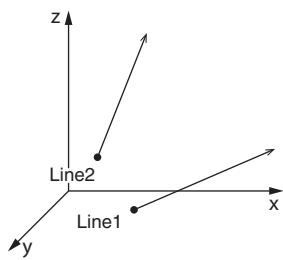
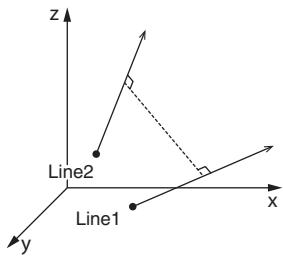
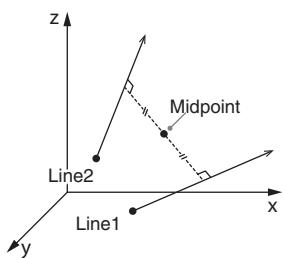


- 2). Calculates the intersection point.



Calculation Image (When the two lines do not intersect)

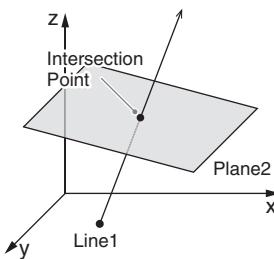
Calculate the 3D coordinates of the midpoint of the two lines.
The processing flow for [Intersection of Two Lines] when the two lines do not intersect is as described below.

1). Specify Line 1 and Line 2.**2). Calculate the common perpendicular line of the two lines.****3). Calculate the midpoint of the common perpendicular line.****Intersection of Line/Plane**

Specify a line (Line 1) and a plane (Plane 2) and calculate the 3D coordinates of the point where the line and plane intersect.



A calculation error occurs if the line and plane do not intersect.

**Setting Item****• Line 1**

Specify a line (Page 8-145).

• Plane 2

Specify a plane (Page 8-148).

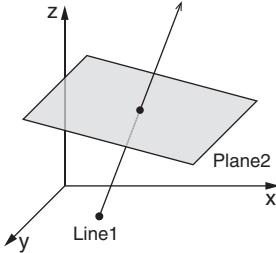
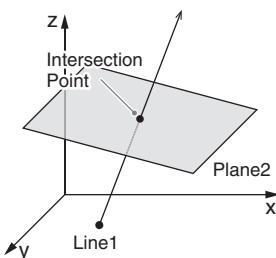
Main Calculation Results

- 3D Coordinates of Intersection Point (X/Y/Z)
- 3D Coordinates of Starting Point of Line 1 (X/Y/Z)
- Vector of Line 1 (X/Y/Z)
- Plane Formula of Plane 2 (XYZ)
- X Slope of Plane 2
- Y Slope of Plane 2
- Z Intercept of Plane 2

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

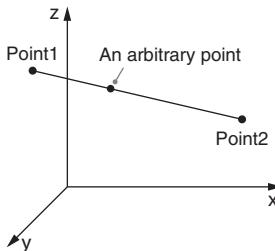
Calculation Image

The processing flow for [Intersection of Line/Plane] is as described below.

1). Specify Line 1 and Plane 2.**2). Calculate the point where the line and plane intersect.**

Midpoint of Points

Specify two points (Point 1/Point 2) and calculate the 3D coordinates of an arbitrary point (Calculation Point) between the points.



Setting Item

- Point 1/Point 2**

Specify a point (Page 8-142).

- Options**

- **Calculation Point:** Specifies the point for the calculation ("Midpoint", "Point 1" or "Point 2").
- **Offset:** Offsets the specified calculation point. The direction from Point 1 to Point 2 will be the + direction.



Main Calculation Results

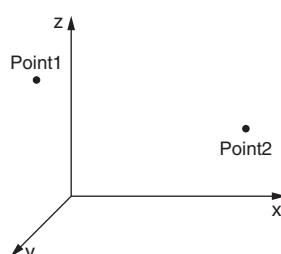
- 3D Coordinates of Calculation Point (X/Y/Z)
- 3D Coordinates of Point 1 (X/Y/Z)
- 3D Coordinates of Point 2 (X/Y/Z)

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

Calculation Image

The processing flow for [Midpoint of Points] is as described below.

- 1). **Specify Point 1 and Point 2.**

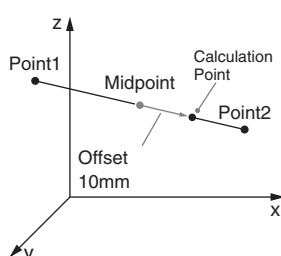


- 2). **Calculate the calculation point according to the settings.**

Example)

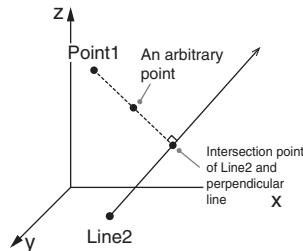
Calculation Point:

Midpoint (Offset: 10 mm)



Point Between Point and Line

Specify a point (Point 1) and line (Line 2) and find the "Intersection of Point/Line" (Page 8-133). Calculate the 3D coordinates of an arbitrary point (Calculation Point) between the point and the intersection.



Setting Item

- Point 1**

Specify a point (Page 8-142).

- Line 2**

Specify a line (Page 8-145).

- Options**

- **Calculation Point:** Specifies the point for the calculation ("Midpoint", "Point 1" or "Line 2").



Point Line 2 in [Calculation Point] refers to the point where the perpendicular line drawn from Point 1 to Line 2 and Line 2 intersect.

- **Offset:** Offsets the specified calculation point.

The direction from Point 1 to Line 2 will be the + direction.



Main Calculation Results

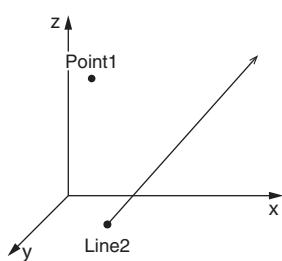
- 3D Coordinates of Calculation Point (X/Y/Z)
- 3D Coordinates of Point 1 (X/Y/Z)
- 3D Coordinates of Starting Point of Line 2 (X/Y/Z)
- Vector of Line 2 (X/Y/Z)

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

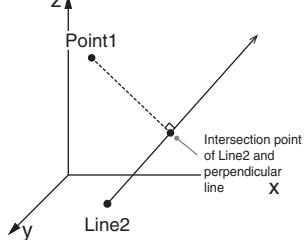
Calculation Image

The processing flow for [Point Between Point and Line] is as described below.

1). Specify Point 1 and Line 2.



2). Determine the point where the perpendicular line drawn from Point 1 to Line 2 and Line 2 intersect (Page 8-133).

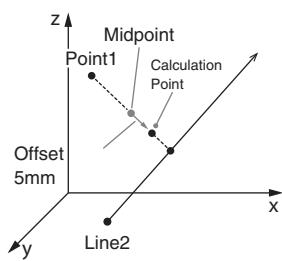


3). Calculate the calculation point according to the settings.

Example)

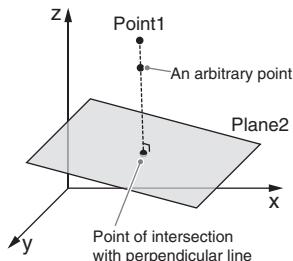
Calculation Point:

Midpoint (Offset: 5 mm)



Point Between Point and Plane

Specify a point (Point 1) and plane (Plane 2) and find the "Intersection of Point/Plane" (Page 8-134). Calculate the 3D coordinates of an arbitrary point (Calculation Point) between Point 1 and the determined intersection.



Setting Item

• Point 1

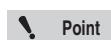
Specify a point (Page 8-142).

• Plane 2

Specify a plane (Page 8-148).

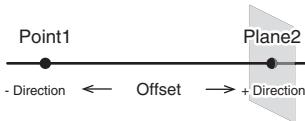
• Options

- **Calculation Point:** Specifies the point for the calculation ("Midpoint", "Point 1" or "Plane 2").



[Plane 2] in [Calculation Point] refers to the point where the perpendicular line drawn from Point 1 to Plane 2 and Plane 2 intersect.

- **Offset:** Offsets the specified calculation point. The direction from Point 1 to Plane 2 will be the + direction.



Main Calculation Results

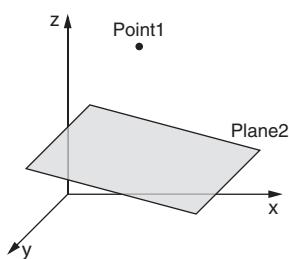
- 3D Coordinates of Calculation Point (X/Y/Z)
- 3D Coordinates of Point 1 (X/Y/Z)
- Plane Formula of Plane 2 (XYZ)
- X Slope of Plane 2
- Y Slope of Plane 2
- Z Intercept of Plane 2

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

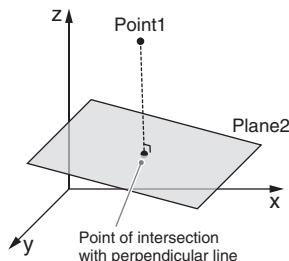
Calculation Image

The processing flow for [Point Between Point and Plane] is as described below.

1). Specify Point 1 and Plane 2.



2). Calculate the point where the perpendicular line drawn from Point 1 to Plane 2 and Plane 2 intersect (Page 8-134).

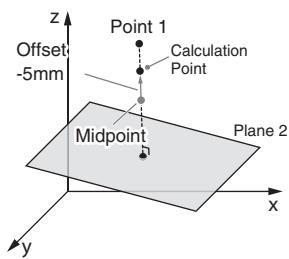


3). Calculate the calculation point according to the settings.

Example)

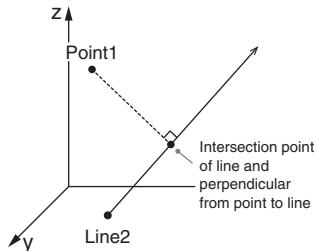
Calculation Point:

Midpoint (Offset: -5 mm)



Intersection of Point/Line

Specify a point (Point 1) and line (Line 2) and calculate the 3D coordinates of the point where the perpendicular line drawn from Point 1 to Line 2 and Line 2 intersect.



Setting Item

- **Point 1**

Specify a point (Page 8-142).

- **Line 2**

Specify a line (Page 8-145).

Main Calculation Results

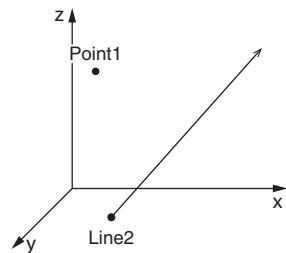
- 3D Coordinates of Intersection Point (X/Y/Z)
- 3D Coordinates of Point 1 (X/Y/Z)
- 3D Coordinates of Starting Point of Line 2 (X/Y/Z)
- Vector of Line 2 (X/Y/Z)

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

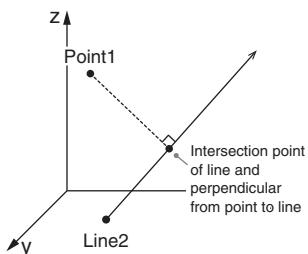
Calculation Image

The processing flow for [Intersection of Point/Line] is as described below.

1). Specify Point 1 and Line 2.

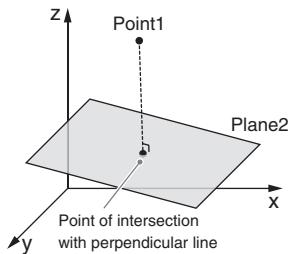


2). Calculate the point where the perpendicular line drawn from Point 1 to Line 2 and Line 2 intersect.



Intersection of Point/Plane

Specify a point (Point 1) and plane (Plane 2) and calculate the 3D coordinates of the point where the perpendicular line drawn from Point 1 to Plane 2 and Plane 2 intersect.



Setting Item

- Point 1**

Specify a point (Page 8-142).

- Plane 2**

Specify a plane (Page 8-148).

Main Calculation Results

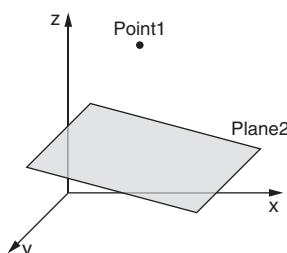
- 3D Coordinates of Intersection Point (X/Y/Z)
- 3D Coordinates of Point 1 (X/Y/Z)
- Plane Formula of Plane 2 (XYZ)
- X Slope of Plane 2
- Y Slope of Plane 2
- Z Intercept of Plane 2

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

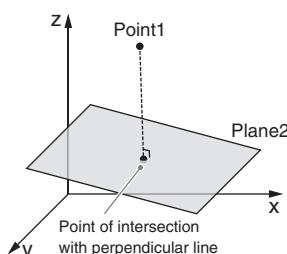
Calculation Image

The processing flow for [Intersection of Point/Plane] is as described below.

1. **Specify Point 1 and Plane 2.**



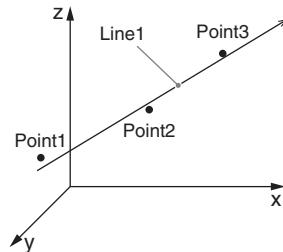
2. **Calculate the point where the perpendicular line drawn from Point 1 to Plane 2 and Plane 2 intersect.**



Line

Specify multiple points and calculate a line using the least-squares method on the specified group of points.

Reference A line can also be calculated from the line data of other units or by specifying the start point and vector in numeric values.



Setting Item

- Line 1**

Specify a line (Page 8-145).

Main Calculation Results

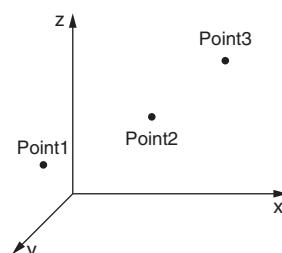
- 3D Coordinates of Starting Point of Line 1 (X/Y/Z)
- Vector of Line 1 (X/Y/Z)

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

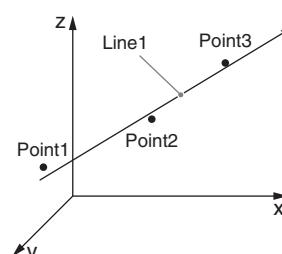
Calculation Image

The processing flow for [Line] is as described below.

1. **Specify multiple points (two or more) for calculating Line 1.**

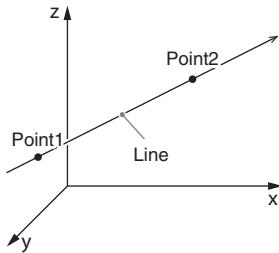


2. **Calculate the line using the least-squares method.**



Line Defined by Two Points

Specify two points (Point 1/Point 2) and calculate the line connecting the points.



Setting Item

- **Point 1/Point 2**

Specify a point (Page 8-142).

Main Calculation Results

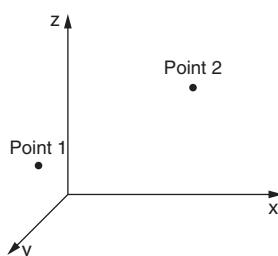
- 3D Coordinates of Starting Point of Line (X/Y/Z)
- Vector of Line (X/Y/Z)
- 3D Coordinates of Point 1 (X/Y/Z)
- 3D Coordinates of Point 2 (X/Y/Z)

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

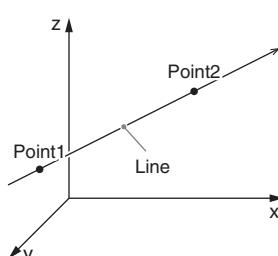
Calculation Image

The processing flow for [Line Defined by Two Points] is as described below.

- 1). **Specify Point 1 and Point 2.**

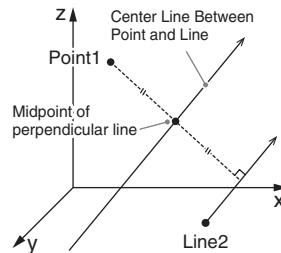


- 2). **Calculate the line connecting the two points.**



Center Line Between Point and Line

Specify a point (Point 1) and line (Line 2) and calculate the line with the same vector as Line 2 which passes through the midpoint of the perpendicular line drawn from Point 1 to Line 2.



Setting Item

- **Point 1**

Specify a point (Page 8-142).

- **Line 2**

Specify a line (Page 8-145).

- **Option**

Offset: Offsets the calculated median line. The direction from Point 1 to Line 2 will be the + direction.



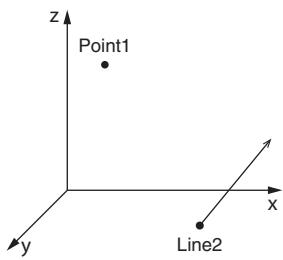
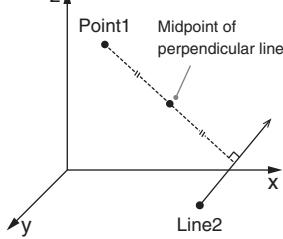
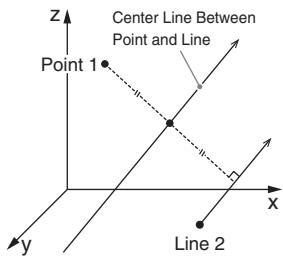
Main Calculation Results

- 3D Coordinates of Starting Point of Line (X/Y/Z)
- Vector of Line (X/Y/Z)
- 3D Coordinates of Point 1 (X/Y/Z)
- 3D Coordinates of Starting Point of Line 2 (X/Y/Z)
- Vector of Line 2 (X/Y/Z)

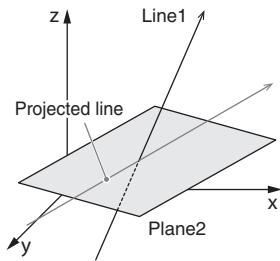
For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

Calculation Image

The processing flow for [Center Line Between Point and Line] is as described below.

1). Specify Point 1 and Line 2.**2). Calculate the midpoint of the perpendicular line drawn from Point 1 to Line 2.****3). Calculate the line with the same vector as Line 2 which passes through the calculated midpoint.****Line Projection onto Plane**

Specify a line (Line 1) and plane (Plane 2) and calculate the line formed by projecting Line 1 on to Plane 2.

**Setting Item****• Line 1**

Specify a line (Page 8-145).

• Plane 2

Specify a plane (Page 8-148).

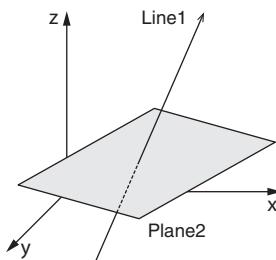
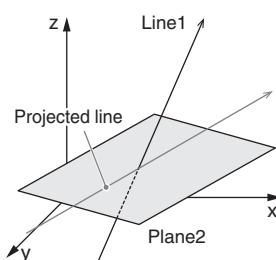
Main Calculation Results

- 3D Coordinates of Starting Point of Line (X/Y/Z)
- Vector of Line (X/Y/Z)
- 3D Coordinates of Starting Point of Line 1 (X/Y/Z)
- Vector of Line 1 (X/Y/Z)
- Plane Formula of Plane 2 (XYZ)
- X Slope of Plane 2
- Y Slope of Plane 2
- Z Intercept of Plane 2

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

Calculation Image

The processing flow for [Line Projection onto Plane] is as described below.

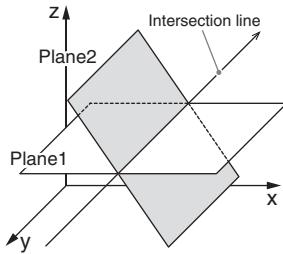
1). Specify Line 1 and Plane 2.**2). Project Line 1 onto Plane 2, and calculate the line.**

Line Between Planes

Specify two planes (Plane 1/Plane 2) and calculate the line formed by Plane 1 and Plane 2 intersecting with each other.



A calculation error occurs if the planes are parallel.



Setting Item

- Plane 1/Plane 2**

Specify a plane (Page 8-148).

Main Calculation Results

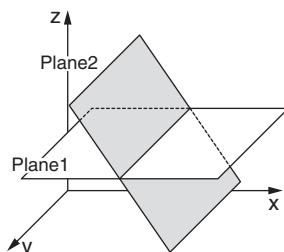
- 3D Coordinates of Starting Point of Line (X/Y/Z)
- Vector of Line (X/Y/Z)
- Plane Formula of Plane 1 (XYZ)
- X Slope of Plane 1
- Y Slope of Plane 1
- Z Intercept of Plane 1
- Plane Formula of Plane 2 (XYZ)
- X Slope of Plane 2
- Y Slope of Plane 2
- Z Intercept of Plane 2

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

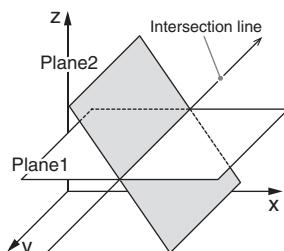
Calculation Image

The processing flow for [Line Between Planes] is as described below.

- Specify Plane 1 and Plane 2.**



- Calculate the line of intersection of Plane 1 and Plane 2.**

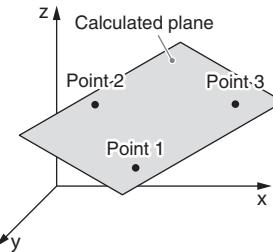


Plane

Specify multiple points and calculate a plane using the least-squares method on the specified group of points.



A plane can also be calculated from the plane data of other units or by specifying the plane data in numeric values.



Setting Item

- Plane 1**

Specify a plane (Page 8-148).

Main Calculation Results

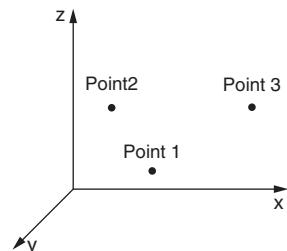
- Plane Formula of Plane (XYZ)
- X Slope of Plane
- Y Slope of Plane
- Z Intercept of Plane

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

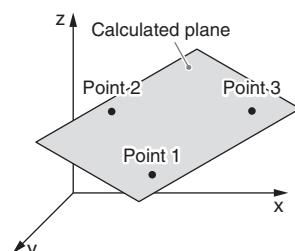
Calculation Image

The processing flow for [Plane] is as described below.

- Specify multiple points (three or more) for calculating Plane 1.**

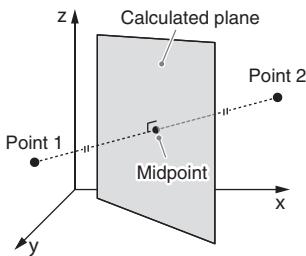


- Calculate the plane that includes the 3 points. When 4 or more points are specified, the plane is calculated by means of the least squares method.**



Center Plane Between Two Points

Specify two points (Point 1/Point 2) and calculate the plane which passes through the midpoint of Point 1 and Point 2 and is perpendicular to the line connecting Point 1 and Point 2.



Setting Item

- Point 1/Point 2**

Specify a point (Page 8-142).

- Option**

Offset: Offsets the calculated center plane. The direction from Point 1 to Point 2 will be the + direction.



Main Calculation Results

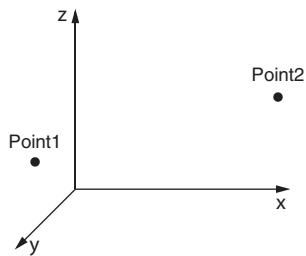
- Plane Formula of Center Plane (XYZ)
- X Slope of Center Plane
- Y Slope of Center Plane
- Z Intercept of Center Plane
- 3D Coordinates of Point 1 (X/Y/Z)
- 3D Coordinates of Point 2 (X/Y/Z)

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

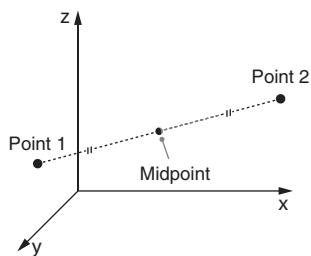
Calculation Image

The processing flow for [Center Plane Between Two Points] is as described below.

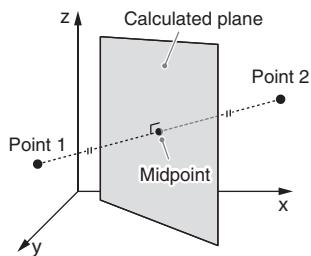
- Specify Point 1 and Point 2.**



- Calculate the midpoint of the line connecting the two points.**

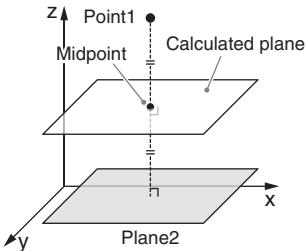


- Calculate the plane which passes through the midpoint and is perpendicular to the line connecting Point 1 and Point 2.**



Center Plane Between Point and Plane

Specify a point (Point 1) and plane (Plane 2) and calculate the plane which passes through the midpoint of the perpendicular line drawn from Point 1 to Plane 2 and is perpendicular to the perpendicular line.



Setting Item

- Point 1**

Specify a point (Page 8-142).

- Plane 2**

Specify a plane (Page 8-148).

Main Calculation Results

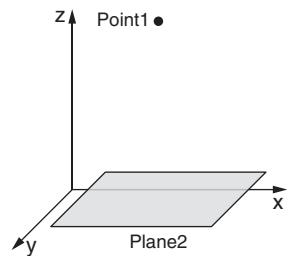
- Plane Formula of Center Plane (XYZ)
- X Slope of Center Plane
- Y Slope of Center Plane
- Z Intercept of Center Plane
- 3D Coordinates of Point 1 (X/Y/Z)
- Plane Formula of Plane 2 (XYZ)
- X Slope of Plane 2
- Y Slope of Plane 2
- Z Intercept of Plane 2

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

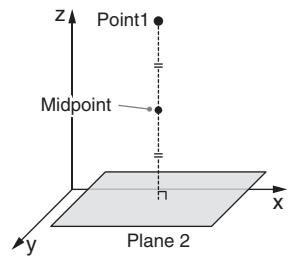
Calculation Image

The processing flow for [Center Plane Between Point and Plane] is as described below.

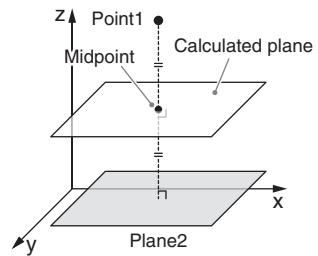
- Specify Point 1 and Plane 2.**



- Draw a perpendicular line from Point 1 to Plane 2 and calculate its midpoint.**

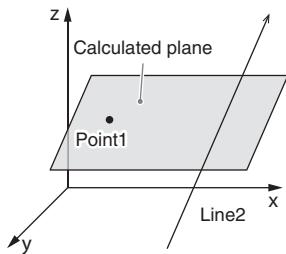


- Calculate the plane which passes through the midpoint and is perpendicular to the perpendicular line.**



Plane Determined by Point and Line

Specify a point (Point 1) and line (Line 2) and calculate the plane containing Point 1 and Line 2.



Setting Item

- Point 1**

Specify a point (Page 8-142).

- Line 2**

Specify a line (Page 8-145).

Main Calculation Results

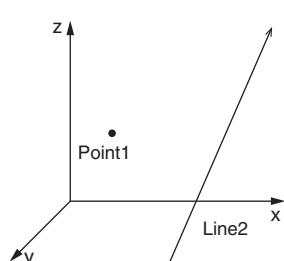
- Plane Formula of Plane (XYZ)
- X Slope of Plane
- Y Slope of Plane
- Z Intercept of Plane
- 3D Coordinates of Point 1 (X/Y/Z)
- 3D Coordinates of Starting Point of Line 2 (X/Y/Z)
- Vector of Line 2 (X/Y/Z)

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

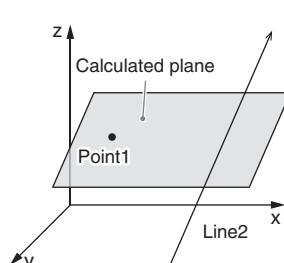
Calculation Image

The processing flow for [Plane Determined by Point and Line] is as described below.

- 1). Specify Point 1 and Line 2.



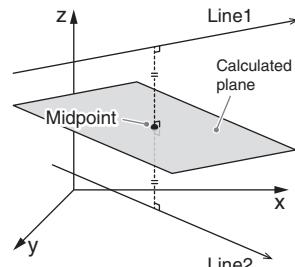
- 2). Calculate the plane including Point 1 and Line 2.



Plane Determined by Two Lines

Specify two lines (Line 1/Line 2) and calculate the plane which passes through the midpoint of the common perpendicular line of Line 1 and Line 2 and is perpendicular to the common perpendicular line.

It is also possible to parallelize the two lines and measure a plane containing the two lines.



Setting Item

- Line 1/Line 2**

Specify a line (Page 8-145).

- Option**

Parallelize Lines: When enabled, the average of the vector of the two lines will be taken to adjust the direction of the lines.

Main Calculation Results

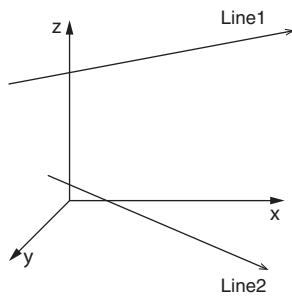
- Plane Formula of Plane (XYZ)
- X Slope of Plane
- Y Slope of Plane
- Z Intercept of Plane
- 3D Coordinates of Starting Point of Line 1 (X/Y/Z)
- Vector of Line 1 (X/Y/Z)
- 3D Coordinates of Starting Point of Line 2 (X/Y/Z)
- Vector of Line 2 (X/Y/Z)

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

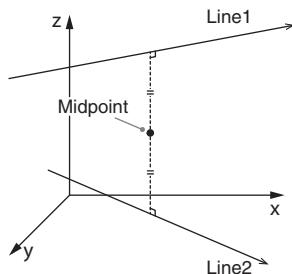
Calculation Image

The processing flow for [Plane Determined by Two Lines] is as described below.

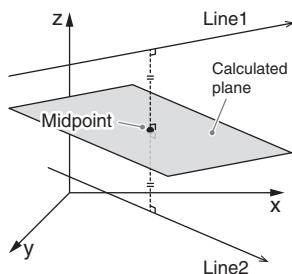
1). Specify Line 1 and Line 2.



2). Calculate the midpoint of the common perpendicular line.



3). Calculate the plane which passes through the midpoint and is perpendicular to the common perpendicular line.

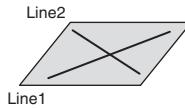


Option

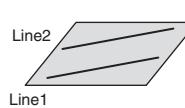
- **Parallelize Lines**

In 3D space, the positional relationship of two lines is one of the three patterns shown below.

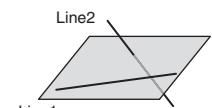
Intersecting



Parallel



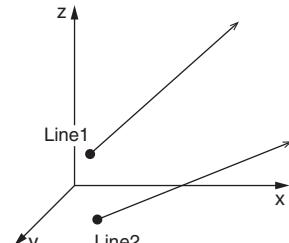
Skew Position



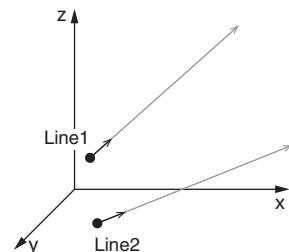
If the two lines are not perfectly parallel, it is also possible to calculate the plane by parallelizing the lines.

The processing flow in the case when the lines are parallelized is as described below.

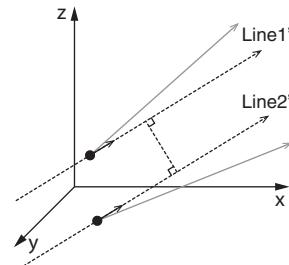
1). Specify Line 1 and Line 2.



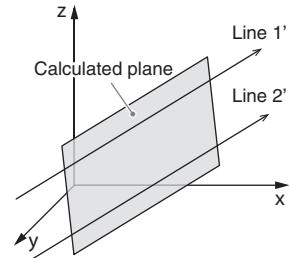
2). Align the length without moving the start point. Line 1 or Line 2 is inverted if they are deviated by 180 degrees or greater.



3). Take the average of the vector of Line 1 and Line 2 and align their direction (Line 1'/Line 2').

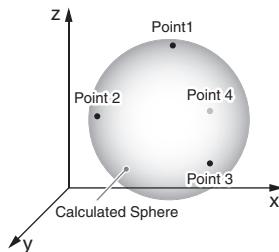


4). Calculate the plane containing the two lines.



Sphere

Specify multiple points and calculate a sphere from the specified group of points by using the least squares method.



Setting Item

Sphere 1

Specify a sphere (Page 8-151).

Measured Value Correction

Correct the measured value to match the full-scale value (Page 8-118).

Main Calculation Results

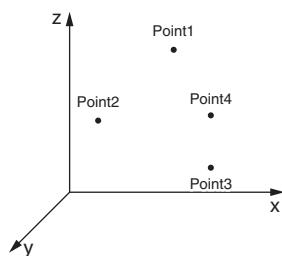
- 3D Coordinates of Center of Sphere (X/Y/Z)
- Radius of Sphere

For more information about the calculated result data, refer to the XG-X2000 Series Communications Control Manual.

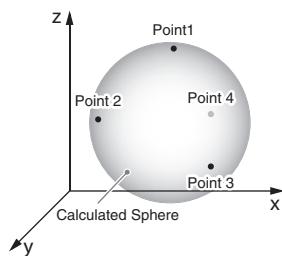
Calculation Image

The processing flow for [Sphere] is as described below.

1. **Specify multiple points (four or more) for calculating a sphere.**



2. **Calculate a sphere from the specified group of points.**

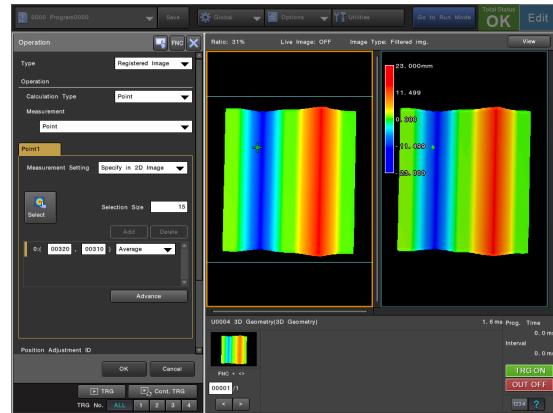


Point Measurement Setting

Specify the input element: Point according to the [Measurement Setting] setting selected in [Operation].

[Measurement Setting]: [Specify in 2D Image]

Specify a point directly on the height image.



Select

Select this option to move the point on the height image.

Reference When using the mouse, the point on the height image can be moved directly by dragging and dropping.

Selection Size

Specify the detection range of the detection point of each position coordinate.

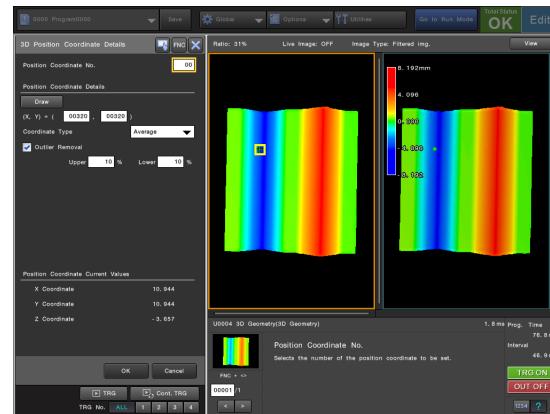


Position Coordinate List

- Position Coordinate No.:** The number of the position coordinate. It is fixed to [00] for a point because there is only one coordinate.
- XY Coordinates:** The XY coordinates on the height image can be specified in numeric values.
- Coordinate Type:** Specifies the type of the point coordinates to be used as the input element from the pixels within the [Selection Size] centered around the specified XY coordinates.
 - Peak:** Uses the coordinates of the point with the maximum height in the selection range as the input element.
 - Bottom:** Uses the coordinates of the point with the minimum height in the selection range as the input element.
 - Average:** The point with the specified XY coordinates and the average height of the selection range as the Z coordinate is used as the input element.
 - Median:** The point with the specified XY coordinates and the median height of the selection range as the Z coordinate is used as the input element.
 - Edge (Top):** Detects an edge in the selection range and uses the point in the top part of the edge as the input element.
 - Edge (Bottom):** Detects an edge in the selection range and uses the point in the bottom part of the edge as the input element.
 - Corner (Top):** Detects a corner in the selection range and uses the point in the top part of the corner as the input element.
 - Corner (Bottom):** Detects a corner in the selection range and uses the point in the bottom part of the corner as the input element.

Advance

Select this option to specify the details of the point coordinates.



- Position Coordinate No.:** Specifies the number of the coordinate to be set. It is fixed to [00] for a point because there is only one coordinate.

Position Coordinate Details

- Draw:** Change to Draw mode and adjust the part position. See “Editing the placement position of a part (Draw mode)” (Page 4-24) for more details.
- (X, Y):** The XY coordinates on the height image can be specified in numeric values.
- Coordinate Type:** Specifies the type of the point coordinates to be used as the input element from the pixels within the [Selection Size] centered around the specified XY coordinates.
- Detected Position Margin:** Selects a distance between the position to detect and the detected edge or corner. Changing between “Top” and “Bottom” inverts the direction, in which the detected point will be placed. This option can be selected only when [Coordinate Type] is [Edge (Top)], [Edge (Bottom)], [Corner (Top)], or [Corner (Bottom)].

Large: The detected point will be a point with a long distance to the edge or corner.

Medium: The detected point will be a point with an average distance to the edge or corner.

Small: The detected point will be a point with a short distance to the edge or corner.

Auto: Switches between Large, Medium, and Small in accordance with the slope.

None: The edge or corner will be the detected point.

- Outlier Removal:** Removes the unexpected abnormal data from the target that will be used to calculate the average value. Orders the pixel in the selection range in descending order, removes the specified percentage ([Upper]/[Lower]) and calculates the new average value. This option can be selected only when [Coordinate Type] is [Average].

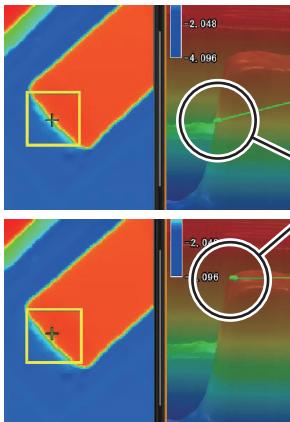
- Position Coordinate Current Values:** Displays the obtained coordinates.

Precautions on Specifying Edge (Top)/(Bottom) or Corner (Top)/(Bottom)

If the profile shape in the selection range is any of the following, fluctuations may occur when obtaining the coordinates:

- The edge/corner is rounded.
- The edge/corner is not vertical (i.e. it is sloped).

Example: Rounded Edge



If the specified position shifts, fluctuations will occur with the acquired coordinates.

The edge/corner can be obtained in a stable manner if the profile shape is close to perpendicular.

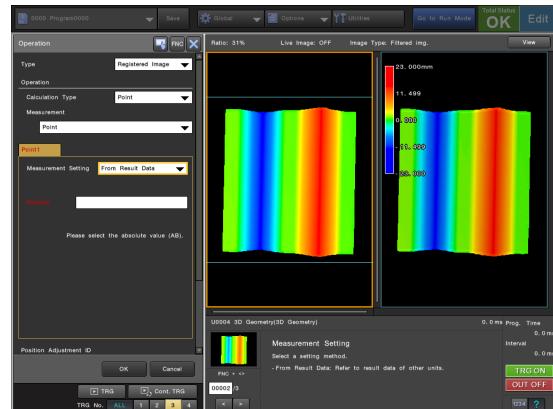
It is recommended to apply position adjustment to reduce deviations.



To specify a precise point, measure the position using profile measurement (Page 8-49) and specify [Measurement Setting] using [From Result Data].

[Measurement Setting]: [From Result Data]

Specify a point on the height image by referencing the result data of other measurement units or a variable.



Position

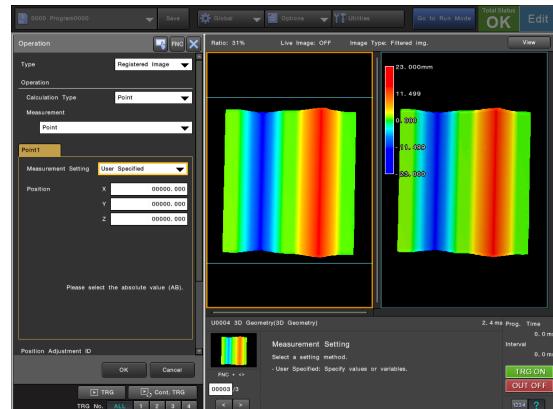
Specify the 3D position type result data or variable for the point coordinate.



When referencing the result data of other units, specify a 3D position type absolute measured value (AB).

[Measurement Setting]: [User Specified]

Specify the X, Y, and Z coordinates of the point in numeric values.



Position

Enter the point coordinates in [X], [Y], and [Z].

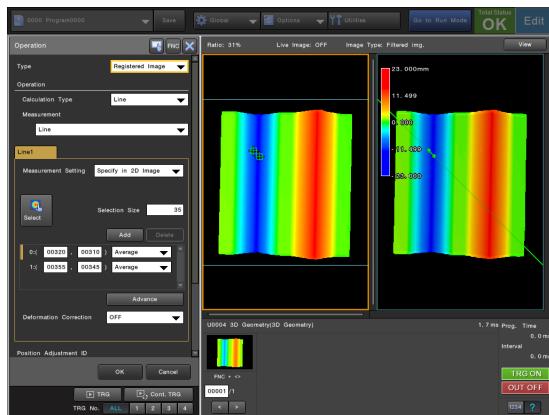
Line Measurement Setting

Specify the input element: Line according to the [Measurement Setting] setting selected in [Operation].

[Measurement Setting]: [Specify in 2D Image]

Specify two or more points directly on the height image and calculate a line. When two points are specified, the line that passes through the two points is calculated.

If three or more points are specified, the line is calculated by using the least-squares method on the coordinates of the specified points.



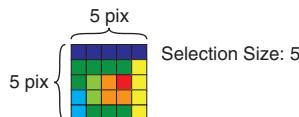
Select

Select this option to move the points on the height image.

Reference When using the mouse, the points on the height image can be moved directly by dragging and dropping.

Selection Size

Specify the detection range of the detection point of each position coordinate.



Add

Adds a point on the height image.

Two points have already been added by default.

Delete

Deletes the selected point.

Two or more points need to be kept.

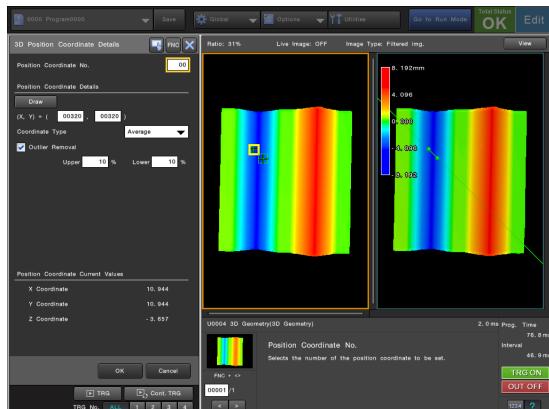
Position Coordinate List

- **Position Coordinate No.:** The number of the position coordinate.
- **XY Coordinates:** The XY coordinates on the height image can be specified in numeric values.
- **Coordinate Type:** Specifies the type of the point coordinates to be used as the input element from the pixels within the [Selection Size] centered around the specified XY coordinates.
 - **Peak:** Uses the coordinates of the point with the maximum height in the selection range as the input element.
 - **Bottom:** Uses the coordinates of the point with the minimum height in the selection range as the input element.
 - **Average:** The point with the specified XY coordinates and the average height of the selection range as the Z coordinate is used as the input element.
 - **Median:** The point with the specified XY coordinates and the median height of the selection range as the Z coordinate is used as the input element.
 - **Edge (Top):** Detects an edge in the selection range and uses the point in the top part of the edge as the input element.
 - **Edge (Bottom):** Detects an edge in the selection range and uses the point in the bottom part of the edge as the input element.
 - **Corner (Top):** Detects a corner in the selection range and uses the point in the top part of the corner as the input element.
 - **Corner (Bottom):** Detects a corner in the selection range and uses the point in the bottom part of the corner as the input element.

3D Geometry

Advance

Select this option to specify the details of the point coordinates.



- Position Coordinate No.:** Specifies the number of the coordinate to be set.
- Position Coordinate Details:** Sets the coordinate details.
 - Draw:** Change to Draw mode and adjust the part position. See “Editing the placement position of a part (Draw mode)” (Page 4-24) for more details.
 - (X, Y):** The XY coordinates on the height image can be specified in numeric values.
 - Coordinate Type:** Specifies the type of the point coordinates to be used as the input element from the pixels within the [Selection Size] centered around the specified XY coordinates.
 - Detected Position Margin:** Selects a distance between the position to detect and the detected edge or corner. Changing between “Top” and “Bottom” inverts the direction, in which the detected point will be placed. This option can be selected only when [Coordinate Type] is [Edge (Top)], [Edge (Bottom)], [Corner (Top)], or [Corner (Bottom)].
 - Large:** The detected point will be a point with a long distance to the edge or corner.
 - Medium:** The detected point will be a point with an average distance to the edge or corner.
 - Small:** The detected point will be a point with a short distance to the edge or corner.
 - Auto:** Switches between Large, Medium, and Small in accordance with the slope.
 - None:** The edge or corner will be the detected point.
 - Outlier Removal:** Removes the unexpected abnormal data from the target that will be used to calculate the average value. Orders the pixel in the selection range in descending order, removes the specified percentage ([Upper]/[Lower]) and calculates the new average value. This option can be selected only when [Coordinate Type] is [Average].
 - Position Coordinate Current Values:** Displays the obtained coordinates.

Deformation Correction

If this option is set to [ON], calculation is done with the noise excluded during line detection to reduce the noise influence.

Calculation Condition

Specify the condition for specifying the start point of the calculated line.

For more information on the calculation conditions, refer to “Line/Plane Distance” (Page 8-123) in “Measurement method”.

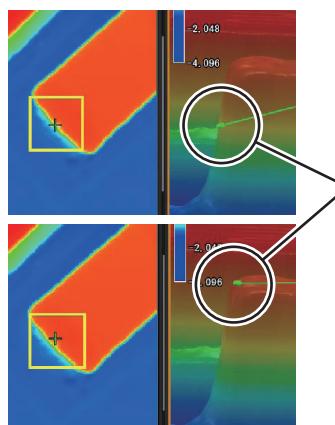
- Least-Squares Method:** Sets the point determined using the least-squares method on the Z coordinate of all the points specified for calculating a line as the start point.
- Average:** Sets the average point of the Z coordinate of all the points specified for calculating a line as the start point.
- Minimum Distance:** Among the Z coordinate of all the points specified for calculating a line, sets the point with the minimum distance from the plane as the start point.
- Maximum Distance:** Among the Z coordinate of all the points specified for calculating a line, sets the point with the maximum distance from the plane as the start point.
- Median:** Sets the median value of the Z coordinate of all the points specified for calculating a line as the start point.

Precautions on Specifying Edge (Top)/(Bottom) or Corner (Top)/(Bottom)

If the profile shape in the selection range is any of the following, fluctuations may occur when obtaining the coordinates:

- The edge/corner is rounded.
- The edge/corner is not vertical (i.e. it is sloped).

Example: Rounded Edge



If the specified position shifts, fluctuations will occur with the acquired coordinates.

The edge/corner can be obtained in a stable manner if the profile shape is close to perpendicular.

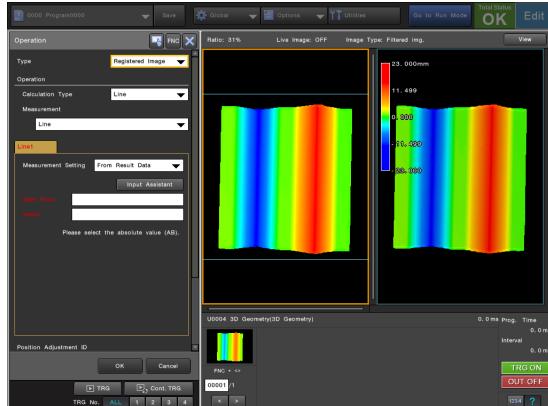
It is recommended to apply position adjustment to reduce deviations.



To specify a precise point, measure the position using profile measurement (Page 8-49) and specify [Measurement Setting] using [From Result Data].

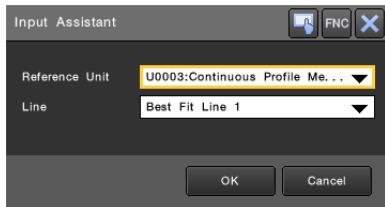
[Measurement Setting]: [From Result Data]

Calculate a line from the start point and vector by referencing the result data of other measurement units or variables.



Input Assistant

Selecting this option opens the [Input Assistant] menu. [Start Point] and [Vector] are specified according to the settings in this menu.



- **Reference Unit:** Specifies the reference unit.
- **Line:** Specifies the line data.

Start Point

Specify the start point using a result data or variable.

Point When referencing the result data of other units, specify an absolute measured value (AB).

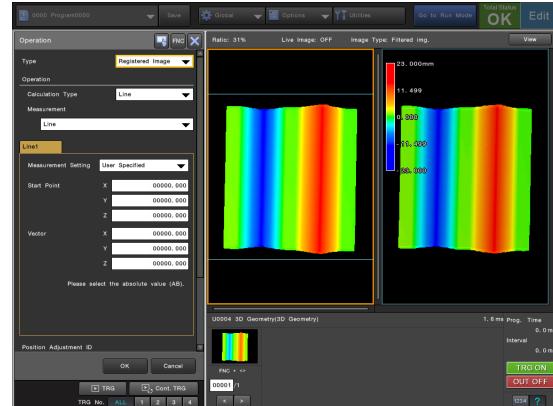
Vector

Specify the line vector using a result data or variable.

Point When referencing the result data of other units, specify an absolute measured value (AB).

[Measurement Setting]: [User Specified]

Specify the coordinates of the start point and vectors in numeric values.



Start Point

Enter the start point coordinates into [X], [Y], and [Z].

Point When referencing the result data of other units, specify an absolute measured value (AB).

Vector

Enter the line vector into [X], [Y], and [Z].

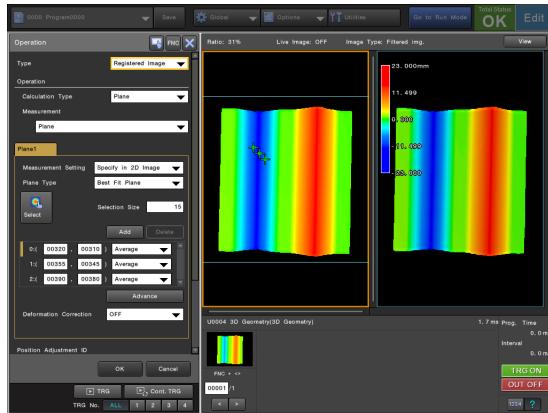
Point When referencing the result data of other units, specify an absolute measured value (AB).

Plane Measurement Setting

Specify the input element: Plane according to the [Measurement Setting] setting selected in [Operation].

[Measurement Setting]: [Specify in 2D Image]

Specify three or more points directly on the height image and calculate a plane.



Plane Type

Specify the method for calculating a plane from the specified points.

- **Best Fit Plane:** Calculates the plane using the least-squares method.
- **Tangential Plane (Top):** Calculates the plane connecting to the detected points from above.
- **Tangential Plane (Bottom):** Calculates the plane connecting to the detected points from underneath.

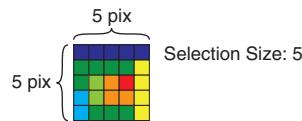
Select

Select this option to move the points on the height image.

 When using the mouse, the points on the height image can be moved directly by dragging and dropping.

Selection Size

Specify the detection range of the detection point of each position coordinate.



Add

Adds a point on the height image.

Three points have already been added by default.

Delete

Deletes the selected point.

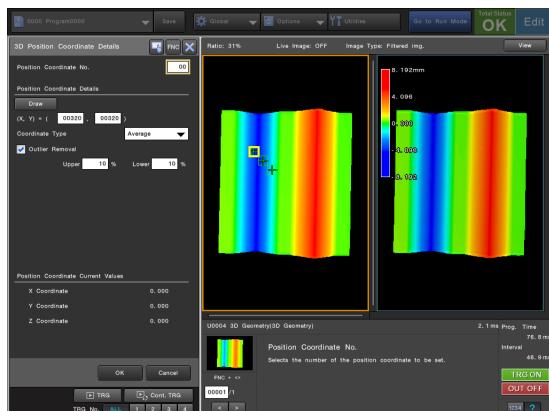
Three or more points need to be kept.

Position Coordinate List

- **Position Coordinate No.:** The number of the position coordinate.
- **XY Coordinates:** The XY coordinates on the height image can be specified in numeric values.
- **Coordinate Type:** Specifies the type of the point coordinates to be used as the input element from the pixels within the [Selection Size] centered around the specified XY coordinates.
 - **Peak:** Uses the coordinates of the point with the maximum height in the selection range as the input element.
 - **Bottom:** Uses the coordinates of the point with the minimum height in the selection range as the input element.
 - **Average:** The point with the specified XY coordinates and the average height of the selection range as the Z coordinate is used as the input element.
 - **Median:** The point with the specified XY coordinates and the median height of the selection range as the Z coordinate is used as the input element.
 - **Edge (Top):** Detects an edge in the selection range and uses the point in the top part of the edge as the input element.
 - **Edge (Bottom):** Detects an edge in the selection range and uses the point in the bottom part of the edge as the input element.
 - **Corner (Top):** Detects a corner in the selection range and uses the point in the top part of the corner as the input element.
 - **Corner (Bottom):** Detects a corner in the selection range and uses the point in the bottom part of the corner as the input element.

Advance

Select this option to specify the details of the point coordinates.



- Position Coordinate No.**: Specifies the number of the coordinate to be set.
- Position Coordinate Details**: Sets the coordinate details.
 - Draw**: Change to Draw mode and adjust the part position. See "Editing the placement position of a part (Draw mode)" (Page 4-24) for more details.
 - (X, Y)**: The XY coordinates on the height image can be specified in numeric values.
 - Coordinate Type**: Specifies the type of the point coordinates to be used as the input element from the pixels within the [Selection Size] centered around the specified XY coordinates.
 - Detected Position Margin**: Selects a distance between the position to detect and the detected edge or corner. Changing between "Top" and "Bottom" inverts the direction, in which the detected point will be placed. This option can be selected only when [Coordinate Type] is [Edge (Top)], [Edge (Bottom)], [Corner (Top)], or [Corner (Bottom)].
 - Large**: The detected point will be a point with a long distance to the edge or corner.
 - Medium**: The detected point will be a point with an average distance to the edge or corner.
 - Small**: The detected point will be a point with a short distance to the edge or corner.
 - Auto**: Switches between Large, Medium, and Small in accordance with the slope.
 - None**: The edge or corner will be the detected point.
 - Outlier Removal**: Removes the unexpected abnormal data from the target that will be used to calculate the average value. Orders the pixel in the selection range in descending order, removes the specified percentage ([Upper]/[Lower]) and calculates the new average value. This option can be selected only when [Coordinate Type] is [Average].
- Position Coordinate Current Values**: Displays the obtained coordinates.

Deformation Correction

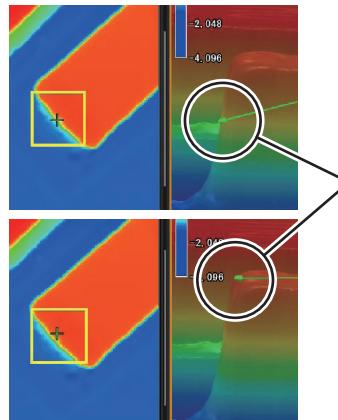
If this option is set to [ON], calculation is done with the noise excluded during plane calculation to reduce the noise influence.

Precautions on Specifying Edge (Top)/(Bottom) or Corner (Top)/(Bottom)

If the profile shape in the selection range is any of the following, fluctuations may occur when obtaining the coordinates:

- The edge/corner is rounded.
- The edge/corner is not vertical (i.e. it is sloped).

Example: Rounded Edge



If the specified position shifts, fluctuations will occur with the acquired coordinates.

The edge/corner can be obtained in a stable manner if the profile shape is close to perpendicular.

It is recommended to apply position adjustment to reduce deviations.

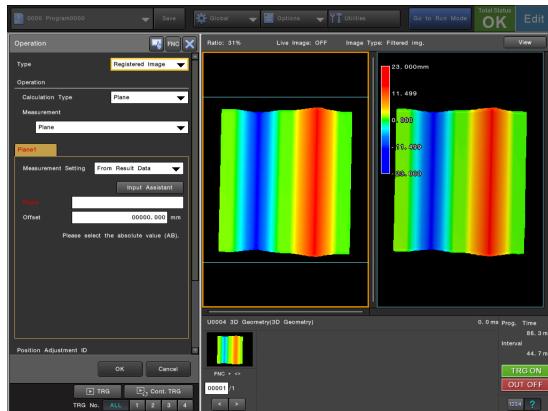


To specify a precise point, measure the position using profile measurement (Page 8-49) and specify [Measurement Setting] using [From Result Data].

3D Geometry

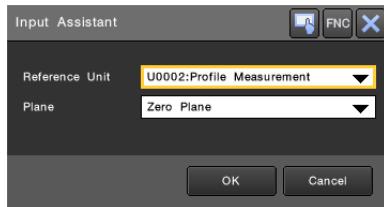
[Measurement Setting]: [From Result Data]

Calculate a plane by referencing the result data of other measurement units or a variable.



Input Assistant

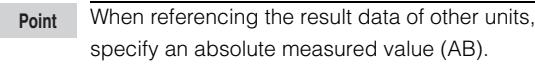
Selecting this option opens the [Input Assistant] menu. [Plane] is specified according to the settings in this menu.



- **Reference Unit:** Specifies the reference unit.
- **Plane:** Specify the plane data.

Plane

Specify the plane using a result data or variable.

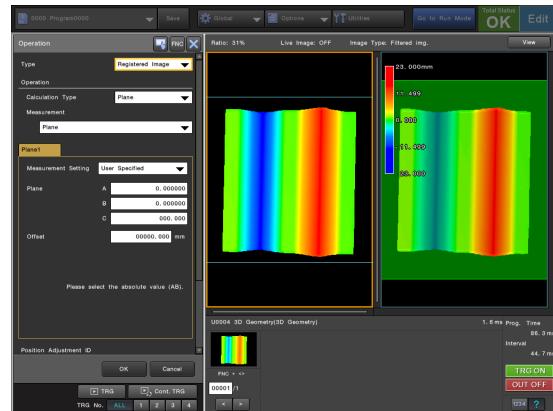


Offset

The calculated plane can be offset in the direction perpendicular to the plane (unit: mm).

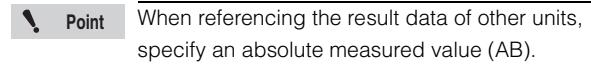
[Measurement Setting]: [User Specified]

Specify the plane and offset in numeric values.



Plane

Enter the inclination in the XY direction and Z intercept of the plane into [A], [B], and [C].



Offset

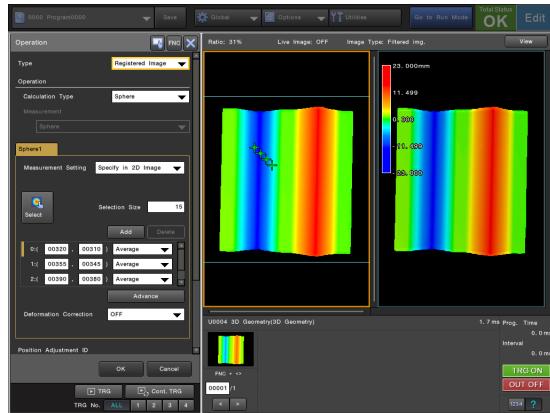
The calculated plane can be offset in the direction perpendicular to the plane (unit: mm).

Sphere Measurement Setting

Specify the input element: Sphere according to the [Measurement Setting] setting selected in [Operation].

[Measurement Setting]: [Specify in 2D Image]

Specify four or more points directly on the height image and calculate a sphere.



Select

Select this option to move the points on the height image.

Reference When using the mouse, the points on the height image can be moved directly by dragging and dropping.

Selection Size

Specify the detection range of the detection point of each position coordinate.



Add

Adds a point on the height image.

Four points have already been added by default.



If four points are specified, a sphere that touches the four points is calculated. If five or more points are specified, a sphere is calculated from the group of points using the least-squares method.

Delete

Deletes the selected point.

Four or more points need to be kept.

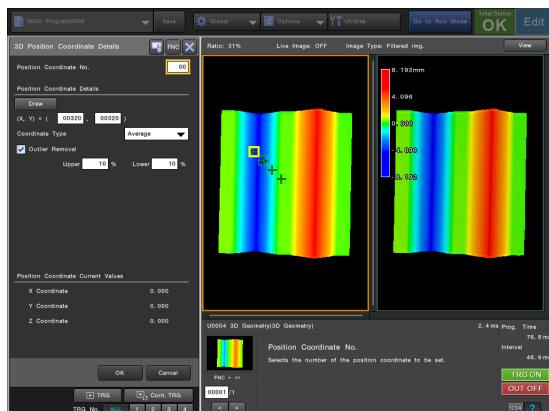
Position Coordinate List

- **Position Coordinate No.:** The number of the position coordinate.
- **XY Coordinates:** The XY coordinates on the height image can be specified in numeric values.
- **Coordinate Type:** Specifies the type of the point coordinates to be used as the input element from the pixels within the [Selection Size] centered around the specified XY coordinates.
 - **Peak:** Uses the coordinates of the point with the maximum height in the selection range as the input element.
 - **Bottom:** Uses the coordinates of the point with the minimum height in the selection range as the input element.
 - **Average:** The point with the specified XY coordinates and the average height of the selection range as the Z coordinate is used as the input element.
 - **Median:** The point with the specified XY coordinates and the median height of the selection range as the Z coordinate is used as the input element.
 - **Edge (Top):** Detects an edge in the selection range and uses the point in the top part of the edge as the input element.
 - **Edge (Bottom):** Detects an edge in the selection range and uses the point in the bottom part of the edge as the input element.
 - **Corner (Top):** Detects a corner in the selection range and uses the point in the top part of the corner as the input element.
 - **Corner (Bottom):** Detects a corner in the selection range and uses the point in the bottom part of the corner as the input element.

3D Geometry

Advance

Select this option to specify the details of the point coordinates.



- Position Coordinate No.:** Specifies the number of the coordinate to be set.
- Position Coordinate Details:** Sets the coordinate details.
 - Draw:** Change to Draw mode and adjust the part position. See “Editing the placement position of a part (Draw mode)” (Page 4-24) for more details.
 - (X, Y):** The XY coordinates on the height image can be specified in numeric values.
 - Coordinate Type:** Specifies the type of the point coordinates to be used as the input element from the pixels within the [Selection Size] centered around the specified XY coordinates.
 - Detected Position Margin:** Selects a distance between the position to detect and the detected edge or corner. Changing between “Top” and “Bottom” inverts the direction, in which the detected point will be placed. This option can be selected only when [Coordinate Type] is [Edge (Top)], [Edge (Bottom)], [Corner (Top)], or [Corner (Bottom)].
 - Large:** The detected point will be a point with a long distance to the edge or corner.
 - Medium:** The detected point will be a point with an average distance to the edge or corner.
 - Small:** The detected point will be a point with a short distance to the edge or corner.
 - Auto:** Switches between Large, Medium, and Small in accordance with the slope.
 - None:** The edge or corner will be the detected point.
 - Outlier Removal:** Removes the unexpected abnormal data from the target that will be used to calculate the average value. Orders the pixel in the selection range in descending order, removes the specified percentage ([Upper]/[Lower]) and calculates the new average value. This option can be selected only when [Coordinate Type] is [Average].
- Position Coordinate Current Values:** Displays the obtained coordinates.

Deformation Correction

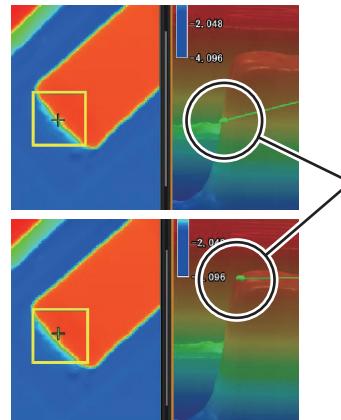
If this option is set to [ON], calculation is done with the noise excluded during sphere calculation to reduce the noise influence.

Precautions on Specifying Edge (Top)/(Bottom) or Corner (Top)/(Bottom)

If the profile shape in the selection range is to any of the following, fluctuations may occur when obtaining the coordinates:

- The edge/corner is rounded.
- The edge/corner is not vertical (i.e. it is sloped).

Example: Rounded Edge



If the specified position shifts, fluctuations will occur with the acquired coordinates.

The edge/corner can be obtained in a stable manner if the profile shape is close to perpendicular.

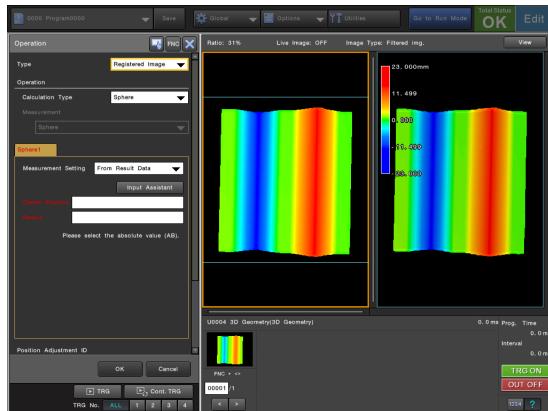
It is recommended to apply position adjustment to reduce deviations.

Point

To specify a precise point, measure the position using profile measurement (Page 8-49) and specify [Measurement Setting] using [From Result Data].

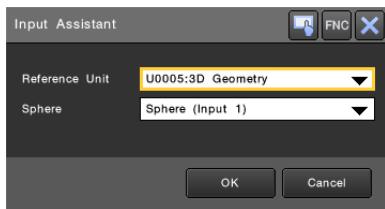
[Measurement Setting]: [From Result Data]

Calculate a sphere from the center coordinates and radius by referencing the result data of other measurement units or variables.



Input Assistant

Selecting this option opens the [Input Assistant] menu. [Center Position] and [Radius] are specified according to the settings in this menu.



- Reference Unit:** Specifies the reference unit.
- Sphere:** Specifies the sphere data.

Center Position

Specify the center position using a result data or variable.

Point When referencing the result data of other units, specify an absolute measured value (AB).

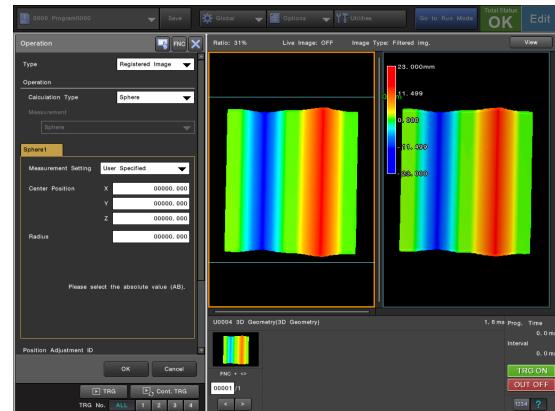
Radius

Specify the radius using a result data or variable.

Point When referencing the result data of other units, specify an absolute measured value (AB).

[Measurement Setting]: [User Specified]

Specify the center position and radius in numeric values.



Center Position

Enter the center position coordinates into [X], [Y], and [Z].

Point When referencing the result data of other units, specify an absolute measured value (AB).

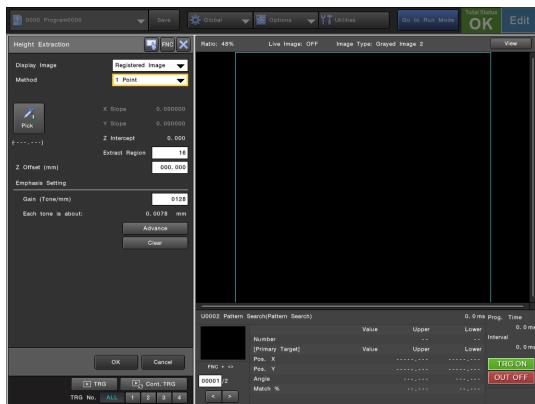
Radius

Enter the radius size (unit: mm).

Point When referencing the result data of other units, specify an absolute measured value (AB).

Height Extraction

When using 3D camera or LJ-V series head, [Height Extraction] will appear instead of [Color Extraction], allowing you to specify the range of the height to measure. [Height Extraction] will appear on the top menu of each measurement unit.



Display Image

Switch the image displayed on the screen.

- Captured Image:** Displays the latest image from the specified camera (image variable).
- Registered Image:** The registered image is displayed.

Method

Choose the extraction method for the height range.

Specifiable Extract Plane

	Changes According to the Captured Image	Does Not Change According to the Captured Image
Plane Parallel to Reference Plane	Real-time(Ave. Height)	1 Point
Arbitrary Plane	Real-time(Plane)	3 Points (Plane)
Free-form Plane	Real-time (Free-form Plane)	-

* The extract plane can also be specified by referring to result data (From Result Data).

- 1 Point** (Default): The extract plane will be the plane that is parallel to the reference plane whose Z intercept is the height of the specified point. This extract plane will not vary depending on the captured image.
- 3 Points (Plane):** The plane calculated using the 3D information at the specified three points will be used as the extract plane. This extract plane will not vary depending on the captured image.
- Real-time:** The extract plane is calculated using the 3D information of the captured image within the specified region. This extract plane will vary for each captured image

- From Result Data:** Enter a plane type variable into the [Plane] field or directly specify and reference the zero planes, height extract planes, detected planes, etc. of other units. Selecting [Input Assistant] opens a menu in which the result data of other units can be selected easily.

Point

- If the reference unit itself refers to the result data of another unit, the setting will result in an error.
- Other units can not be referenced if the unit is the Pattern Search, ShapeTrax2, ShapeTrax3, or PatternTrax unit, or if the [Subtract Filter] is set in [Image Enhance].

Calc. Basis

If you have selected [Real-time] in [Method], select the method for specifying the extract plane.

- Ave. Height:** The extract plane will be the plane that is parallel to the reference plane whose Z intercept is the average Z value of the captured image in the specified region.
- Plane:** The least square plane calculated using the 3D information of the captured image within the specified region will be used as the extract plane.
- Free-form Plane:** This method uses the curved plane estimated based on the extract size value as the extract plane.

Extract Region

Specify this option when [Real-time] is selected in [Method] and [Ave. Height] or [Plane] is selected in [Calc. Basis]. Specify the extract region individually when specifying the extract plane from other than the inspection region. You can also set a mask region.

Point

The region specified here will only be used for calculating the extract plane.

Extract Size

Specify the size of the high/low sections to be extracted if [Free-form Plane] has been selected under [Real-time] in [Method] (4 to 256; Default: 32).

Point

Reducing the extract size will increase the responsiveness to steeper curved surfaces, enabling extraction of finer irregularities (however, the processing time will be longer).

Border

You can select whether to reference the image outside of the inspection region for processing if [Free-form Plane] has been selected under [Real-time] in [Method].

- OFF:** Does not reference images outside of the region.
- ON** (Default): References and processes images outside of the region.

Extract Direction

Specify the extraction plane's extraction direction if [Free-form Plane] has been selected under [Real-time] in the [Method].

Z Offset (mm)

Specify the offset value for the Z axis direction for the extract plane.

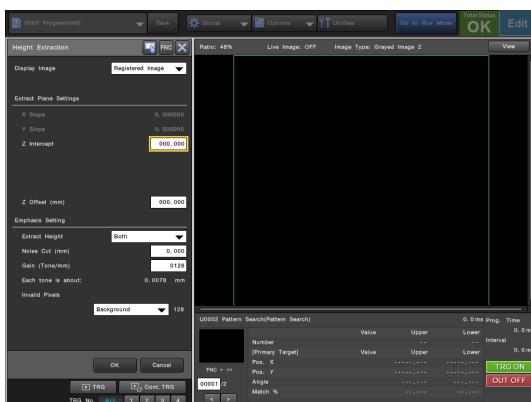
Emphasis Setting

Gain (Tone/mm)

Adjust the extraction range by specifying the grayscale value for the extracted image per 1 mm of extracted height (Default: 128).

Advance

When you select [Advance], the [Advance] screen will appear which allows you to specify the extract plane and emphasis method in detail.



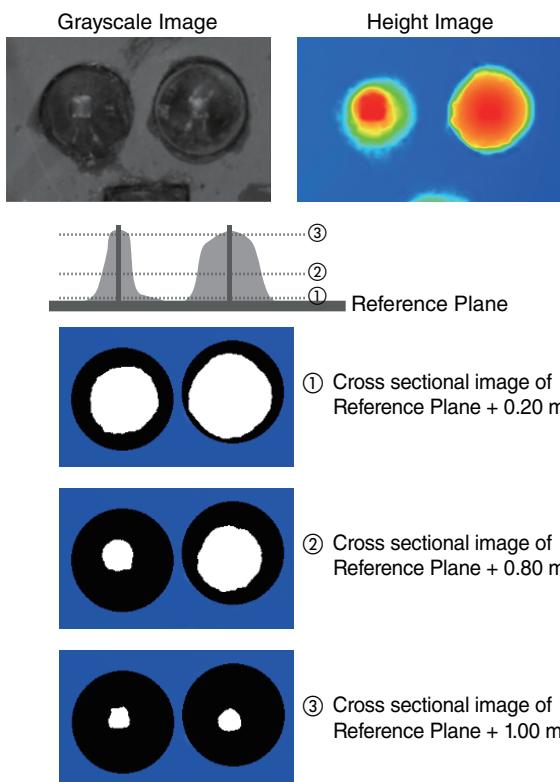
- Extract Plane Settings:** If you have selected [1 Point] or [3 Points (Plane)] in [Method], you can specify the selected plane by entering numeric values or using a variable.
 - X Slope:** The slope in the X axis direction of the extract plane is specified using the slope amount per pixel in the Z direction (mm/pixel).
 - Y Slope:** The slope in the Y axis direction of the extract plane is specified using the slope amount per pixel in the Z direction (mm/pixel).
 - Z Intercept:** Specify the Z intercept of the extract plane.
- Extract Height:** Choose the direction of the height to extract for the extract plane.
 - Upper Part:** Select this option if you wish to only extract the upper part of the extract plane (The grayscale value of the extract plane will be set to 0).
 - Lower Part:** Select this option if you wish to only extract the lower part of the extract plane (The grayscale value of the extract plane will be set to 255).
 - Both** (Default): Select this option to specify both the higher and lower parts of the extract plane as the extraction range (The grayscale value of the extract plane will be set to 128).

- **Cross Section:** Pixels are binarized in such a way that those having a height that is greater than or equal to the extract plane become white (others will be black), and the images which were binarized are displayed for the [Grayed Image]. Cross sectional images can be generated via a reference plane of arbitrary height by concurrently using the [Z Offset].

- Noise Cut:** The range in which the height from the extract plane is equal to or lower than the specified value will be removed as noise (Default: 0.000 mm.)
- Invalid Pixels:** Select the extracted grayscale value for the pixels from which no height information could be acquired.
 - Default:** Treats the pixels as having the most distant height from the extract plane.
 - Background (Default):** Treats the pixels as having the height on the extract plane.
 - Specified:** Treats the pixels as having the specified grayscale value after the extraction.

Height Extraction Application

Soldering defect inspection specimens based on cross sectional images



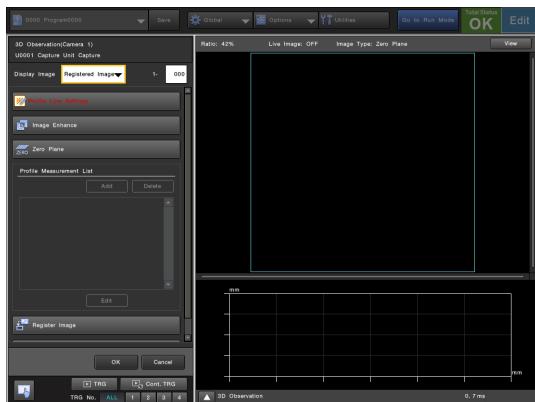
Checking the Workpiece Profile (3D Observation)

This displays the specified line position profiles for the height data which have been obtained via the 3D camera or the LJ-V series head, and various measured values similar to those of the Profile Measurement unit can be easily checked.

If the height image status is to be checked right after the 3D camera is installed, or if the height images for each workpiece are to be checked in detail when defects occur, etc., this is convenient for being able to check the height data without having to add a Profile Measurement unit to the flow.

Display the 3D Observation Screen

On the [Utilities] screen, select [3D Observation] to display the [3D Observation] screen.



Point

- You can only select [3D Observation] when a 3D camera or an LJ-V Series head is connected and the [Enable] check box is selected in the Capture unit.
- When just capturing grayscale images with 3D cameras, 3D observation is not supported.
- If you are using multiple Capture units or multiple 3D compatible cameras are set, you need to select the camera and the Capture unit before displaying the [3D Observation] screen.

Specify the Profile Line and Select the Types of Measurement to Perform

Specify the profile line on the image. You can perform various measurements for the profile at the position of the profile line.

1 On the [3D Observation] screen, select [Profile Line Settings].

The [Profile Line Settings] screen appears.

2 Select the specification method for the profile line.

Profile Line

Choose the method for specifying the profile line.

- None:** This is the state where a profile line is not specified (default). Specify a profile line to perform profile measurement.
- Specify 2 Points:** Specify two points on the image, the start and end points, to draw a profile line.
- Vertical Line:** Draw a straight profile line in the Y direction on the image.
- Horizontal Line:** Draw a straight profile line in the X direction on the image.
- Circle:** Draw a profile line in a circumferential direction on the image.

Advance

Set the details of the profile line. The setting items vary depending on the selection in [Profile Line].

- When [Specify 2 Points] is selected
 - Point 1:** Specifies the starting point.
 - Point 2:** Specifies the end point.
 - Profile Width:** Specifies the width of the profile line.
- When [Vertical Line] is selected
 - X:** Specifies the X coordinate of the vertical line.
 - Profile Width:** Specifies the width of the profile line.
- When [Horizontal Line] is selected
 - Y:** Specifies the Y coordinate of the horizontal line.
 - Profile Width:** Specifies the width of the profile line.
- When [Circle] is selected
 - Center:** Specifies the center of the circle.
 - Radius:** Specifies the radius.
 - Start Angle:** Specifies the angle that will serve as the starting point of the profile line.
 - Profile Width:** Specifies the width of the profile line.

Point

The number of profiles specified in [Profile Width] are obtained; and the profile to be measured is obtained according to the [Profile Calculation Method] setting.

Profile Calculation Method

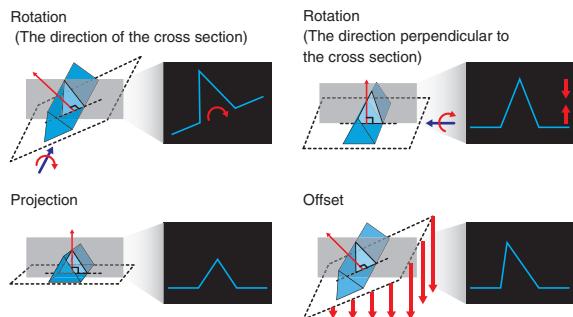
Specify the profile calculation method for obtaining the profile to be used for measurement, using the profile line specified on the height image and the profiles obtained from the [Profile Width] setting.

- **Average Value:** The average of the obtained profiles is used for the measurement.
- **Maximum Value:** The maximum pixel of the obtained profiles is combined to form the profile to use for the measurement.
- **Minimum Value:** The minimum pixel of the obtained profiles is combined to form the profile to use for the measurement.

Profile Shape Correction

The shape of the profile is corrected by rotating the profile line according to the inclination of the zero plane.

- **Rotation + Projection:** The shape of the profile will not be distorted, even when the zero plane is tilted in the cross-section direction or a direction perpendicular to the cross-section. The profile is rotated in the cross-section plane and then projected onto a cross-section that is perpendicular to the zero plane.
- **Rotation Only:** The shape of the profile will not be distorted, even when the zero plane is tilted in the direction of the cross-section. The profile is rotated in the cross-section plane in accordance with the inclination. Use this option to measure the profile by a cross-section parallel to the Z axis.
- **None:** Calculates the profile by subtracting from each individual point the corresponding height of the zero plane. The shape of the profile will be distorted if the zero plane is tilted.



Valid Pixel Border Processing

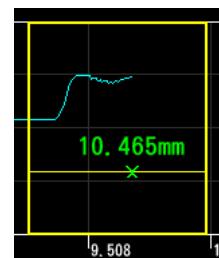
Select the processing method of the profile at the border section between valid and invalid pixels.

- Point** Only influences the measured value of edges and inflection points.

- **Extend Upward:** Connects the upper limit with the valid pixels.



- **Extend Downward:** Connects the lower limit with the valid pixels.



- **None:** There will be no connection at the border section. Therefore edges and inflection points will not be detected.

3 Select [OK].

4 On the [3D Observation] screen, select [Add] in the [Measurement Item List] field.

The [Profile Measurement Settings] screen appears.

5 After you select the profile measurement settings that you want to add, select [Add].

For details, see "Profile Measurement Settings that Can be Used for 3D Observation" (Page 8-158).

6 After specifying the details for each measurement type, select [OK].

Profile Measurement Settings that Can be Used for 3D Observation

You can measure the following profiles for 3D Observation.



The measurable items conform to the Profile Measurement unit. See Measurement Item List (Page 8-60) of the Profile Measurement unit for more details.

Height

The head's Z coordinate zero point, or the zero plane's Z coordinate zero point is the reference by which the height (Z coordinate) of an arbitrary point in the profile is measured.

Level Difference

Measure the Reference Height and the Measurement Height from two measurement ranges, and calculate (the values are signed) the level difference by [Measurement Height] - [Reference Height].

If either one of the measurement targets is undetectable, the measurement values will be 0.000.

Position

The profile's start point is the reference by which the position (distance from the start point) of an arbitrary point in the profile is measured.

Center Position

Specify two measurement ranges, and measure the intermediate position (distance from the start point) between the respective measurement results (positions 1 and 2).

Width

Specify two measurement ranges, and measure the distance (width) between the respective measurement results (positions 1 and 2).

Angle from Horizontal

Calculate an approximate line from the profile inside the measurement range, and measure the angle (angle intersecting with the X-axis) from the horizontal. If all of the data inside the measurement range are invalid pixels, the measurement value will be 0.000.

Angle Formed by Two Lines

Calculate two approximate lines, for the reference angle and measurement angle, from two measurement ranges, and measure the intersecting angle of the approximate lines. The angle will be measured counterclockwise against the measurement target's approximate line from the approximate line of the reference target. If all of the data inside the measurement range are invalid pixels, the measurement values will be 0.000.

Radius of Circle

Calculate an approximate circle from the profile inside the measurement range, and measure the radius. If all of the data inside the measurement range are invalid pixels, the measurement value will be 0.000.

In addition, even if the center of the approximate circle is outside of the measurement range, the measurement value will be output.

Cross-Section Area

The area of the region demarcated by the profile, measurement range and reference plane (or the zero plane) is measured.

1-Line Cross-Section Area

Calculate an approximate line from the profile inside the measurement range, and measure the area of the region demarcated by the approximate line and the profile.

2-Line Cross-Section Area

Specify two measurement ranges and calculate two approximate lines, and measure the area of the region demarcated by those two approximate lines and the profile.

Points Distance

Specify two arbitrary measurement target points on the profile, and measure the distance between the two points.

Point/Line Distance

Measure the length of a perpendicular line which is suspended onto a line that has been calculated from the measurement range which was specified on the profile from an arbitrary point on the profile (the measurement value is a positive number).

Count

Counts the number of measurement targets (edges, inflection points, and distances from the reference line) which have been detected inside the measurement range.

Defect Detection

Measure the area of the region demarcated by the profile and the reference line.

Changing the 3D Observation Settings

Apply a Filter to the Display Image (Image Enhance)

You can apply a filter to the image that is targeted by profile measurement.

For more details, see "Image Enhance" (Page 8-58).

Specify a Zero Plane (Zero Plane)

You can set any plane other than the reference plane as a 3D measurement reference.

For more details, see "Zero Plane" (Page 8-59).

Saving profile data or height image data to an SD card

Selecting [Save CSV Data] with an SD card inserted into the controller saves the profile data or height image data as text data.

Two csv text files are saved into the "/xg/csv" folder of the specified SD card.

- YYMMDD_HHMMSS_height.csv: Height Image Data
- YYMMDD_HHMMSS_profile.csv: Profile Data

Reference

- When a zero plane is specified, the height image data of the zero plane is output.
- The data in the saved files can be viewed or edited using a text or spreadsheet program.

Other Available Functions for Measuring by Means of 3D-compatible Cameras

Changing the Display Method for Images Captured Using 3D-compatible Cameras

The display method for the height images captured using 3D-compatible cameras, profiles obtained using the profile measurement/continuous profile measurement units, and 3D objects configured using the 3D geometry unit can be adjusted.

Make adjustments on the 2D Display screen, 3D Display screen, and Profile Display screen according to the content to be checked.

- 2D Display Screen (Page 8-160)
- 3D Display Screen (Page 8-162)
- Profile Display Screen (Page 8-164)



Precautions on the Switching of Image Displays in Run Mode

If multiple image displays have been placed in a single display pattern, switching one image display does not cause the other image display to switch in link.

Switch them individually or use PRW (Change Result Display Conditions of Profile) command, PMW (Change Measurement Item No. of Profile) command to switch the measurement items to display and the display conditions on the Profile Display screen.

For more details regarding the command, see the XG-X2000 Series Communications Control Manual.

2D Display Screen

Display the height image captured using a 3D-compatible camera in a height (Z-axis direction) color representation.



The height image display can be adjusted using the VIEW bar or touch menu.

	The screen is split showing the 2D Display screen on the left side and the 3D Display screen on the right side. It is only displayed while the following units are being edited:
	Switches to the 3D display screen (Page 8-162).
	Displays colors based on the height range in the current inspection region. [Fit Range within Region] will be executed automatically at every screen update.
	Displays colors based on the currently displayed height range.
	Displays colors based on the height range in the current inspection region.
	Displays different colors based on the upper/lower limits of the range in which height measurement can be performed.
	Specify the display range of the height image (Page 8-166).
	Specify the transparency of the displayed menu (Page 1-14).
	Display the image in enlarged/reduced size (Page 1-14).
	The screen will be adjusted automatically such that the entire image fits in the center of the screen (Page 1-14).
	Scroll and display the region that has run off the screen as a result of enlarging the image, etc. (Page 1-15)

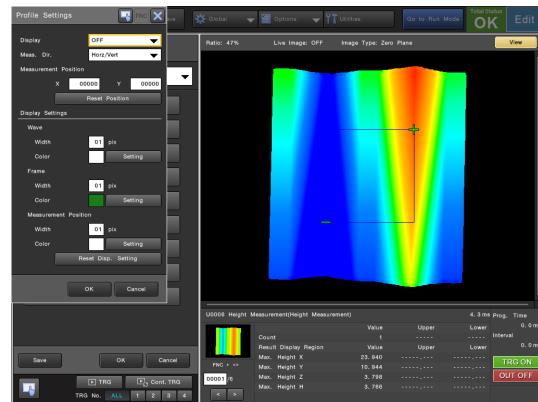
	Switch the type of image displayed on the screen.
Display Type	<ul style="list-style-type: none"> Raw 1: Displays the height image captured using the 3D camera or LJ-V series head as it is. Raw 2: Displays the image captured using the 3D camera or LJ-V series head with the inspection region drawn on top of it. Filtered Image: Displays the enhanced image with the inspection region drawn on top of it. Filtered Image 2: Displays the enhanced image with the inspection region of all units drawn on top of it. Zero Plane: Displays the height distribution image based on the zero plane. Contrast Image: Narrows down the preprocessed images to the inspection region range and displays them. Grayscale: Displays the grayscale image (in 8-bit grayscale bitmap format).
Change Image Dsp.	When multiple image displays are available, this function specifies the target for the VIEW toolbar operations.
Display Profile	Specify whether to show the profile on top of the height image.
Profile Position Specification	Specifies the display position of the profile. Select the button and select on the screen the part whose profile it is you wish to display and check.
Profile Settings	Change the display settings of the profile (Page 8-161).

Reference

- The profile display in the 2D display shows the profile in the position of the profile line set by  and . The profile obtained using the profile measurement unit or continuous profile measurement unit can be checked on the Profile Display screen (Page 8-164).
- If Display Profile is enabled on the 2D display, the profile graph of the height is displayed when the displayed image is a height image. When the grayscale image or an image after height extraction is displayed, the intensity profile graph will be displayed.

Changing the Profile Display Settings

Selecting  opens the [Profile Settings] screen on which you can change the profile display setting.



- Display:** Sets [Display profile] to ON or OFF.
- Meas. Dir.:** Specifies the direction of the profile line.
 - Horizontal:** Sets the profile line to horizontal direction.
 - Vertical:** Sets the profile line to vertical direction.
 - Horz/Vert:** Sets the profile line to both horizontal and vertical directions.
- Measurement Position:** Sets the profile line position (X/Y) in numeric values.
- Reset Position:** Resets the measurement position.
- Display Settings:** Specifies the line thickness and color of the profile (wave), profile display area (frame) and profile line (measurement position).
- Reset Disp. Setting:** Resets the display settings.

Other Available Functions for Measuring by Means of 3D-compatible Cameras

3D Display Screen

The image is displayed in 3D based on the 3D coordinates (X/Y/Z) of the height image captured using a 3D-compatible camera.



The 3D display screen can be adjusted using the VIEW bar or touch menu.

	The screen is split showing the 2D Display screen on the left side and the 3D Display screen on the right side. It is only displayed while the following units are being edited:
	• Profile Measurement Unit • Continuous Profile Measurement Unit • 3D Geometry Unit
	Switches to the 2D display screen (Page 8-160).
	Displays colors based on the height range in the current inspection region. [Fit Range within Region] will be executed automatically at every screen update.
	Displays colors based on the height range in the current inspection region.
	Displays different colors based on the upper/lower limits of the range in which height measurement can be performed.
	Specify the display range of the height image (Page 8-166).
	Set the display method of the 3D display screen (Page 8-162).
	Displays the operation guide for the 3D display screen.
	Select the ratio of the mixed display of the height image and grayscale image being displayed in 3D. A larger value displays the grayscale image more clearly.
	Specify the transparency of the displayed menu (Page 1-14).
	Display the displayed 3D image in enlarged/reduced size (Page 1-14).
	The screen will be adjusted automatically such that the entire image fits in the center of the screen (Page 1-14).
	Scroll and display the region that has run off the screen as a result of enlarging the image, etc. (Page 1-15)
	Rotate the 3D display image around the vertical or horizontal axis.

Display Type

Switch the type of image displayed on the screen.

- **Raw:** Displays the height image captured using the 3D camera or LJ-V series head as it is.
- **Filtered Image:** Displays the image with the enhanced image displayed.
- **Zero Plane:** Displays the height distribution image based on the zero plane.

Display Options

Set the zero plane display method when the display type is [Zero Plane]. It can be used to display the plane of the zero plane or sections higher/lower than the zero plane (Page 8-163).

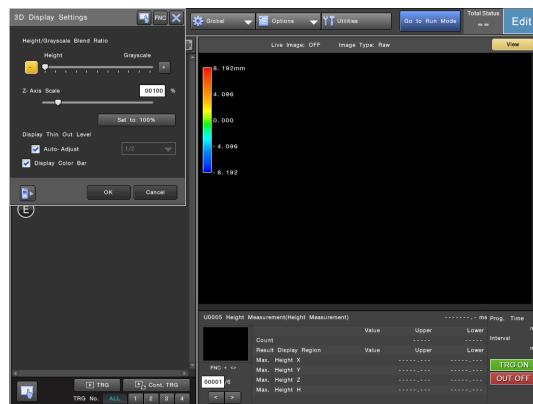
3D Object

Set the display method for the detected plane in height measurement, detected lines/plane in continuous profile measurement, and 3D objects in 3D geometry (Page 8-163).

Setting the Method to Display the 3D View

(3D Display Settings)

If you select to display the [3D Display Settings] screen, you can change the method to display the height image and so on.

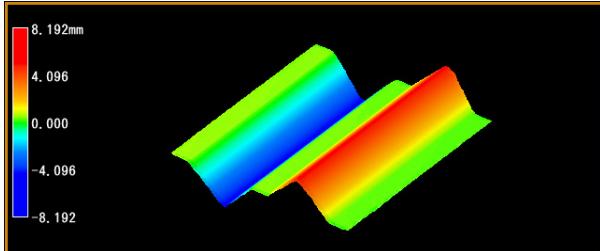


- **Height/Grayscale Blend Ratio:** Select the ratio of the mixed display of the height image and grayscale image on the 3D view.
- **Z-Axis Scale:** Specify the display magnification of the height direction.
- **Display Thin Out Level:** Select the thinning ratio if you want to accelerate the display.
- **Display Color Bar:** Select this check box if you want to display the color bar on the 3D view.

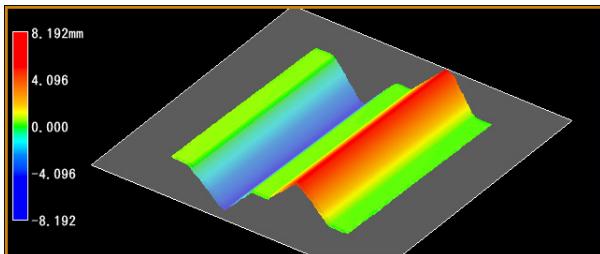
Setting the Display Options for Zero Plane Images

The display option for the zero plane image can be changed when [Display Type] is set to [Zero Plane].

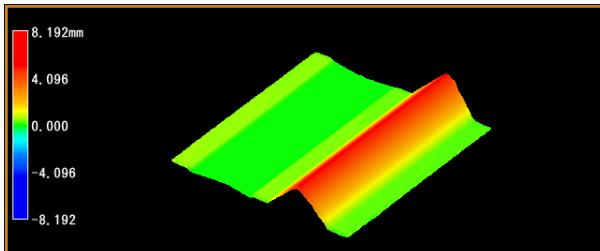
- **Normal:** Displays the height image based on the zero plane.



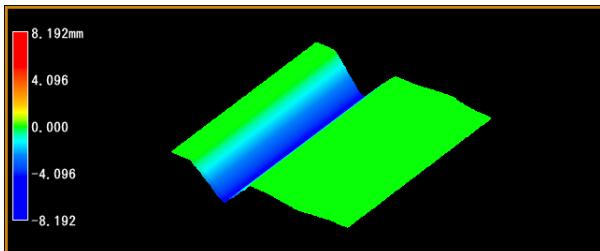
- **Plane:** Displays the height image based on the zero plane and the zero plane.



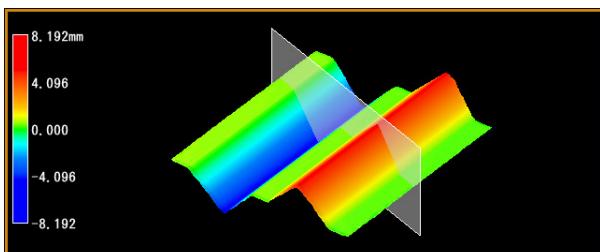
- **Convex Part:** Displays only sections that are higher than the zero plane.



- **Concave Part:** Displays only sections that are lower than the zero plane.



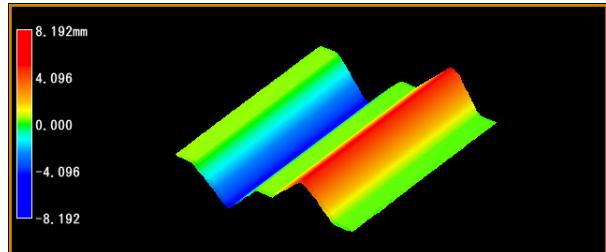
- **Profile Cross-Section:** Displays the profile cross-section of the unit currently selected in the Flowchart view.



Displaying a 3D Object

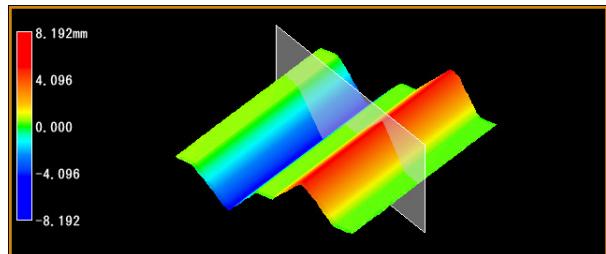
When [Display Type] is [Raw] or [Filtered Image], the 3D object can be displayed on the 3D display.

- **OFF:** Does not display the 3D object.



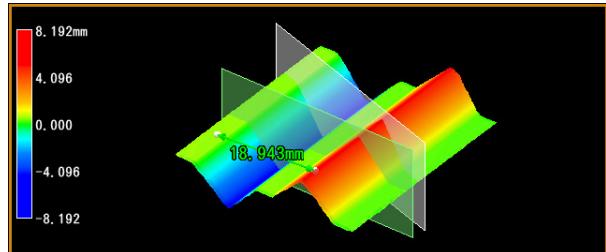
- **ON:** Displays the 3D object of the unit selected in the Flowchart view.

Example) Profile Measurement: Profile Cross-Section



- **ON(Multiple):** Displays the 3D objects of multiple units (displays at the same time the regions and results of other units, when they refer to the same image variable and are checked in the display settings of the screen editor).

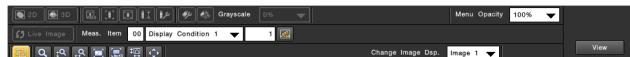
Example) Profile Measurement and Continuous Profile Measurement: Profile Cross-Section, 3D Geometry: Points Distance



Other Available Functions for Measuring by Means of 3D-compatible Cameras

Profile Display

Displays the profile set in the profile measurement unit and continuous profile measurement unit.



The profile display screen can be adjusted using the VIEW bar or touch menu.

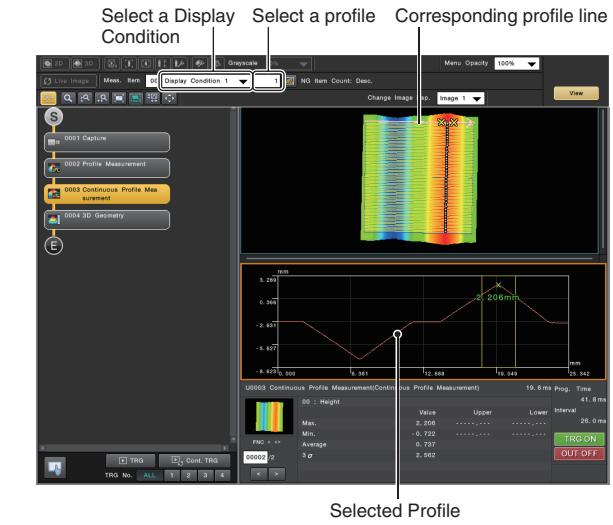
Meas. Item 00	Select the measurement item for displaying the profile from the measurement items set in the unit currently selected in the Flowchart .
Display Condition 1 1	Specify the profile display condition from among those specified in [Profile Result] (Page 8-89) in the continuous profile measurement (Page 8-164).
Display Multiple Profiles	Displays all four profiles of the specified display condition.
Display Multiple Profile Measurement Results	Displays all measurement ranges and measurement results when multiple profile measurement settings have been set in the currently selected unit.
Enlarge/Reduce	Display the image in enlarged/reduced size (Page 1-14).
Up/Down Enlarge/Reduce	Enlarges/reduces the displayed profile in the vertical direction.
Left/Right Enlarge/Reduce	Enlarges/reduces the displayed profile in the horizontal direction.
Fit	The screen will be adjusted automatically such that the entire profile fits in the center of the screen (Page 1-14).
Auto Fit	Always automatically adjusts the zoom ratio to fit the entire profile in the Profile Display screen. If Auto Fit is enabled, it automatically changes the zoom ratio for the displayed profile every time the size of the Profile Display screen changes.
Display X-Z Scale Matched	Displays the current profile with the vertical and horizontal scales matched.
Scroll	Scroll and display the region that has run off the screen as a result of enlarging the profile, etc. (Page 1-15)
Change Image Dsp.	When multiple image displays are available, this function specifies the target for the VIEW toolbar operations.

Specifying the Profile Display Condition

Specify a display condition set in [Condition] - [Profile Result] (Page 8-89) in [Continuous Profile Measurement].

Check the four profiles selected based on the display condition one by one or display and check them all at once.

Checking the profile one by one

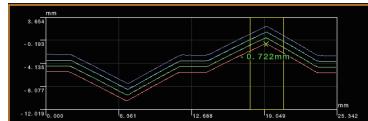


[Profile No.] is added to the display conditions when editing a unit. Select this option to check the profiles in the inspection region individually.

Displaying and checking all profiles at once

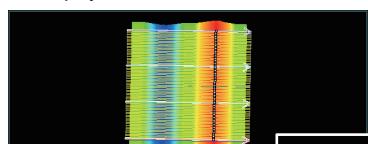


Profile Display Screen

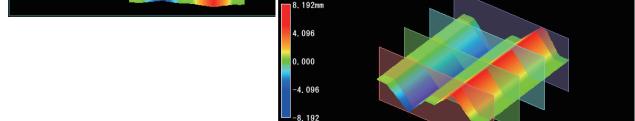


Linked

2D Display Screen



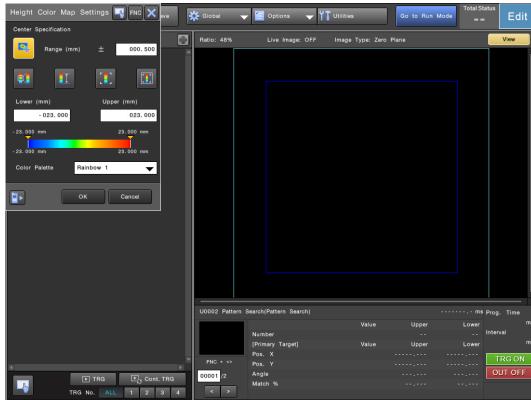
3D Display Screen



Setting the Display Range for the Height Image (Height Color Map Settings)

If you select  to display the [Height Color Map Settings] screen, you can change the display range for the height image and so on.

 The height color map settings are common for the 2D Display and 3D Display screens.



	Center Specification	Select the height that will be the center of the height color map.
	Expand/Reduce/Shift Range	Expands, reduces, or shifts the height range. If you select this setting, you can expand or reduce the range with the up/down keys on the handheld controller or the  /  buttons on the VIEW bar. You can also shift the range with the left/right keys on the handheld controller, or the  /  buttons on the VIEW bar.
	Reset Range	Displays different colors based on the upper/lower limits of the range in which height measurement can be performed.
	Fit Range	Displays different colors based on the currently displayed height range.
	Fit Range within Region	Displays different colors based on the height range in the current inspection region.
Lower Limit/Upper Limit	Lower Limit/Upper Limit	You can specify the display range for the height color map with numerical values.
Color Palette	Color Palette	Select the display palette of the height color map.

Setting the Correction Value for Converting Measurement Results into Actual Size Values (Scaling)

Scaling needs to be set in order to convert the measured values of a 3D camera or an LJ-V Series sensor head into actual size values (mm).



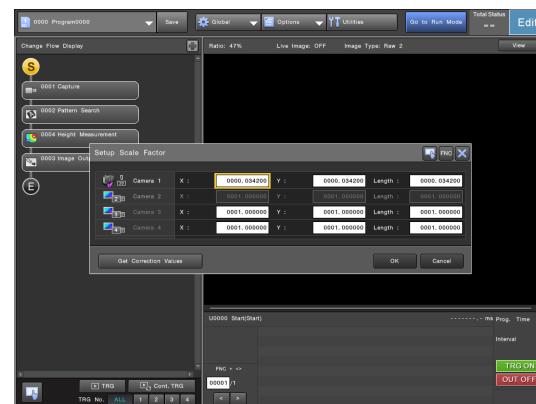
When you create program settings with a 3D camera or an LJ-V Series sensor head connected, new settings will be added with the scaling already set.



- If a 3D camera or an LJ-V Series sensor head is newly selected in [Camera Selection] of the program setting after the program setting has been created, a confirmation message will appear prompting confirmation of whether to configure the scaling automatically.
- Measured values in the Z direction have no scale factor setting as they are always output in actual size.
- The height measurement unit can also display measurement results using μm as the height direction unit.

1 From [Options] on the top of the screen, select [Camera Settings] - [Scaling].

The [Setup Scale Factor] screen will appear.



2 Select [Get Correction Values].

3 Select the camera to set the scale factor for, and then select [OK].

The correct scale factor for converting the measured values of a 3D camera or an LJ-V Series sensor head into actual size values (mm) will be set automatically.

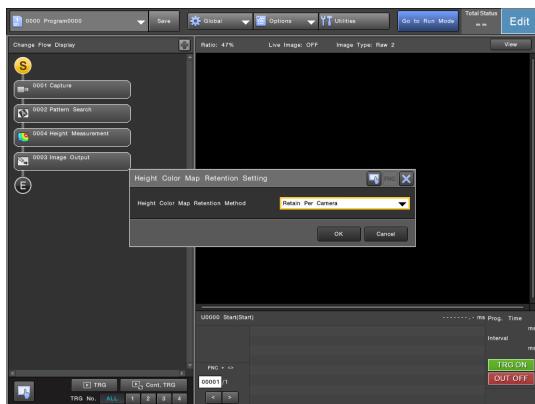


- The scale factor value varies depending on a 3D camera or an LJ-V Series sensor head type selected.
- If [XY Normalization] is set to [OFF], values will not be correctly calculated even if the scale factor is set (3D camera only).

Retaining the Color Map Settings for the Height Image (Height Color Map Retention Setting)

You can select whether to share the display range for the height image on the run screen and flow editor by camera. This is handy as you do not need to set the display range for the height image on the run screen and flow editor individually.

From [Options] on the top of the screen, select [Camera Settings] - [Height Color Map Retention Setting] - [Retain Per Camera].



Correcting the 3D Camera

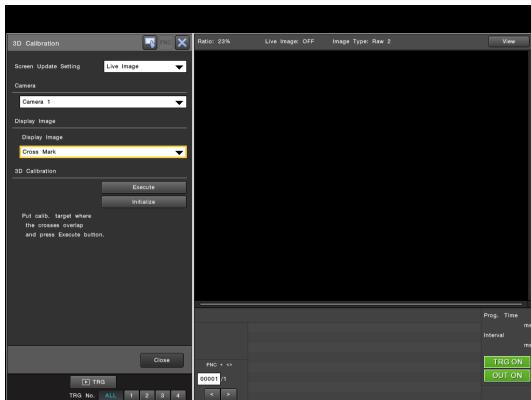
Correcting the 3D Camera Parameters (3D Calibration)

The positional relationship of the camera and projector may change due to factors such as aging or temperature changes, resulting in errors in the measured values. In such a case, you can correct the positional relationship of the devices and eliminate the deviation in the measured values by performing 3D calibration using a separately sold calibration target (OP-87740 or OP-87741).

Point After the 3D camera is turned on, correction values vary due to the heat generated by the camera unit. Normally, a warm-up time of approximately 2 hours is required until the correction values stabilize. Note that the warm-up time until the correction values become stable varies depending on the ambient environment. Before using the camera, check its warm-up time in the environment where it will actually be installed.

1 On the [Global] menu, select [Camera Common Settings] - [3D Camera Maintenance]- [3D Calibration].

The [3D Calibration] screen will appear.



2 Change the display image settings as necessary.

Screen Update Setting

Select whether or not to update the camera image continuously.

- Trigger:** Update the image only when a trigger input is received.
- Live Image:** Choose this option to display live images through a continuous feed.

Display Image

The settings are the same as [3D Imaging] - [Display Image] (Page 8-17) of the capture unit.

3 Place the optional calibration target in the plane position you wish to use as a reference.

Position it such that the dot pattern occupies the entire screen.

4 Select [Execute].

3D calibration will be executed.

3D calibration takes several tens of seconds to complete.

Point Do not move the 3D camera or the calibration target during the projection of stripe pattern that is executed after the start of the 3D calibration.

5 When 3D calibration is complete, select [Close].

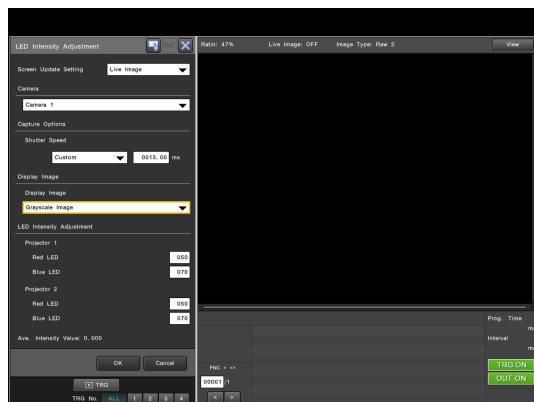
- Point**
- There are two types of calibration targets. One is for XR-HT15M, and the other is for XR-HT40M.
 - To avoid the effects of ambient light, use a light shield when performing 3D calibration if possible.
 - When you select [Initialize], the existing calibration settings will be deleted and the factory default correction state will be restored.

Adjusting the Light Intensity of the Projector (LED Intensity Adjustment)

Since LED elements are used in the projectors of the camera, measurement results may vary depending on ambient temperature or reduction in intensity due to age deterioration. In such cases, adjust the LED light intensity of the projector.

- On the [Global] menu, select [Camera Common Settings] - [3D Camera Maintenance]- [LED Intensity Adjustment].

The [LED Intensity Adjustment] screen will appear.



- Change the display image settings as necessary.

Screen Update Setting

Select whether to update the camera images continuously.

- Trigger:** Update the image only when a trigger input is received.
- Live Image:** Choose this option to continuously update and display the most recent image.

Shutter Speed

Select the shutter speed for the camera or input a numeral value.

Display Image

The settings are the same as [3D Imaging] - [Display Image] (Page 8-17) of the capture unit.

If you select [Grayscale Image], the average intensity value will appear at the bottom left of the screen which can be used as a guide for the brightness of the entire screen.

- Adjust the light intensity level as required in the [LED Intensity Adjustment] field.

Adjust the light intensity level while checking the display image.

- When the LED intensity adjustment is complete, select [OK].

Measurement Using Line Scan Cameras

Measurement Using
3D-compatible Cameras

▶ **Measurement Using
Line Scan Cameras**

Retaining and Using
Different Settings for Each Type
(Recipe Function)

Preparing a Line Scan Camera

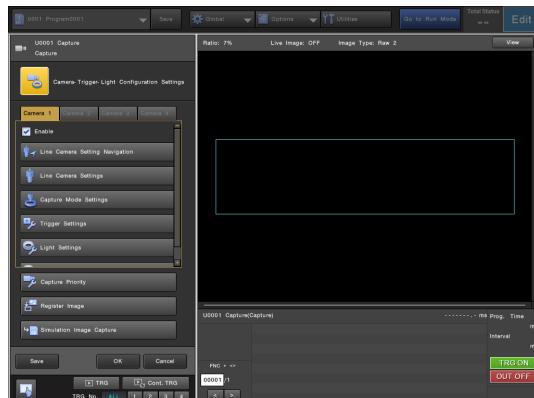
Here, the basic flow of settings is explained using an example where the capture method is set to [Fixed] and the line trigger cycle is set to [Time Delay].

Preparation 1: Changing the Camera, Trigger, and Light Settings

Configure the following settings when using fixed capture.

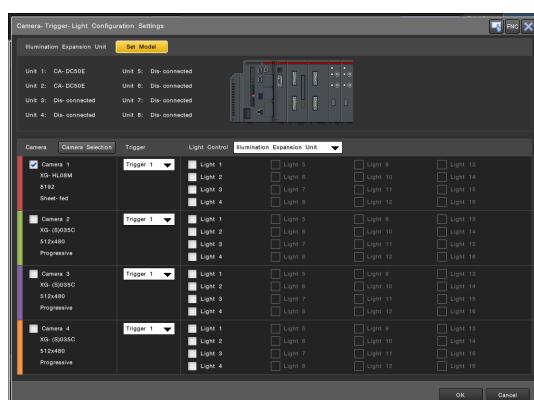
- 1 Prepare and connect a line scan camera.**
- 2 Select the capture unit from the flowchart.**

The top menu for the capture unit will appear.



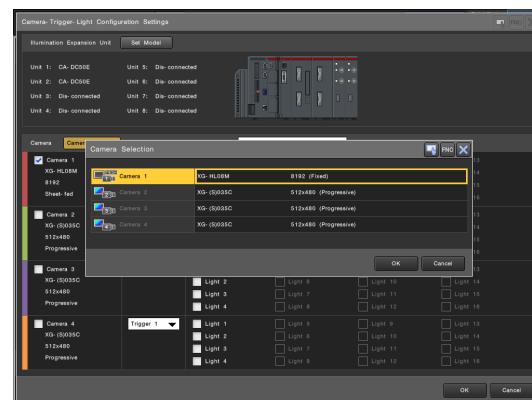
- 3 Select [Camera - Trigger - Light Configuration Settings].**

The [Camera - Trigger - Light Configuration Settings] screen appears.



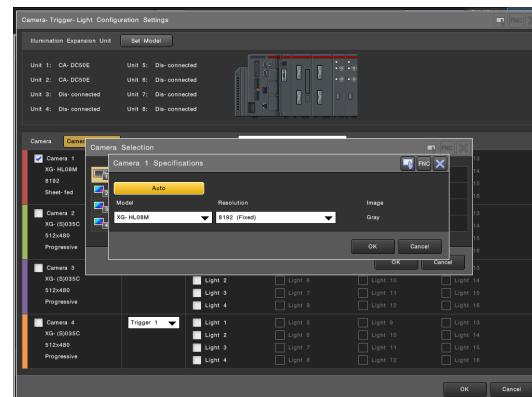
4 Select [Camera Selection].

The [Camera Selection] menu appears.



5 Select the camera No. where the line scan camera is connected.

The [Camera * Specifications] screen appears.



6 Check that the camera model displayed in the [Model] field matches the connected camera.

If a Different Camera is Displayed

Select [Auto] on the [Camera * Specifications] screen.

7 Select the resolution and capture method in the [Resolution] field.

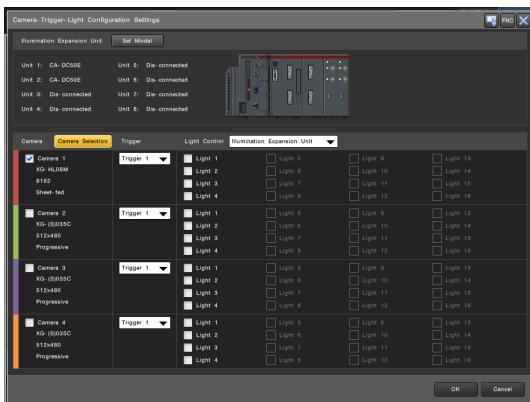
Here, select [Fixed] as an example.

8 Select the number of channels used (only for CA-HL*MX).

Increasing the number of channels can increase the speed in which images are transferred, but this decreases the number of cameras that can be connected and the maximum cable length. For more details, refer to "Channels Used (only available for CA-HL*MX)" (Page 8-176).

9 Select [OK].

10 Specify the light to be used for the capture.



- In the [Light Control] field, select the connection destination of the lights to be used from [Illumination Expansion Unit] or [External Flash].
- Select and check the desired light number ([Light*] or [External Flash*]). The position corresponding to the selected light number is highlighted on the screen.

11 Select [OK].

12 Select [OK].

Preparation 2: Changing the Settings to Capture the Workpiece Correctly (Line Camera Setting Navigation)

Use the Line Camera Setting Navigation to change the capture settings such that the workpiece can be captured correctly using fixed capture.

- Open Line Camera Setting Navigation (Page 8-171)
- Change the settings in accordance with the capture environment (Page 8-172): Change the settings in accordance with the capture environment.
- Change the trigger settings (Page 8-173): Change the settings in accordance with the triggers that will be input into the controller.
- Adjust the image ratio (Page 8-174): Change the settings so that the image aspect ratio is 1:1.

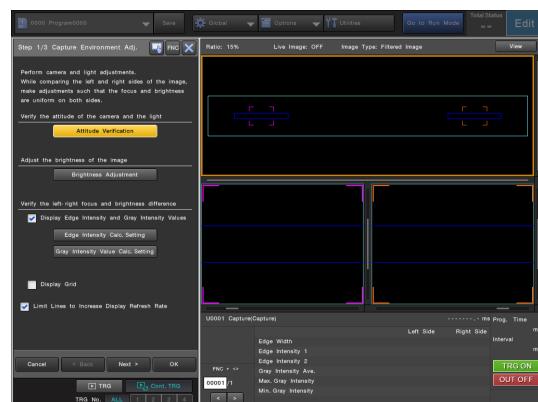


For more details on the installation conditions for each line scan camera model, see the FOV chart (Page 9-2).

1. Open Line Camera Setting Navigation

- Select the capture unit from the flowchart.
- Select the tab of the camera No. where the line scan camera is connected.
- Select [Line Camera Setting Navigation].

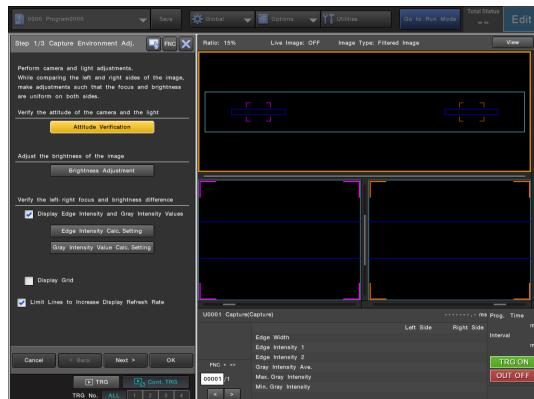
The [Step 1/3 Capture Environment Adj.] screen of the Line Camera Setting Navigation appears.



Preparing a Line Scan Camera

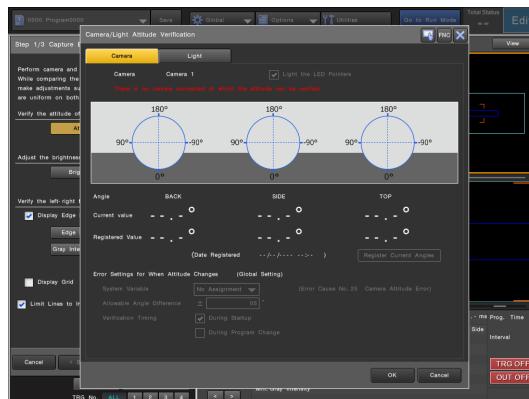
2. Change the settings in accordance with the capture environment

On the [Step 1/3 Capture Environment Adj.] screen of the Line Camera Setting Navigation, change the settings in accordance with the capture environment.



1 Select [Attitude Verification].

The [Camera/Light Attitude Verification] screen appears.



2 Select the [Camera] tab.

3 Adjust the camera attitude while looking at the screen.

By registering the current attitude, you can receive a system error notification when the attitude changes. For more details, refer to "Error Messages" (Page 9-35).

Reference

- The attitude will not be displayed for connected cameras for which the attitude cannot be checked.
- The LED pointers that are projected from the camera can be used as the capture position guide for the CA-HL*MX.

4 Select the [Light] tab.

5 Adjust the light attitude while looking at the screen.

By registering the current attitude, you can receive a system error notification when the attitude changes. For more details, refer to "Error Messages" (Page 9-35).

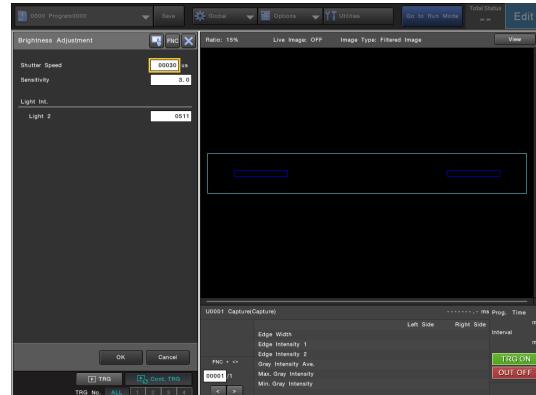
Reference

- The attitude will not be displayed for connected lights for which the attitude cannot be checked.
- When using LumiTrax Specular Reflection Mode, adjust the camera and light so that they both have the same angle with respect to the workpiece surface.

6 Select [OK].

7 Select [Brightness Adjustment].

The [Brightness Adjustment] screen appears.



8 Adjust the shutter speed (Page 8-177), sensitivity (Page 8-177), and light intensity (Page 8-182).

9 Select [OK].

10 While looking at the enlarged image on the bottom left and right of the camera screen, finely adjust the camera attitude such that both the left and right sides are in focus.

In addition to adjusting by looking at the image, you can also select [Edge Intensity Calc.Setting] and adjust the focus by making the left and right edge intensity value the same. If the left and right values greatly differ, check the installation conditions.

11 While looking at the enlarged image on the bottom left and right of the camera screen, finely adjust the camera and light attitudes to make the left and right brightness the same.

In addition to adjusting by looking at the image, you can also select [Gray Intensity Value Calc.Setting] and adjust the brightness by making the left and right gray intensity values the same. If the left and right values greatly differ, check the installation conditions.

Reference

- Select the [Display Grid] check box to display a grid with the specified spacing on the screen. This grid is useful for adjusting the workpiece position.
- Select the [Limit Lines to Increase Display Refresh Rate] check box to temporarily decrease the number of lines to 512 and reduce the image refresh interval. This setting is useful for adjusting while checking the result on the screen.

12 Select [Next].

The [Step 2/3 Trigger Settings] screen of the Line Camera Setting Navigation appears.

The aperture and focus of the lens can also be adjusted while referring to the indicators at the back of the camera.

Capture an area of the workpiece where there is an intensity difference. The [Brightness] lamps at the top will light in white when the brightness increases; and the [Sharpness] lamps at the bottom will light in blue when the intensity difference increases.



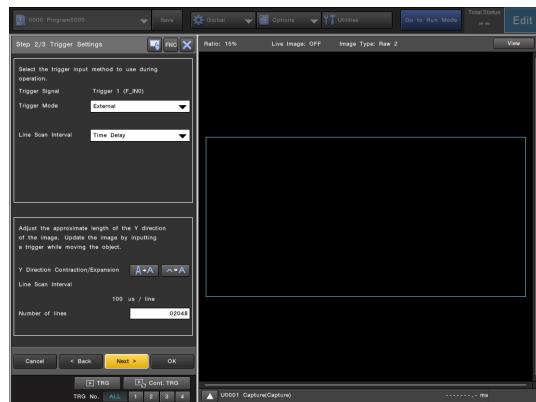
There are three lamps each and they indicate the following values by default (0 to 255; the unit is tone).

	(1)	(2)	(3)
Brightness (Maximum Brightness Value)	64	128	192
Sharpness (Maximum Intensity Difference)	10	20	30

Reference The camera LED threshold value of [Brightness] and [Sharpness] can be changed using [Linescan Calibration] (Page 8-184).

3. Change the trigger settings

On the [Step 2/3 Trigger Settings] screen of the Line Camera Setting Navigation, change the settings in accordance with the triggers that will be input into the controller.



- In the [Trigger Mode] field, select the desired trigger mode.

For more details, refer to "Trigger Mode" (Page 8-181).

- If you selected an internal trigger, specify the trigger cycle in the [Trigger Cycle] field.

For more details, refer to "Trigger Cycle (Only When [Internal] is Selected)" (Page 8-181).

- In the [Line Scan Interval] field, select the method to specify the line scan interval.

For more details, refer to "Line Scan Interval" (Page 8-179).

- While checking the captured image, select **A-A** or **^-^** for [Y Direction Contraction/Expansion] and make the image X:Y ratio close to 1:1.

Adjust the line scan interval such that the X:Y ratio is roughly 1:1 before accurately adjusting the X:Y ratio to 1:1 on the [Step 3/3 X:Y Ratio Adjustment] screen. Change the line scan interval, input a trigger, and then refresh the image.

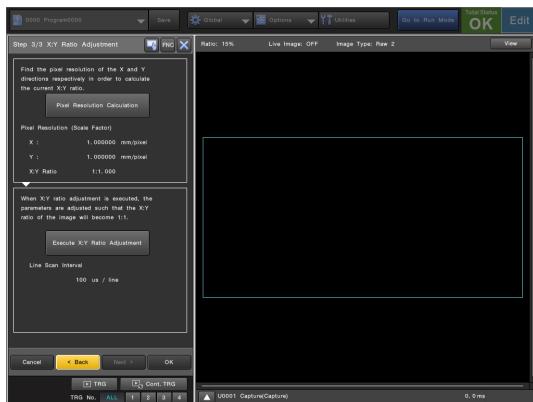
- Select [Next].

The [Step 3/3 X:Y Ratio Adjustment] screen of the Line Camera Setting Navigation appears.

Preparing a Line Scan Camera

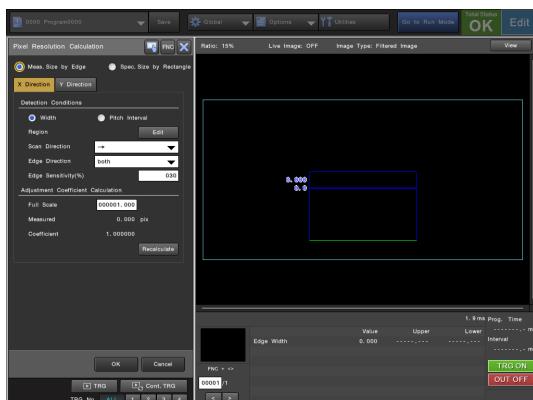
4. Adjust the image ratio

On the [Step 3/3 X:Y Ratio Adjustment] screen of the Line Camera Setting Navigation, change the settings so that the image X:Y ratio becomes 1:1.



1 Select [Pixel Resolution Calculation].

The [Pixel Resolution Calculation] screen appears.



2 Select the [X Direction] tab and calculate the pixel resolution in the X direction.

Capture a workpiece whose width or pitch interval is known, enter the known actual value, and select [Recalculate] to obtain the width or pitch measured value (pixel count) by means of edge measurement. The X direction pixel resolution can then be obtained from the measured value and the actual value that was input.

For more details, refer to "Notes on Adjusting the Line Scan Interval" (Page 8-186).

3 Select the [Y Direction] tab and calculate the pixel resolution in the Y direction.

Capture a workpiece whose width or pitch interval is known, enter the known actual value, and select [Recalculate] to obtain the width or pitch measured value (pixel count) by means of edge measurement. The Y direction pixel resolution can then be obtained from the measured value and the actual value that was input.

For more details, refer to "Notes on Adjusting the Line Scan Interval" (Page 8-186).

4 Select [OK].

5 Select [Execute X:Y Ratio Adjustment].

Based on the calculated pixel resolution, parameters such as the line scan interval and encoder settings (when an encoder is used) are adjusted so the X:Y ratio gets as close as possible to 1:1.

6 Select [OK].

Capture (When Line Scan Camera is Used)

A capture unit is used for capturing images of the inspection/measurement target workpiece using a camera. When the CA-DC40E/DC50E/DC60E illumination expansion unit is connected, the settings (flashing/light intensity) can be controlled without wiring to the controller.

- This section describes the settings to use a Line Scan Camera. When using other cameras, refer to the descriptions below:
 - Area Camera: Page 2-25
 - 3D Camera: Page 8-14
 - LJ-V Series Head: Page 8-22
- When using Capture Mode, refer to the descriptions below:
 - LumiTrax Mode (area camera only): Page 7-11
 - LumiTrax Specular Reflection Mode (area camera): Page 7-32
 - LumiTrax Specular Reflection Mode (line scan camera): Page 7-44
 - MultiSpectrum Mode (area camera only): Page 7-62
 - Standard Lighting Mode Using MultiSpectrum Light: Page 7-86

Image Capture Setup

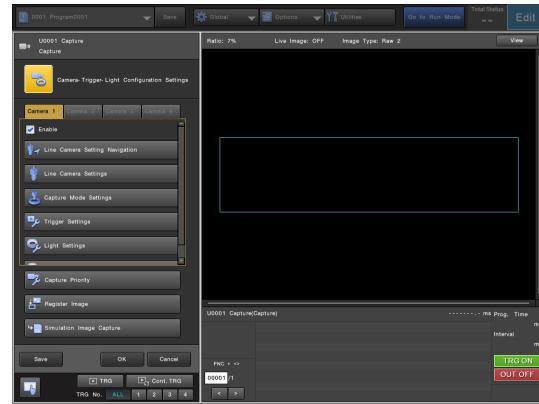
In the capture unit, images are captured by using the cameras, maximum of 4, connected to the controller. The image data is sent from the camera to the controller and assigned to a specified image variable.



- If the cameras used in a capture unit are different from the cameras actually connected to the controller, a camera setting error will occur. No image capturing and subsequent image processing units will be processed. In such cases, set the camera model setting correctly or turn off the controller and connect the correct camera.
- The model and other information for the camera set in a capture unit can be viewed in the [Camera Selection] screen (Page 4-11).

Top Menu

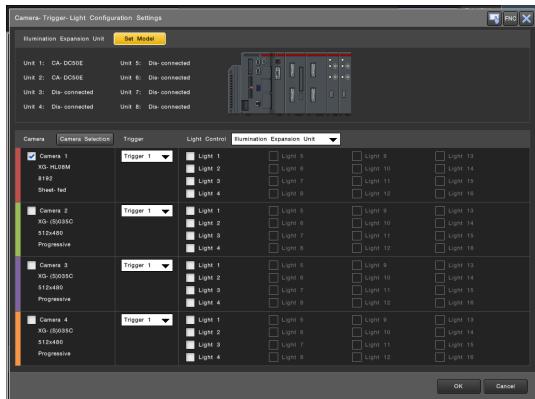
The capture unit menu has the following options. Change the settings as required.



Camera - Trigger - Light Configuration Settings (Page 8-176)	The connected cameras and illumination expansion units, trigger input for each camera, and illumination control targets can be configured together.
Line Camera Setting Navigation (Page 8-177)	Adjust the camera and light.
Line Camera Settings (Page 8-177)	You can specify the conditions for image capture.
Trigger Settings (Page 8-181)	Specify the settings for triggering the controller to take an image.
Light Settings (Page 8-182)	When an illumination expansion unit CA-DC40E/DC50E/DC60E (sold separately) is connected to the controller, the settings related to the light brightness and illumination are configured per light.
External Flash Settings (Page 8-182)	Set the illumination timing for controlling external light equipment using the external FLASH terminal.
Capture Priority (Page 8-183)	This option controls the conditions of the trigger input status for capture unit completion (transition to the next unit) with priority.
Register Image (Page 8-183)	Register images to use as the basis for measurements and setting.
Simulation Image Capture (Page 8-183)	Save the captured image to the SD card. The saved images can be referenced as simulation images in XG-X VisionEditor.

Camera - Trigger - Light Configuration Settings

The connected cameras and illumination expansion units, trigger input for each camera, and illumination control targets can be configured together.



Illumination Expansion Unit

Displays the information of the illumination expansion units connected to the controller. Select [Set Model] to specify the model of the connected illumination expansion units for each light unit No.

Camera

Check the camera No. box of the camera to be used. Select [Camera Selection] and on the [Camera Selection] screen that appears, select the field where the camera model is displayed to specify the model and resolution of the connected camera for each camera number. For more details, refer to "Specifying the Model of the Connected Camera (Camera Selection)" (Page 4-11).



Model

Select the model of the connected camera.

Resolution

Select the horizontal camera resolution and operation mode.

- Resolution (Fixed)
- Resolution (Continuous)
- Resolution (Fixed, X Binning) (only available for CA-HL*MX)
- Resolution (Continuous, X Binning) (only available for CA-HL*MX)

Point X binning is the process of handling two pixels along the X direction of the line sensor as one pixel. The X direction pixel resolution is halved but the image brightness is doubled.

Channels Used (only available for CA-HL*MX)

By specifying the number of channels used for the CA-HL*MX camera, you can increase transfer speed.

- If you select [2] for [Channels Used], the transfer speed is approximately twice as fast than if you select [1]. However, as one camera uses two cameras' worth of channels, the number of connectable cameras decreases by that amount.
- You cannot set [4ch] for just Camera 3 and Camera 4. Additionally, you cannot connect the CA-HL*MX camera and another camera to one camera input unit and use them at the same time (you can connect two CA-HL*MX cameras).
- The maximum length of connection cables for cameras that can be used differs depending on the [Channels Used] set for the camera.
 - When [4ch] is set: 10 m
 - When [2ch] is set: 20 m (Up to two extension cables)
 - When [1ch] is set: 20m (Up to two extension cables)

Y Binning (only available for CA-HL*MX)

Select the check box to enable Y binning.

Y binning is the process of handling two lines along the Y direction of the line sensor as one line. The Y direction pixel resolution is halved but the image brightness is doubled.

Trigger

Select the trigger to be assigned to each camera.

Light Control

Specify the control method for the light assigned to each camera.

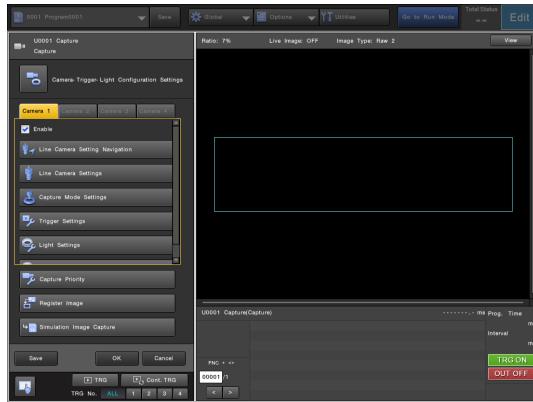
- **Illumination Expansion Unit:** Check the light number of the illumination expansion unit to which you wish to assign an illumination control.
- **External Flash:** Check the external terminal to which an illumination control will be assigned.



The illumination expansion unit and external FLASH terminal can be selected simultaneously.

Camera 1 to Camera 4

Select the tab of the camera for setting the capture options.

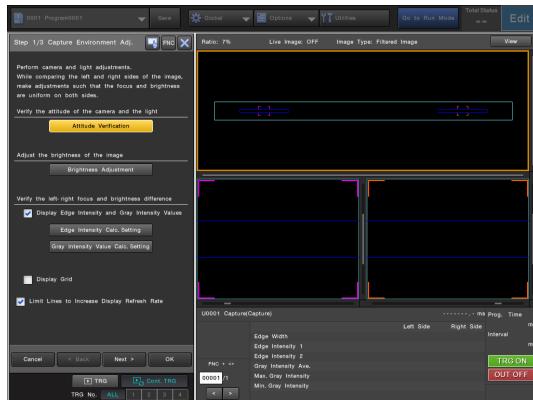


Enable

Check the box to enable the current setting target camera. Remove the check mark if a camera is connected to the controller but is not used.

Line Camera Setting Navigation

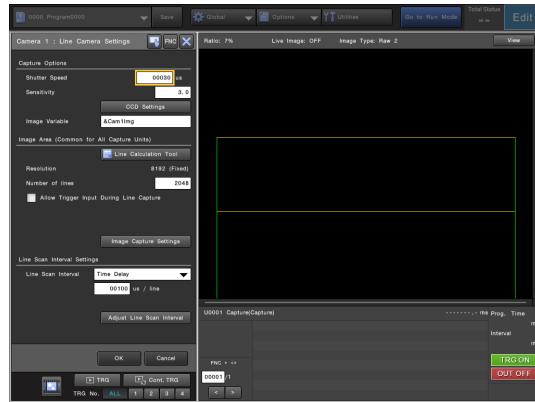
Change the capture options in accordance with the onscreen instructions so that the workpiece can be correctly captured.



For more details, refer to "Preparation 2: Changing the Settings to Capture the Workpiece Correctly (Line Camera Setting Navigation)" (Page 8-171).

Line Camera Settings

You can specify the conditions for image capture.



The image quality can also be adjusted by camera sensitivity adjustment and gain correction of the captured image. This functionality is useful when needing to optimize an image's brightness and adjust for black / white saturation.

Reference The gain adjustment can not only be set for each camera but also be set for each measurement unit as [Contrast Conversion] filter (Page 2-492).

Capture Options

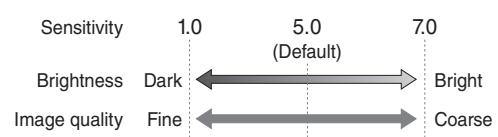
Shutter Speed

Select or enter the shutter speed for the camera specified in camera tab. Select the shutter speed according to the target movement speed and lighting conditions. When setting the shutter speed to match a fast line, prepare a light where the required lighting can be secured for producing the desired images.

Sensitivity

The sensitivity of the camera can be adjusted. Typically, to adjust the brightness of an image, the lens aperture, lighting and shutter speed are the ones adjusted accordingly. However, if none of these improve image brightness, such as in lines where the movement speed is fast then change the camera sensitivity.

Point If the camera sensitivity is increased, so will the overall brightness of the image. However, noise in the image will become more visible (and the image will appear coarser). When the camera sensitivity is decreased, the overall image darkens but the noise will be reduced (the image appears smoother).



Capture (When Line Scan Camera is Used)

CCD Settings

To adjust the image display balance in the high and low tone regions (gain adjustment) for the displayed image of the camera specified in camera tab, select [CCD Settings]. The gain adjustment allows adjustment of the shift (offset) and span (range).

Reference The gain adjustment can also be set for each measurement unit through the [Contrast Conversion] filter (Image Enhance). To adjust the gain for each vision unit, select the [Contrast Conversion] filter in [Image Enhance], and then select [Detail].

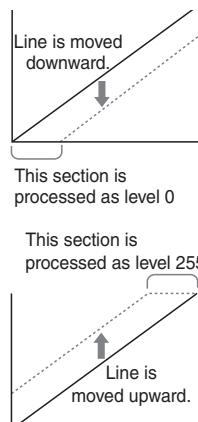
1 Select [CCD Settings].

The [(Camera No.): CCD Settings] menu appears.

2 Select [Shift], and then specify the shift (offset) level for the entire digital signal.

The range of values that can be specified are -255 to +255 (Default: 0).

- To darken the image:** Specify a negative value to move the entire line downward. The section below the minimum value on the Y-axis is processed as level 0 (black).
- To lighten the image:** Specify a positive value to move the entire line upward. The section above the maximum value on the Y-axis is processed as level 255 (white).

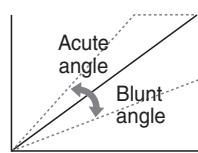


Reference According to one's purposes, shift can also be used to set all bright parts or dark parts above/below certain values to either 255 or 0.

3 Specify a value for [Span (All)] to adjust how correction is to be applied to gradation changes.

The setting range is from 0.0 to 7.9 (Default:1.0).

- To increase the contrast in images:** Use a high value so there is a greater rate of change.
- To decrease the contrast in images:** Use a low value so there is a lesser rate of change.



Point In the same way as [Shift] in Step 2, the range below the minimum value on the Y-axis is processed as 0 (black), and the range above the maximum value is processed as 255 (white).

4 To apply the settings, select [OK].

Reference If [Divide Graph] is checked, it is possible to set an individual contrast span for each of the 16 shades of the graph. Select a level of shading for which to set the span via [Division] and specify the span value.

Image Variable

Specify an image variable which will contain the image captured with the camera selected in camera tab.



- Variables to be specified need to be added in advance in the [Variable Settings] (Page 4-4) screen.
- Changing the setting clears all image variables, archived data, and target classification results.

Image Area (Common for All Capture Units)

The settings vary depending on the image capture method.

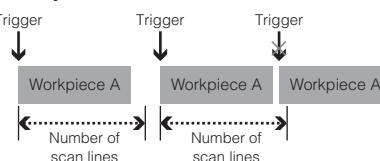
Fixed Capture Settings

- Line Calculation Tool:** If you select [Single Target] for [Capture Target] and then input the full size in millimeters for [Y Direction Length] with the line scan interval correctly adjusted, the number of lines in the vertical direction required for capture will be displayed. Select [Reflect to Capture Parameters] to apply the displayed number of lines to the capture settings (the scaling coefficient must be calculated in advance).
- Resolution:** Displays the number of horizontal direction lines, and operation mode (Fixed Capture).
- Number of lines:** Specifies the number of lines to capture in the vertical direction.
- Allow Trigger Input During Line Capture:** If this option is checked, the trigger signal for the next image will be accepted even if the current image is still being captured. Images can be captured without missing images even when the workpiece interval is non-uniform and the next workpiece arrives while the current image is still being captured.

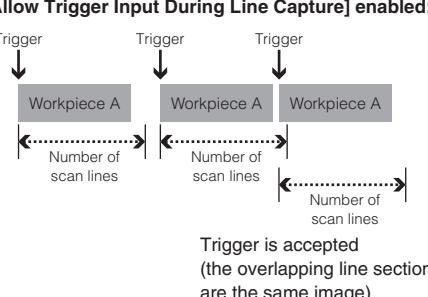


- If [Allow Trigger Input During Line Capture] is not enabled, the next workpiece cannot be captured if it comes in while the capture of the specified line is still in progress (because the line capture has not finished yet).
- The same image is reflected to the overlapping section of the workpiece image currently being captured and the next workpiece image.

Normally:

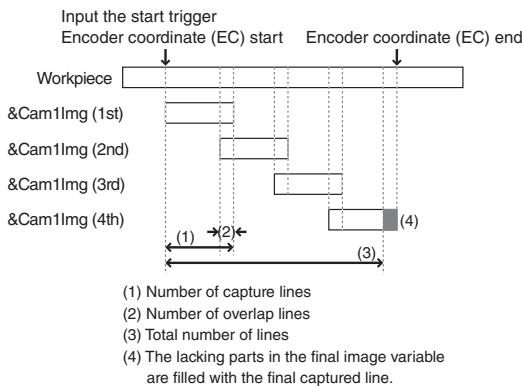


[Allow Trigger Input During Line Capture] enabled:



Continuous Capture Settings

- Line Calculation Tool:** If you select [Continuous Target] for [Capture Target] and then input the full size in millimeters for [Area of Each Capture] and [Overlap Length] with the line scan interval correctly adjusted, the number of lines in the vertical direction and the number of overlap lines required for capture will be displayed. Select [Reflect to Capture Parameters] to apply the displayed numbers of lines to the capture settings (the scaling coefficient must be calculated in advance).
- Resolution:** Displays the number of horizontal direction lines, and operation mode (Continuous Capture).
- Number of lines:** Specifies the number of lines to capture in the vertical direction.
- Overlapping lines:** Specify the number of lines that will be overlapped from the image variable of the previous capture when storing in the image variable.
- Total Number of lines:** Specify the number of lines (999999 lines maximum) to stop capturing at when capturing by continuous capture when the image is big and cannot be fully captured with the single frame capture. When the total number of lines is specified, the system operates as follows:



- The encoder coordinates start counting up when a start trigger is input.
- When the capture for the total number of lines is complete, the counting up of the encoder coordinates will stop and start waiting for the next start trigger (The encoder coordinates will be reset to 0 when the next start trigger is input).
- Missing parts of the final image variable will be filled using the final captured line.



- The area around the edge of the captured image may appear dark when a lens with an image size smaller than the CCD is used and the processing region is set at the edge portion of the CCD.
- These settings are common for all capture units.
- When setting the image area, all image variables, archived data, and the output buffer are cleared.
- When continuously capturing images, if the image processing time is longer than the capture cycle, the image capture buffer may become overloaded, during which captured images are discarded without inspection. Adjust the settings, such as decreasing the processing time or the number of overlap lines, or slowing down the line trigger cycle, so that the image capture buffer does not become overloaded.
- When an overflow of the image capture buffer occurs, "Trigger Pass occurred" is displayed at the bottom right of the screen. The occurrence can also be detected by monitoring %Cam1Status to %Cam4Status.
- If %Ext is input after the start trigger input, the operation follows the [End capture by EXT signal] setting.

Mirror / Rotate Image

Select whether to perform mirror inversion or rotation of the image for the camera selected in camera tab.

- OFF** (Default): Does not mirror the image horizontally.
- Horizontal:** Captures the image horizontally inverted.
- Vertical:** Captures the image vertically inverted.
- 180° Rotate:** Rotates the image by 180° during image capture.



When continuous capture is performed using a line scan camera, vertical inversion and 180 degrees rotation cannot be selected.

Line Scan Interval Settings

Line Scan Interval

Specify the line scan interval.

- When [Time Delay] is selected: Specify the line scan interval in time (24 to 30000 µs per line).
- When [Specify Encoder] is enabled: Specify an encoder count (1 to 99999999) for the line scan interval.

Use Dedicated Encoder (Only When [Specify Encoder] is selected)

Check this option when using the CA-EN100U encoder unit (sold separately). A desired pulse count per rotation can be specified by connecting the controller with CA-EN100U.

This is useful as it eliminates the need for a pulley, etc. for adjusting signals from the encoder.

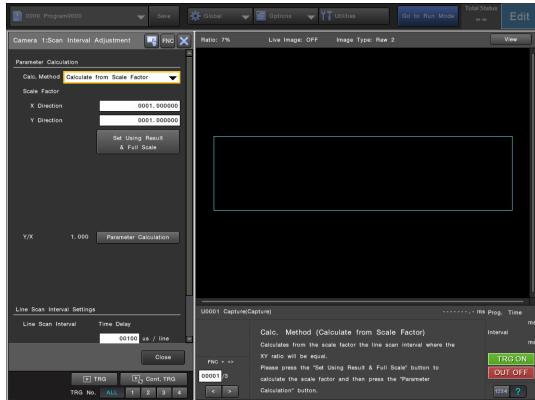
Capture (When Line Scan Camera is Used)

Adjust Line Scan Interval

Adjust the line scan interval to match the X/Y resolutions.



If the X/Y resolutions are different, the generated image may be stretched or shrunk in the Y direction. In such a case, correct measurement is not possible because the length and shape will change according to the rotation angle of the measurement target.



- Calc. Method:** Select the calculation method for the setting values related to the line scan interval. For more details on the adjustment procedure and setting values for each calculation method, see "Notes on Adjusting the Line Scan Interval" (Page 8-186).
- Pulse Count Per 1 Revolution** (only when [Use Dedicated Encoder] is specified): Specifies the pulse count per rotation for the dedicated encoder.
- Line Scan Interval:**
 - When [Time Delay] is selected: Specify the interval per line in time.
 - When [Specify Encoder] is selected: Specify the encoder input count per line.
- Sampling Mode (Only When [Specify Encoder] is Selected)**
 - x1** (Default): Pulse count increases by 1 on the rising edge of phase A of the encoder.
 - x2**: Pulse count increases by 1 on both the rising and falling edge of phase A of the encoder.
 - x4**: Pulse count increases by 1 on both the rising and falling edges of phase A and phase B of the encoder.

Details (Only when [Specify Encoder] is selected)

- Encoder Direction:

OFF (Default): The pulse count goes up for rotation in both the clockwise and counterclockwise directions.

CW: The pulse count always goes up only for rotation in the clockwise direction.

CW and CCW: The pulse count goes up for rotation in the clockwise direction. If there is a pulse count for the counter-clockwise direction, that amount goes down before counting again.

- Reverse Detection:

OFF (Default): The pulse count goes up for rotation in the clockwise direction.

ON: The pulse count goes up for rotation in the counter-clockwise direction.

- Z-Phase Function :

None (Default): Encoder Z phase input is not used.

Trigger: Used as trigger input.

Reset Pulse Count: Used to reset the encoder count.

Reset Pulse Count and Trigger: Used to reset the encoder count and as trigger input.

- External Trigger:

Trigger: Used as trigger input.

Reset Pulse Count and Trigger: Used to reset the encoder count and as trigger input.

Detect Timeout: Specify the duration before a timeout error occurs when an encoder count stops (units: ms).

Check Encoder Connection (When [Specify Encoder] is selected)

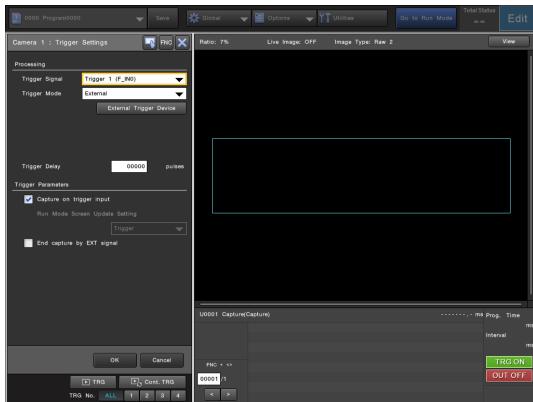
The [Check Encoder Connection] screen is displayed.



The encoder terminal to be used will vary depending on the model of the camera input unit and the selected trigger signal. The position of the encoder terminal to use with the current program setting can be checked on the [Check Encoder Connection] screen.

Trigger Settings

Specify the settings for triggering the controller to take an image.



Processing

Trigger Signal

Select the trigger signal to be used. The assignment of trigger signals and terminals are specified on the [Terminal Block & Parallel Port] screen (Page 6-11) in the global settings.

Trigger Mode

Select the type of trigger to be used.

- External** (Default): Captures images in response to trigger inputs from the handheld controller or trigger signals sent from an external device. The process is performed only once for each trigger input.
- Internal**: Capture images in response to internally generated periodic trigger signals by specifying the interval time or encoder count.



If [Trigger Mode] is set to [Internal] and [Trigger Cycle] is set to [Time Delay], respectively, the trigger will constantly be generated while in Run mode (No triggers are generated in Setup mode). To temporarily stop the generation of internal trigger signals from an external device, use either of the following methods to prohibit trigger input. When internal trigger is disabled, the output of the result data up to that point continues.

- Terminal block input (EXT terminal)
- Communications command (TE,0 command).

For more details, see the XG-X2000 Series Communications Control Manual.

Trigger Cycle (Only When [Internal] is Selected)

- Time Delay** (Default): Select to specify the trigger cycle or line scan interval based on time.
- Specify Encoder**: Select to specify [Trigger Cycle] or [Line Scan Interval] using the encoder count.

External Trigger Device (Only When [External] is Selected)

To use an external trigger, select and check the type of trigger to be used for image capture.

- **Terminal Block**: Trigger input through the external terminal assigned with %Trg1 through to 4
- **Handheld Controller/Mouse**: Trigger input provided by the No.3 (TRIGGER) button on the handheld controller or the TRG button on the screen.
- **RS-232C**: Trigger input through the RS-232C commands
- **Ethernet (TCP/IP)**: Trigger input through the Ethernet commands
- **PLC-Link**: Trigger input through RS-232C or Ethernet PLC-Link commands
- **CC-Link**: Trigger input through the CC-Link bit devices or commands
- **EtherNet/IP**: Trigger input through the EtherNet/IP™ cyclic communication, message communication, or commands
- **PROFINET**: Trigger input through the PROFINET cyclic communication, message communication, or commands
- **EtherCAT**: Trigger input through the EtherCAT cyclic communication, mailbox communication, or commands
- **PC Program**: Trigger input through the ActiveX control method



External triggers using the handheld controller/mouse are always available in Setup mode.

Trigger Delay

To set a time delay between the selected trigger input and capturing of an image, specify a trigger delay time (Trigger Delay).

- The trigger delay can be set in the range between 0 and 999.999 ms for each camera.
- When [Trigger Cycle] or [Line Scan Interval] is set to [Specify Encoder], specify the encoder count (0 to 65535, Default: 0).

Capture (When Line Scan Camera is Used)

Trigger Parameters

Capture on trigger input

Choose whether or not the capture unit will wait for a trigger signal to capture an image. When the check is removed, all cameras that are set will capture images according to the capture processing, regardless of their independent trigger signals.

This is the case when the image capture buffer (Page 4-12) is enabled and empty when the capture unit is processed. If there are any images in the buffer which satisfy the capture priority, the capture will be completed and the next unit will be executed regardless of this setting.

Run Mode Screen Update Setting

Select whether to update the camera images continuously in Run mode.

- Trigger:** Update the image only when a trigger input is received.
- Live Image:** Always displays the latest image while waiting for a trigger signal.

Point

- If the capture on trigger input is disabled in the trigger settings (Page 8-181), this setting cannot be changed.
- When [Live Image] is selected for a moving object, take care when capturing as there will be a time lag between the external trigger input and the actual image capture.
- In principle, [Live Image] is applied when the capture unit being edited is being executed (waiting for a trigger input). When the image capture buffer is enabled, the images collected in the buffer will still be displayed even if the capture unit is not running, as long as it is waiting for a trigger.
- Live Image is not available while a line scan camera is being used.

End Capture by EXT Signal

If enabled, the capture process can be terminated via EXT signal input.

Point

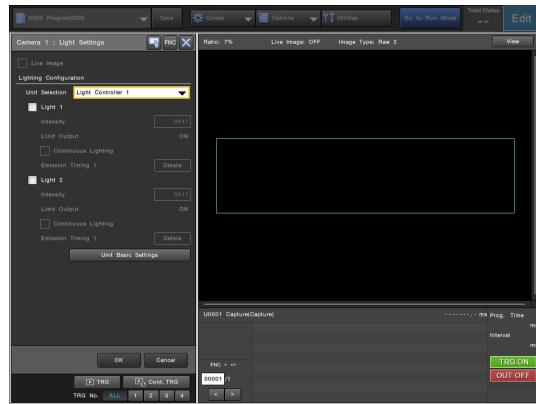
- The missing (non-captured) line parts will be filled using the final line.

Light Settings

When an illumination expansion unit CA-DC40E/DC50E/DC60E (sold separately) is connected to the controller, the settings related to the light brightness and illumination are configured per light.

Point

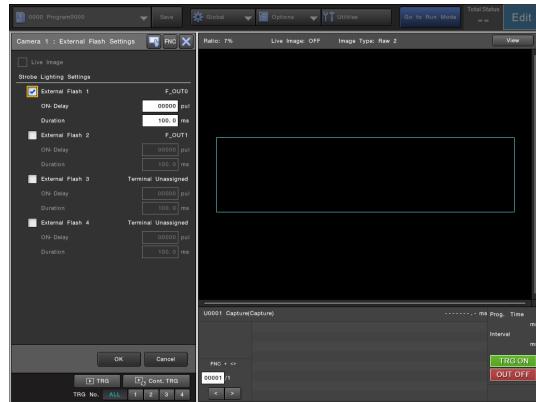
- If the PWM mode is used while using a line scan camera, the brightness may fluctuate between lines. Make sure to use the DC mode.
- Using CA-DZW*X with the XG-HL*M camera will forcibly enable continuous lighting.



The settings are the same as for area cameras. See "Light Settings" (Page 2-32) for more details.

External Flash Settings

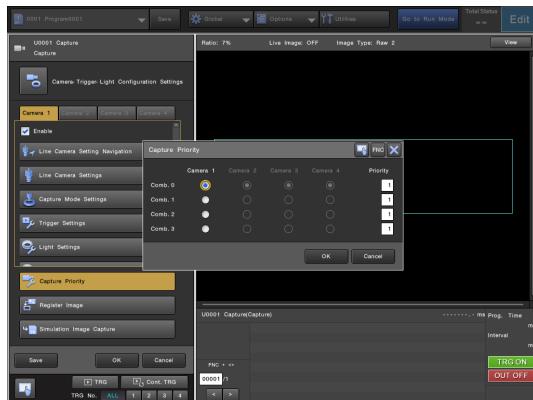
Specify the conditions for when using flash for image capture.



The settings are the same as for area cameras. See "External Flash Settings" (Page 2-33) for more details.

Capture Priority

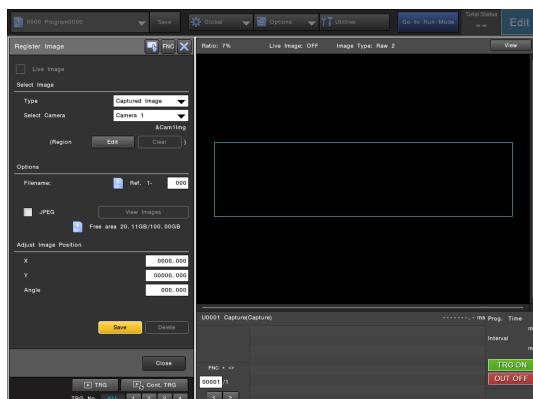
The [Capture Priority] screen appears, which controls the conditions of the trigger input status for capture unit completion (transition to the next unit) with priority. Normally, the capture unit is complete when the trigger inputs for all enabled cameras are received. It is possible to move to the next unit when the trigger input(s) of the specified camera(s) combination is received.



The settings are the same as for area cameras. See "Capture Priority" (Page 2-34) for more details.

Register Image

Register images to use as the basis for measurements and setting.



The settings are the same as for area cameras. See "Register Image" (Page 2-34) for more details.

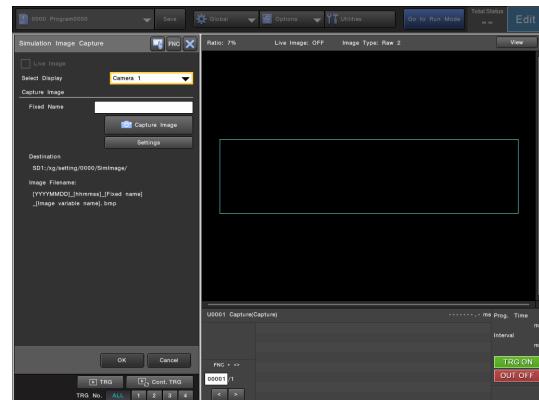
Live Image

Check this box to display the latest images through a continuous feed.

Point [Live Image] is only applied in Setup Mode.

Simulation Image Capture

The simulation image capture allows you to check the actual images captured by the camera based on the changed settings, or save the captured images to the SD card in the image format specified in the output settings. This is useful for quickly checking camera settings and saving images for simulation in XG-X VisionEditor.



The settings are the same as for area cameras. See "Simulation Image Capture" (Page 2-35) for more details.

Save

The settings for all units are saved to the currently used program setting file in SD Card 1 or SD Card 2.



- If the device is turned off before any settings are saved, all of those changes will be deleted.
 - Do not turn off the system power while you are saving the settings. Doing so may cause errors in the internal data.
 - Items specified not to be saved are excluded from the saving operation.
- As examples of items that can be made so they are not saved, there are the variables and the screen, such as a display pattern screen, display state changed in the current program setting.

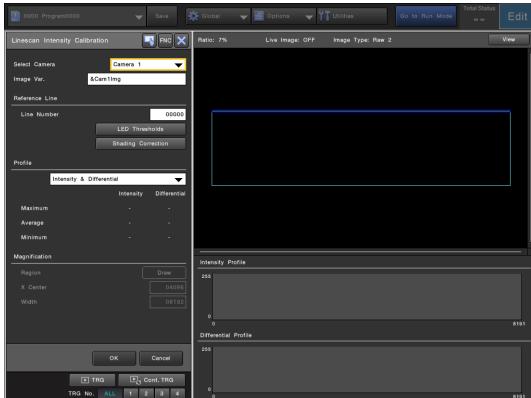
Viewing a Graph of the Line Scan Camera Capture Conditions (Linescan Calibration)

The Linescan Calibration can be used to display a graph of the intensity data for the selected 1 line in the image. Check the graph and adjust the lens focus, adjust the camera LED indicators, or correct shading. This can be used to check the intensity graph, differential graph, and other information for the captured image, or to change the settings for the selected line or magnification region.

Displaying the Linescan Calibration

From the capture unit edit menu or Function menu, select [Utilities] – [Linescan Calibration].

The [Linescan Intensity Calibration] screen appears, and the input image that was most recently captured is displayed.



Reference Line

Specify the pixel line (0 - 16383) to display the graph for.

Profile

The displayed contents change as shown below according to the display graph settings. (Vertical axis indicates the pixel value 0 - 255.)

- Intensity & Differential:** The intensity profile graph for the entire selected line is shown on top, and the differential profile graph for the entire selected line is shown on bottom.
- Intensity:** The intensity profile graph for the entire selected line is shown on top, and the intensity profile graph for the zoom area of the selected line is shown on bottom.
- Differential:** The differential profile graph for the entire selected line is shown on top, and the differential profile graph for the zoom area of the selected line is shown on bottom.

 When either [Intensity] or [Differential] is selected, a zoom area can be selected to enlarge and verify the necessary position.

Magnification

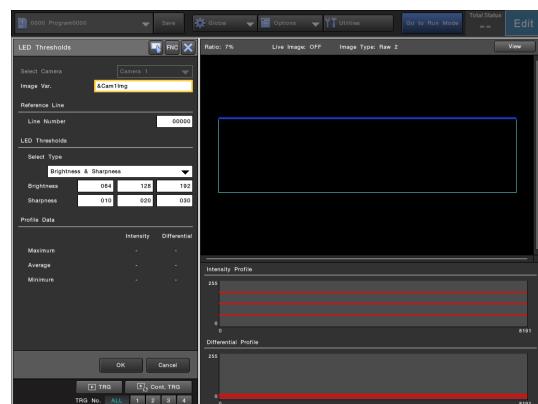
Select the area to be displayed in the zoom graph.

- X Center:** Selects the center position in the X direction.
- Width:** Selects the width in the X direction.

Changing the camera LED threshold setting

- 1 Select [LED Thresholds] on the [Linescan Intensity Calibration] screen.

The [LED Thresholds] screen appears.



- 2 Capture the standard target, and specify each of the 3 LED thresholds under [LED Thresholds] while checking the graph.

The thresholds are linked with the LEDs on the rear of the camera, and the LEDs illuminate when the entered threshold is exceeded.

- **Brightness:** Select intensity within the range of 0 - 255.
- **Sharpness:** Select differential within the range of 0 - 255.

- 3 To finish settings, select [OK].

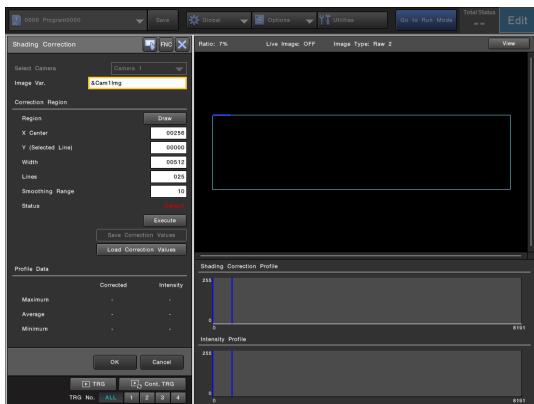
Changing the shading correction



Point Do not use shading correction in LumiTrax Specular Reflection Mode. The appropriate image may become impossible to acquire.

1 Select [Shading Correction] on the [Linescan Intensity Calibration] screen.

The [Shading Correction] screen appears.



The graph which is displayed here shows the intensity graph after filtering on top, and before filtering on bottom. The top graph (intensity graph after filtering) is the graph after Y direction averaging and X direction smoothing of the intensity graph.

2 Specify the area to be the standard for correction.

Two blue lines appear to indicate the width of the displayed graph according to the selected width.

- **Region:** Specify the X Center, Y (Selected Line), Width and Lines (width).
- **X Center:** Selects the center position in the X direction.
- **Y (Selected Line):** Specify the center position (selected line) in the Y direction.
- **Width:** Selects the width in the X direction.
- **Lines:** Specify the Y direction area. (Find the average value of multiple lines.)
- **Smoothing Range:** Specify the degree of correction as a percentage (%) of the image pixels in the X direction. When correction is performed for a narrow range, the value will be small. When performed for a broader range, the value will increase.



The smoothing range is linked to the graph display.

- With a larger value, the graph after filtering becomes smoother.
- With a smaller value, the graph after filtering shows sharper changes.

3 Select [Execute].

Shading correction is executed. The corrected images can then be checked on the captured images.



- Point**
- The correction value for shading correction is saved inside the camera and is retained until [Clear] is executed.
 - When an encoder is used, the image will be displayed after the encoder reaches the designated count.
 - After correction has been executed, the correction value can be saved to an SD card.
 - Output folder: /xg/linacam/
 - File Naming Rule: [Camera type]_[YYMMDD]_[HHMMSS].csv
 - The SD card can be specified in the System Settings in XG-X VisionEditor (default: SD2).
 - The correction value can also be read from an SD card. Save the file that contains the correction value in the following folder.
SD1(2): /xg/linacam/
 - The maximum shading correction value is 5x.
 - For intensity profile graph values after filtering shown at the bottom right of the screen, the intensity maximum values, average values, and minimum values after correction (Corrected) and before correction (Intensity) are displayed.
 - When correction is executed or cleared, or when correction values are loaded, the operation stops.

Notes on Adjusting the Line Scan Interval

If you use a line scan camera or LJ-V Series sensor head, it is important to set the line scan interval so that the pixel interval between the X and Y directions is equal. If you use a line scan camera or LJ-V Series head with a different pixel interval for the X and Y directions, by just tilting the object on the screen the length and the shape will change and stable image processing cannot be performed.

This section describes how to adjust the line scan interval during Sheet-Fed capture for both [Time Delay] and [Specify Encoder].

When [Time Delay] is Set for the Line Scan Interval

Parameters that Must be Adjusted

Line Scan Interval

Specify the scan interval per line with time (μs/line).

Calculate the Parameters

If the line scan interval has been calculated, directly specify the value. If you do not know the line scan interval, you can calculate the appropriate line scan interval with one of the following methods.

Method 1: Calculate from Scale Factor

Capture an image while moving a workpiece for which you know the width in the X/Y direction of and calculate the X/Y direction scale factor based on the measured value and the full scale value that you entered separately. Adjust the line scan interval so that the scale factor becomes 1:1.

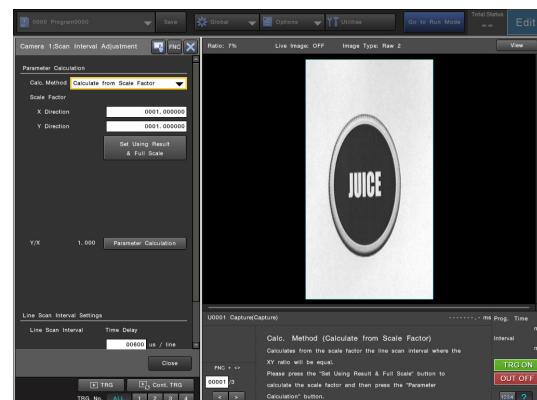
1 Select [Adjust Line Scan Interval].

The [Scan Interval Adjustment] screen appears.



- Depending on the camera that you use, the location of [Adjust Line Scan Interval] differs.
- When using an LJ-V Series sensor head: "Trigger Settings" (Page 8-26)
 - When using a line scan camera: "Line Camera Settings" (Page 8-177)

2 In the [Calc. Method] field, select [Calculate from Scale Factor].



3 Select [Set Using Result & Full Scale].

The [Set Using Result & Full Scale] screen appears.

4 Activate the line and run a workpiece for which you know the width of in the X/Y direction.

5 Input a trigger.

When the number of lines for an image has been captured, the image will be displayed.

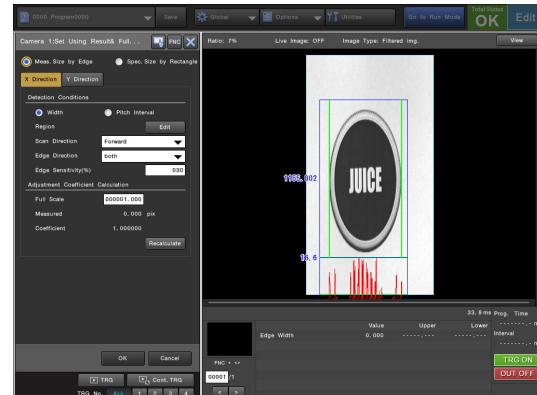
6 Once you have confirmed that an image of the workpiece was correctly captured, enter the conditions for the X/Y width of the workpiece and calculate the scale factor for the X/Y direction.

Calculate the scale factor for the image that you captured with the current line scan interval by finding the number of pixels for the X/Y direction and specifying the full scale.

There are two ways to specify the full scale as shown below.

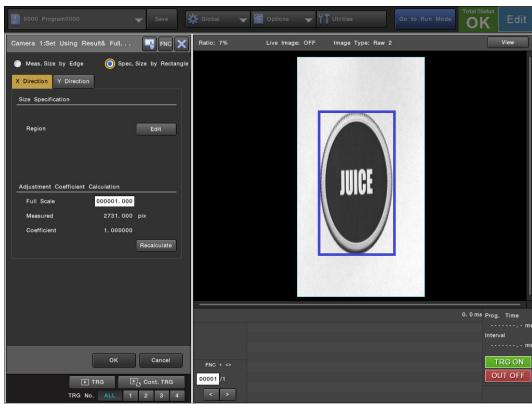
Meas. Size by Edge

Find the pixel count for the specified direction of the workpiece by measuring the edge (width or pitch), and then enter the obtained full scale value in the [Full Scale] field.



Spec. Size by Rectangle

By specifying the region such that it follows the captured workpiece, you can find the pixel count for the X or Y direction. And then, enter the obtained full scale value in the [Full Scale] field.



7 Select [Recalculate].

The scale factor is calculated from the full scale and measured values.

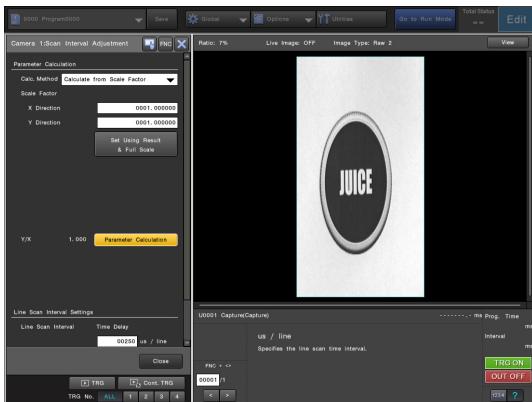


You can specify the scale factor for the X direction only for a line scan camera. There is no need to specify the X direction scale factor for an LJ-V Series head because it is a fixed value that is determined by the LJ-V head model.

8 Select [OK].

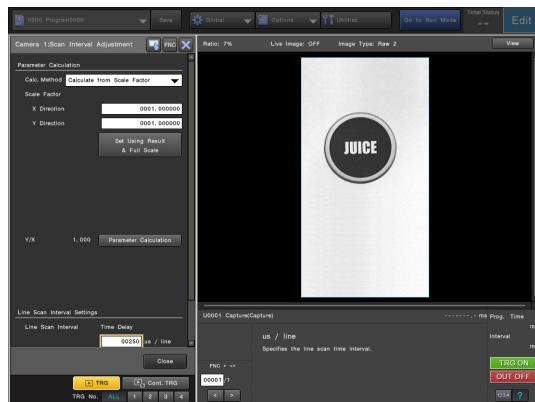
9 Select [Parameter Calculation].

The line scan interval is automatically calculated so that the calculated X/Y Scale Factor approaches 1:1, and Scale Factor Y is recalculated based on that value.



10 Input a trigger.

Check that you were able to capture an image where the pixel spacing for the X/Y direction is matched.



11 Select [Close].

Notes on Adjusting the Line Scan Interval

Method 2: Specify Change Scale Factor

Capture an image while moving a workpiece for which you know the width in the X/Y direction of and, by specifying the scale factor to change the image in the Y direction to N times, calculate the line scan interval for capturing correct images.

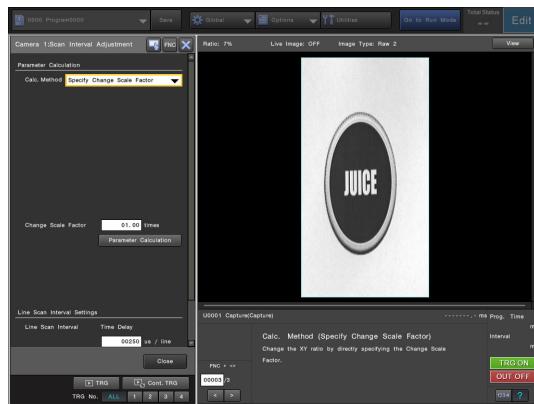
1 Select [Adjust Line Scan Interval].

The [Scan Interval Adjustment] screen appears.



- Depending on the camera that you use, the location of [Adjust Line Scan Interval] differs.
- When using an LJ-V Series sensor head:
"Trigger Settings" (Page 8-26)
 - When using a line scan camera:
"Line Camera Settings" (Page 8-177)

2 In the [Calc. Method] field, select [Specify Change Scale Factor].



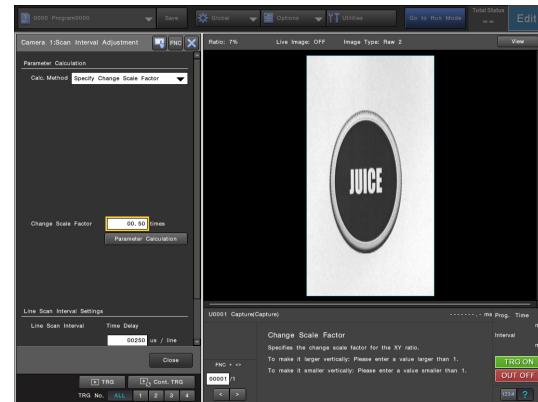
3 Activate the line and run a workpiece for which you know the width of in the X/Y direction.

4 Input a trigger.

When the number of lines for an image has been captured, the image will be displayed.

5 Once you have confirmed that an image of the workpiece was correctly captured, based on the aspect ratio of the full scale and the aspect ratio of the captured image, enter the scale factor that will extend the Y direction to N times into the [Change Scale Factor] field.

If you want to extend the image in the Y direction, specify a value larger than 1. If you want to reduce it, specify a value smaller than 1.

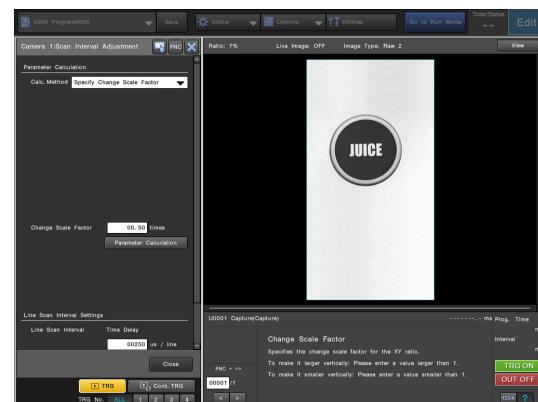


6 Select [Parameter Calculation].

The line scan interval is updated.

7 Input a trigger.

Check that you were able to capture an image where the pixel spacing for the X/Y direction is matched. If the pixel spacing is unmatched, return to step 3 and try the procedure again.



8 Select [Close].

When [Specify Encoder] is Set for the Line Scan Interval

Parameters that Must be Adjusted

When you use an encoder, you can adjust the line scan interval by changing the following parameters:

- Pulse Count Per 1 Revolution (Pulses/Rotation) (In the case of Use Dedicated Encoder)
- Sampling Mode (Count/Pulse)
- Line Scan Interval (Pulses/Line)

Pulse Count Per 1 Revolution

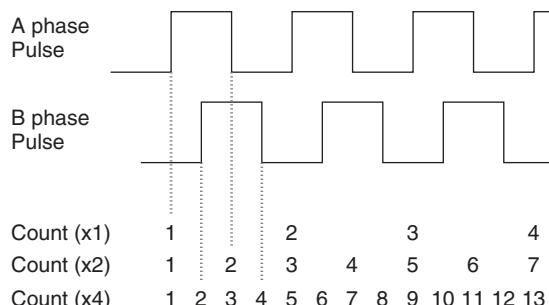
When you use the dedicated encoder, you can set any number of pulses for one revolution. If you do not use the dedicated encoder, the pulse count per revolution is fixed for each encoder, so you need to select an appropriate encoder and pulley diameter.



To change the number of pulses for the dedicated encoder, you need to connect the controller to the dedicated encoder unit with the bundled RS-232C cable. For more details, see the "CA-EN100U Instruction Manual" or the "XG-X2000 Series Setup Manual (LJ-V Edition)."

Sampling Mode

Specify how many counts the encoder pulses are handled as.



- x1** (default setting): Counts the rise of the encoder A phase.
- x2**: Counts the rise and fall of the encoder A phase.
- x4**: Counts the rise and fall of the encoder A and B phases.

Line Scan Interval

Set how many encoder counts are handled as one line.

Calculate the Parameters

If the encoder parameters have been calculated, directly specify those values. If you do not know the parameters, you can calculate the encoder parameters so that the Y direction scale factor matches based on the direction X scale factor with one of the following methods.

Method 1: Calculate from Scale Factor

Capture an image while moving a workpiece for which you know the width in the X/Y direction of and calculate the X/Y direction scale factor based on the measured value and the full scale value that you enter separately. Then adjust the line scan interval so that they become 1:1.

1 Select [Adjust Line Scan Interval].

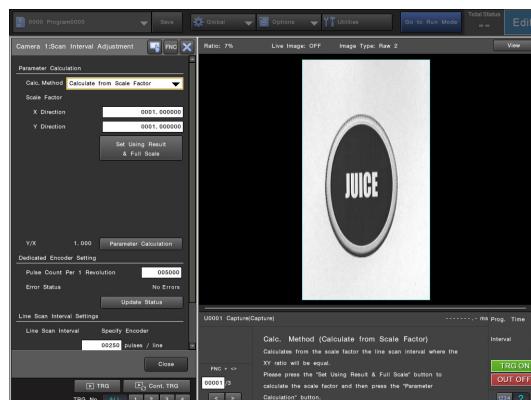
The [Scan Interval Adjustment] screen appears.



Depending on the camera that you use, the location of [Adjust Line Scan Interval] differs.

- When using an LJ-V Series sensor head: "Trigger Settings" (Page 8-26)
- When using a line scan camera: "Line Camera Settings" (Page 8-177)

2 In the [Calc. Method] field, select [Calculate from Scale Factor].



3 Select [Set Using Result & Full Scale].

The [Set Using Result & Full Scale] screen appears.

4 Activate the line and run a workpiece for which you know the width of in the X/Y direction.

5 Input a trigger.

When the number of lines for an image has been captured, the image will be displayed.

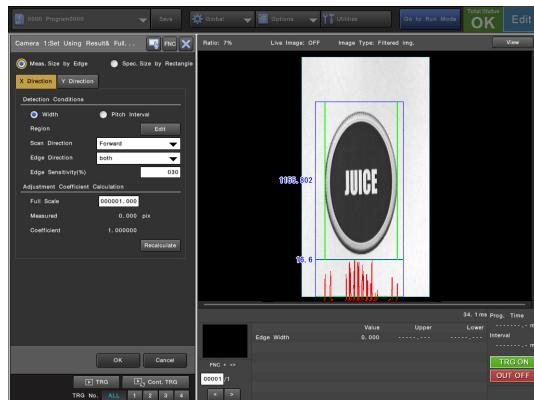
6 Once you have confirmed that an image of the workpiece was correctly captured, enter the conditions for the X/Y width of the workpiece and calculate the scale factor for the X/Y direction.

Calculate the scale factor for the image that you captured with the current encoder parameters by finding the number of pixels for the X/Y direction and specifying the full scale.

There are two ways to specify the full scale as shown below.

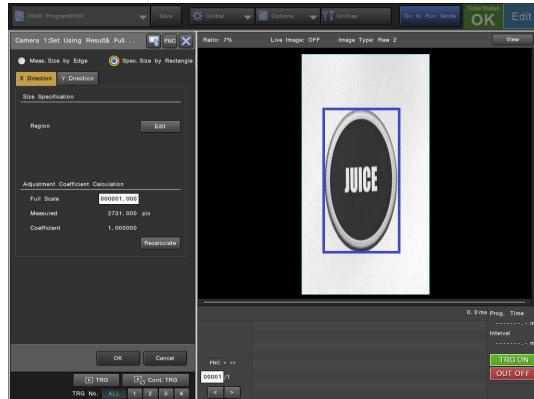
Meas. Size by Edge

Find the pixel count for the specified direction of the workpiece by measuring the edge (width or pitch), and then enter the obtained full scale value in the [Full Scale] field.



Spec. Size by Rectangle

By specifying the region such that it follows the captured workpiece, you can find the pixel count for the X or Y direction. And then, enter the obtained full scale value in the [Full Scale] field.



7 Select [Recalculate].

The scale factor is calculated from the full scale and measured values.

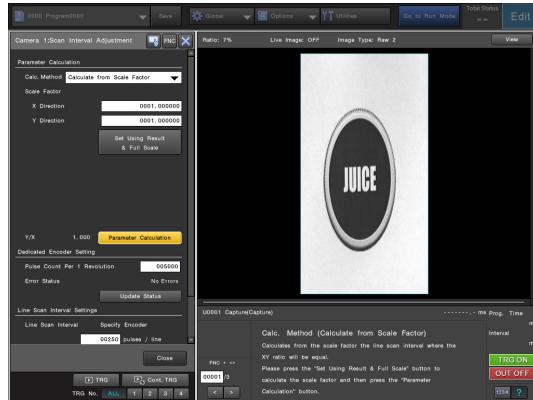


Point You can specify the scale factor for the X direction only for a line scan camera. There is no need to specify the X direction scale factor for an LJ-V Series head because it is a fixed value that is determined by the LJ-V head model.

8 Select [OK].

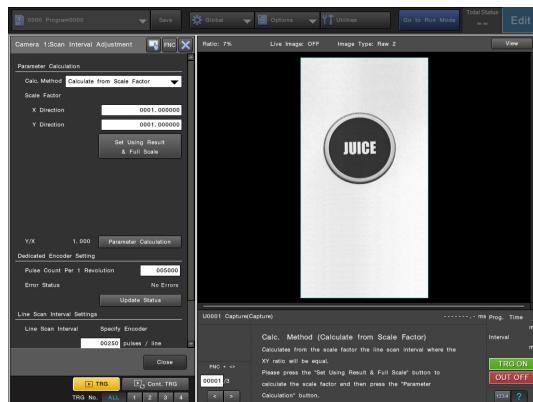
9 Select [Parameter Calculation].

The line scan interval is automatically calculated so that the calculated X/Y Scale Factor approaches 1:1, and Scale Factor Y is recalculated based on that value.



10 Input a trigger.

Check that you were able to capture an image where the pixel spacing for the X/Y direction is matched.



11 Select [Close].

Method 2: Specify Change Scale Factor

Capture an image while moving a workpiece for which you know the width in the X/Y direction of and, by specifying the scale factor to change the image in the Y direction N times, calculate the encoder parameters for capturing such an image.

1 Select [Adjust Line Scan Interval].

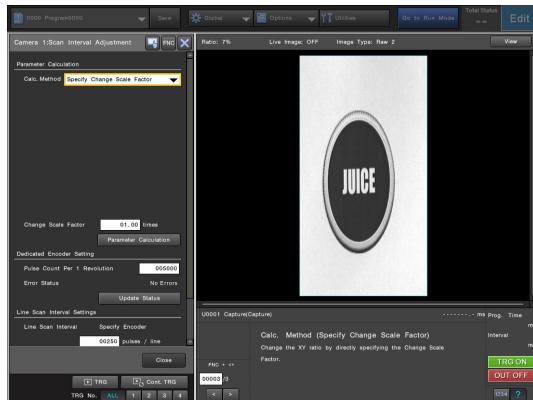
The [Scan Interval Adjustment] screen appears.



Depending on the camera that you use, the location of [Adjust Line Scan Interval] differs.

- When using an LJ-V Series sensor head: "Trigger Settings" (Page 8-26)
- When using a line scan camera: "Line Camera Settings" (Page 8-177)

2 In the [Calc. Method] field, select [Specify Change Scale Factor].



3 Activate the line and run a workpiece for which you know the width of in the X/Y direction.

4 Input a trigger.

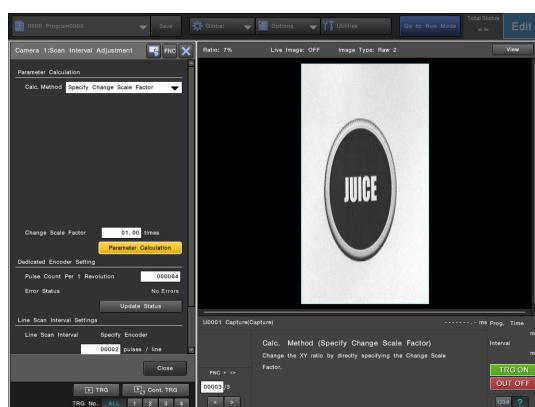
When the number of lines for an image has been captured, the image will be displayed.

5 Once you have confirmed that an image of the workpiece was correctly captured, based on the aspect ratio of the full scale and the aspect ratio of the captured image, enter the change scale factor that will extend the Y direction to N times.

If you want to extend the image in the Y direction, specify a value larger than 1. If you want to reduce it, specify a value smaller than 1.

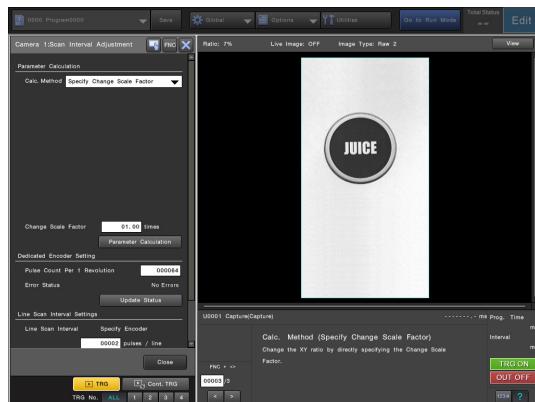
6 Select [Parameter Calculation].

The encoder parameters will be updated.



7 Input a trigger.

Check that you were able to capture an image where the pixel spacing for the X/Y direction is matched. If the pixel spacing is unmatched, return to step 3 and try the procedure again.



8 Select [Close].

Notes on Adjusting the Line Scan Interval

Method 3: Calculate from Encoder Resolution

Use this method when you know the pulse count and the workpiece movement distance for 1 revolution of the encoder. You can specify the movement distance for one revolution of the encoder either by the pulley diameter mounted to the encoder or the movement distance.

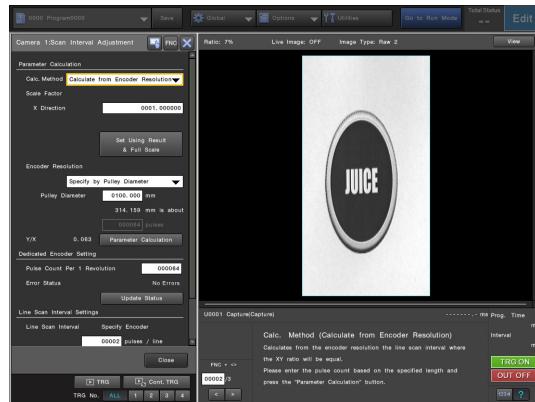
1 Select [Adjust Line Scan Interval].

The [Scan Interval Adjustment] screen appears.



- Depending on the camera that you use, the location of [Adjust Line Scan Interval] differs.
- When using an LJ-V Series sensor head: "Trigger Settings" (Page 8-26)
 - When using a line scan camera: "Line Camera Settings" (Page 8-177)

2 In the [Calc. Method] field, select [Calculate from Encoder Resolution].



3 For a line scan camera, select [Set Using Result & Full Scale].

The [Set Using Result & Full Scale] screen appears. If you are using the LJ-V Series sensor head, proceed to step 9.



- You can specify the scale factor only for a line scan camera. There is no need to specify the scale factor for an LJ-V Series head because it is a fixed value that is determined by the LJ-V head model.

4 Activate the line and run a workpiece for which you know the width of in the X/Y direction.

5 Input a trigger.

When the number of lines for an image has been captured, the image will be displayed.

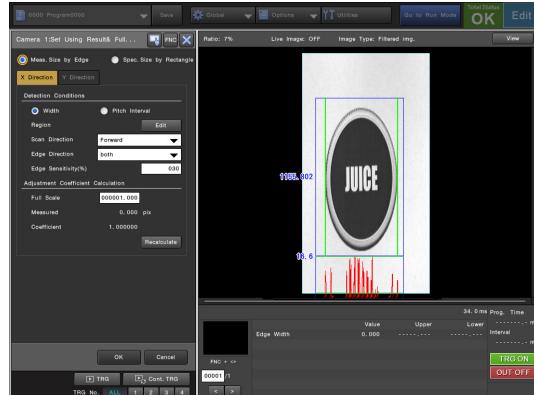
6 Once you have confirmed that an image of the workpiece was correctly captured, calculate the scale factor for the X direction.

Calculate the scale factor based on the image that you captured with the current line scan interval by finding the number of pixels for the X direction and specifying the full scale.

There are two ways to specify the full scale as shown below.

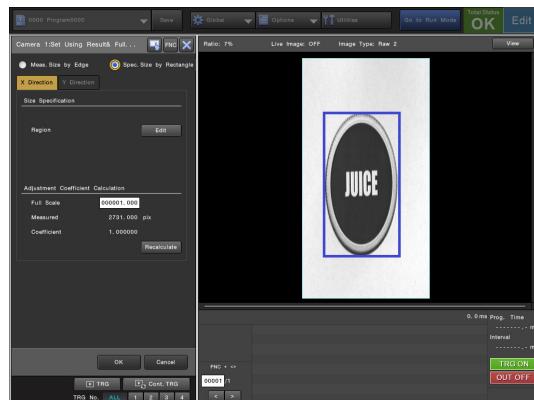
Meas. Size by Edge

Find the pixel count for the X direction of the workpiece by measuring the edge (width or pitch), and then enter the obtained full scale value in the [Full Scale] field.



Spec. Size by Rectangle

By specifying the region such that it follows the captured workpiece, you can find the pixel count for the X direction. And then, enter the obtained full scale value in the [Full Scale] field.



7 Select [Recalculate].

The scale factor is calculated from the full scale and measured values.

8 Select [OK].

9 In the [Encoder Resolution] field, select the method to specify the resolution, and then enter the necessary information.

Specify by Pulse Count (When You Do Not Use a Dedicated Encoder)

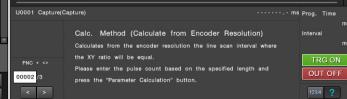
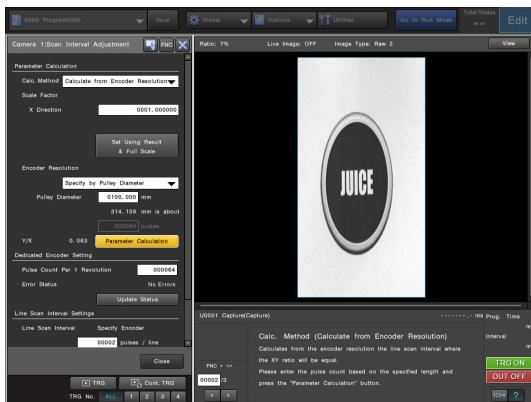
Enter the movement distance per encoder revolution of the workpiece and the pulse count per revolution.

Specify by Pulley Diameter

Enter the diameter of the mounted pulley and the pulse count per revolution stated on the encoder.

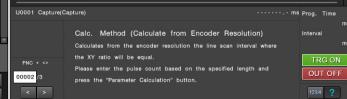
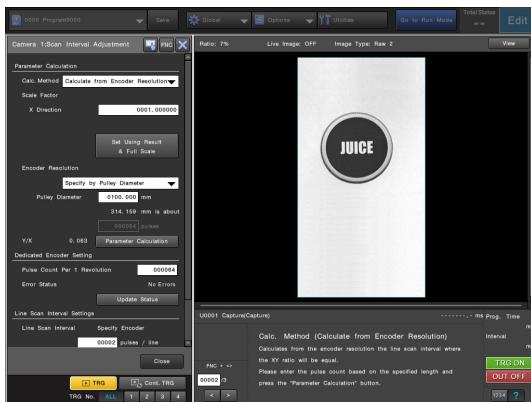
10 Select [Parameter Calculation].

The parameters for the encoder are automatically calculated so that the X/Y scale factor approaches 1:1.



11 Input a trigger.

Check that you were able to capture an image where the pixel spacing for the X/Y direction is matched.



12 Select [Close].

Retaining and Using Different Settings for Each Type (Recipe Function)

Measurement Using
3D-compatible Cameras

Measurement Using
Line Scan Cameras

Retaining and Using

- ▶ **Different Settings for Each Type
(Recipe Function)**

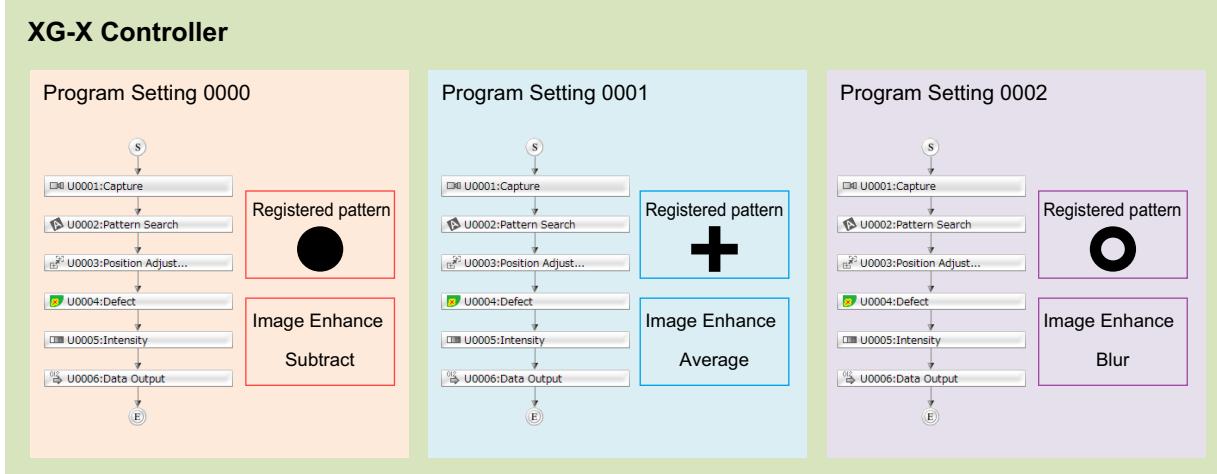
Overview of the Recipe Function

What is the Recipe Function?

By using the Recipe function, you can retain multiple unit setting values that differ by product type in [Recipe] units. Even if only some workflow settings differ, you can greatly decrease the time and effort it takes to maintain program settings as the controller can be run with one program setting.

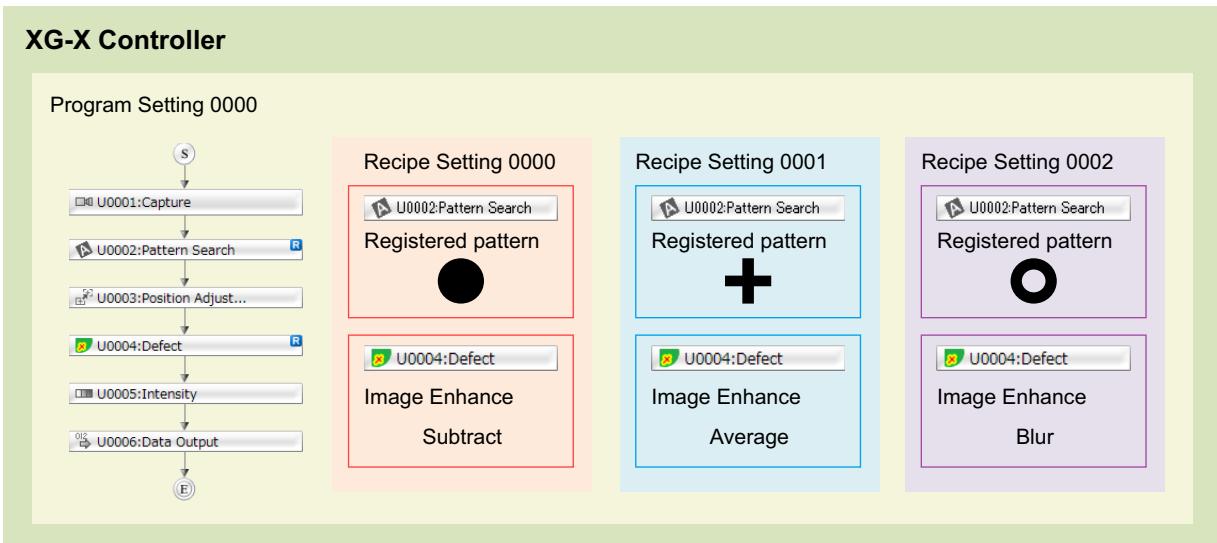
How Product Types Were Managed Previously

For normal program settings, in order to support different types, you need to create multiple program settings even if only some workflow settings are different.



Managing Product Types Using the Recipe Function

By only retaining the differences for each product type as recipe settings, multiple product types can be supported by one program setting. By only changing recipe settings to match the product type to inspect, multiple product types can be supported by one program setting. Furthermore, even if the number of product types increase in the future, they can be supported by just adding recipe settings.



A Practical Example of the Recipe Function

For the setting that retained the areas that differed by product type as recipe settings, if an area that is common across product types needs to be changed, the change to just one setting is reflected to all the product types.



Basic Rules for the Recipe Setting Function

Number of Recipe Settings Per Program Setting

Create recipe settings for the number of product types and run a production line inspection by switching to the recipe setting for the applicable product type. If a product type is added, add a new recipe setting.

Note that the maximum number of recipe settings that can be created per program setting is 1,000 (this depends on the SD card capacity and setting content).

Setting Values Retained by Recipe Settings

Setting Values that are retained by recipe settings are as follows:

- Registered images
 - Simulation image settings
 - Setting values of the unit targeted by the recipe
 - Initial values of the variables targeted by the recipe
 - FTP output base path setting (if it is a recipe target).
Data retained by program settings other than the above are common across all recipe settings.
- Point**
- The variable type and element count etc. are not targeted by recipe settings (they are common in the program setting).
 - While the FTP output base path setting is targeted by recipe settings, other FTP-related settings, such as the server IP address, are not (common in program settings).

Setting Values Read When Recipe Settings are Changed

When recipe settings are changed, the following setting values are read:

- **Settings specified as registered images and recipe targets:** All setting values in the recipe setting after changing
- **Settings that are not specified as recipe targets:** Program setting values

Units That Are Not Recipe Targets

The following units cannot be set as recipe targets:

- Calculation Unit
- Start Unit
- Branch Unit
- Join Unit
- Break Unit
- End Unit

Change in the Way Data is Managed Due to the Addition of the Recipe Function

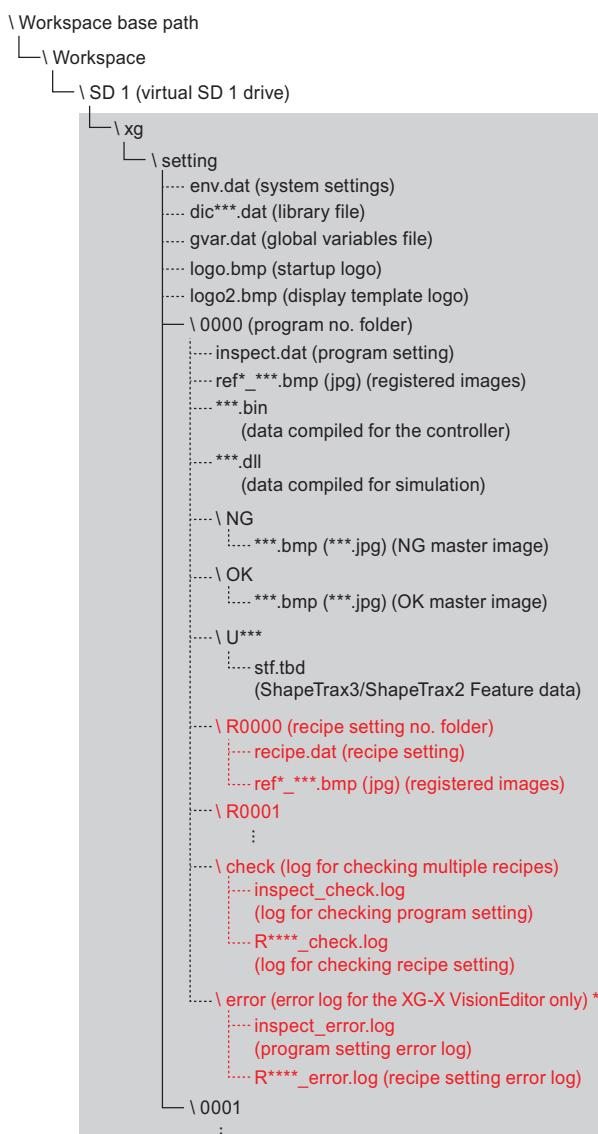
The method to manage XG-X2000 Series settings data changes as follows when using the Recipe function.

Addition of New Settings Data

Recipe settings folder: R0000

Recipe settings file: recipe.dat

An example configuration of the XG-X VisionEditor workspace folder (when using the Recipe function)



Management data in the controller

- * Files are created in XG-X VisionEditor when multiple recipes are checked at the same time (\check) and when an error occurs while copying recipe settings (\error).



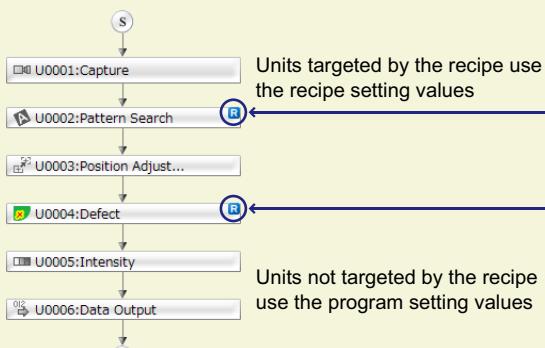
Also see "Management Structure of Settings Files" (Page 2-4).

List of Setting Values State According to the Recipe Function State

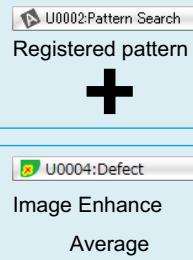
	Uses recipe setting (referencing recipe setting)		Does not use recipe setting (referencing program setting)	
	Recipe Target	Not a Recipe Target	Recipe Target	Not a Recipe Target
Unit display				
Unit setting values Variable initial value FTP base path Simulation image settings	Recipe setting values	Program setting values	Program setting values	Program setting values
Registered image	Registered image in the recipe settings folder		Registered image in the program settings folder	

XG-X Controller

Program Setting 0000



Recipe Setting 0001



Units not targeted by the recipe use the program setting values

Uses the registered image of the recipe setting

Registered images

Operation Flow

The operation flow when using the Recipe function is as follows.

1. Create a program setting

Create a measurement workflow.

2. Specify setting values that are recipe targets (Page 8-201)

Set the units with setting values that differ by product type as recipe targets.

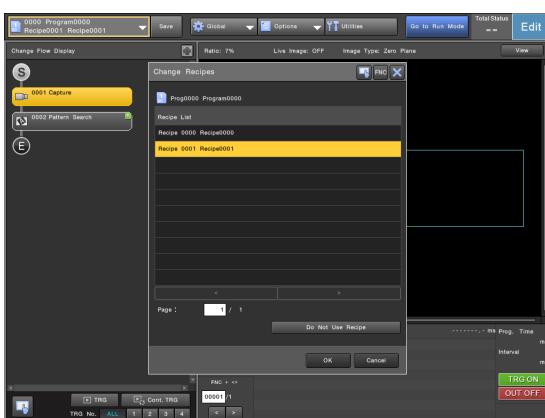
Specify variables (initial values) and the FTP output base path in the same manner to make them recipe targets.

3. Add a recipe setting (Page 8-203)

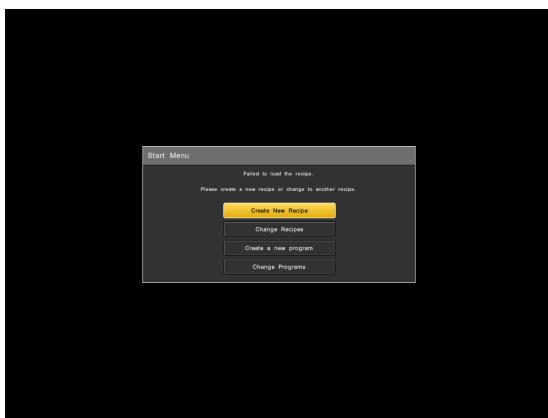
Add recipe settings in accordance with the number of product types.

4. Change recipe settings and edit setting values (Page 8-204)

Change recipe settings and edit setting values to match each product type.



- If reading of the recipe settings fails when starting the controller or changing recipe settings, the [Start Menu (Create New Recipe/Change Recipes)] screen appears.



- If you use the XG-X VisionEditor Check Multiple Recipes function, you can efficiently check whether there are any problems with multiple recipe settings. On the toolbar, select [Check] - [Check Multiple Recipes] and specify the recipe settings that you wish to check.

Before Using the Recipe Function

Precautions for When Using the Recipe Function

If you use the Recipe function on actual measurements, thoroughly verify that errors, such as insufficient memory, will not occur before starting actual operation.

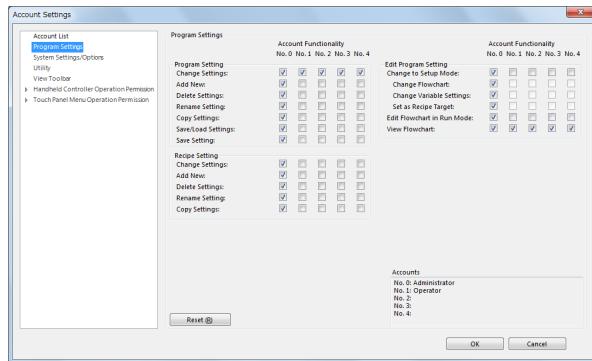
If changing the settings item that modifies the memory usage amount, such as the detection count, with the Recipe function, the memory usage amount may exceed 100% due to changing the recipe settings. If memory usage exceeds 100%, a change recipe settings error will occur on the controller and the recipe settings will not change.



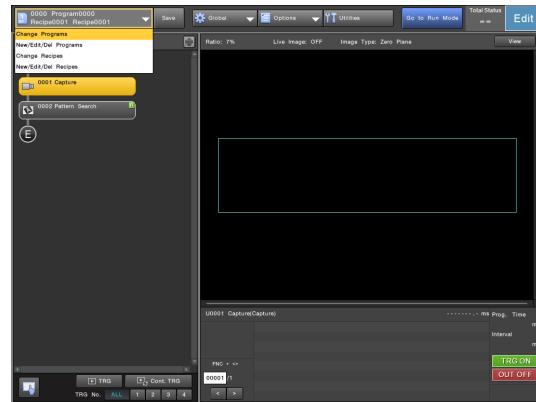
- If you use the XG-X VisionEditor Check Multiple Recipes function, you can efficiently check whether there are any problems with multiple recipe settings. On the toolbar, select [Check] - [Check Multiple Recipes] and specify the recipe settings that you wish to check.
- On the XG-X VisionEditor, even if various memory usage exceeds 100%, the recipe setting will change (except when executing a simulation with the simulator).

Preparations to Use the Recipe Function on the Controller

- To use the Recipe Operation menu on the Function menu on the Controller Operation screen, you need to enable the Recipe Operation menu in the [Recipe Setting] field. To do so, on the XG-X VisionEditor toolbar, click [Other Settings] - [Account Settings] and on the [Account Settings] screen that appears, click [Program Settings].



- If there is at least one recipe target in the program, or if the recipe setting is being used, the Recipe Operation menu is automatically displayed in the setting number display field on the top left of the controller screen.



Specifying a Recipe Target

Specify the unit and variable initial value to apply the recipe setting to. You can also set the FTP output base path as a recipe target.



By changing the account permissions, you can also limit operations to specify recipe targets on the controller (Page 8-200).

Set the Desired Unit as the Recipe Target

Specify the unit to apply the recipe setting to.

- 1 Move the cursor to the unit that you wish to set as a target of the Recipe function and display the Edit Flowchart menu.**
- 2 Select [Edit] - [Recipe Operation] - [Set as Target].**

R will be displayed on the right side of the icon of the unit that you set as a target of the Recipe function.



Once recipe settings are added and the Recipe function is able to be used, R changes to R on the right side of the unit.

Removing a Unit as a Recipe Target

Move the cursor to the unit that you wish to remove as a target of the Recipe function and display the Edit Flowchart menu. Then select [Edit] - [Recipe Operation] - [Remove from Targets].

R disappears from the icon of the unit that is removed as a target of the Recipe function.



If you selected [Remove from Targets] while a recipe setting is in use, the screen to confirm whether the current recipe settings should be reflected to the program setting is displayed.

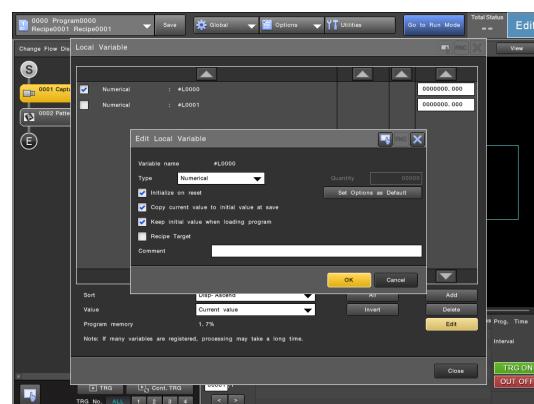
Setting a Variable Initial Value as a Recipe Target

- 1 On the top of the screen, from [Options] select [Variable Settings] and then select the type of variable that you wish to set as a recipe target.**

The Variable List screen appears.

- 2 Check the variable that you wish to set as a recipe target and then select [Edit].**

The Edit Variable screen appears.



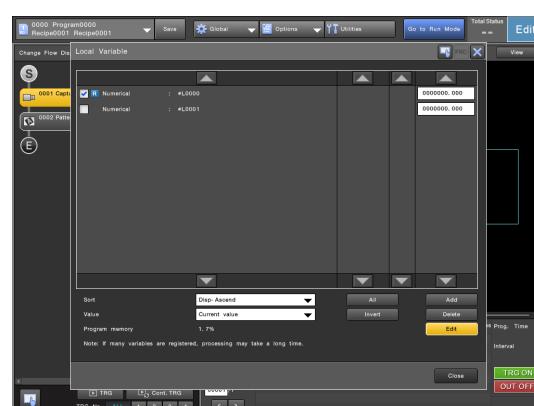
- 3 Check [Recipe Target] and then select [OK].**

A confirmation screen appears.

- 4 Select [OK].**

Returns to the Variable List screen.

R is displayed on the variable that you set as a recipe target.

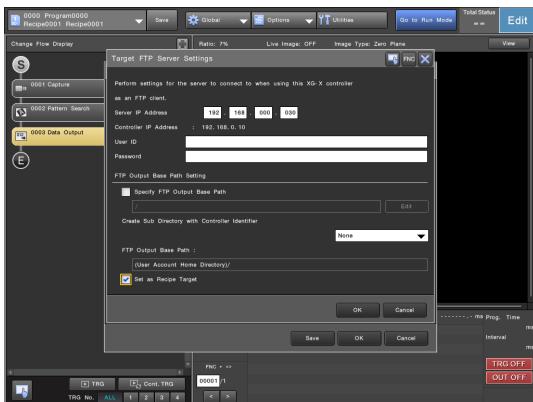


- 5 Select [Close].**

Setting the FTP Output Base Path as a Recipe Target

- 1 If [FTP] was selected as the output destination, select [FTP Settings] on the output settings screen of each output unit.

The [Target FTP Server Settings] screen appears.



- 2 Check [Set as Recipe Target] and then select [OK].

Adding Recipe Settings

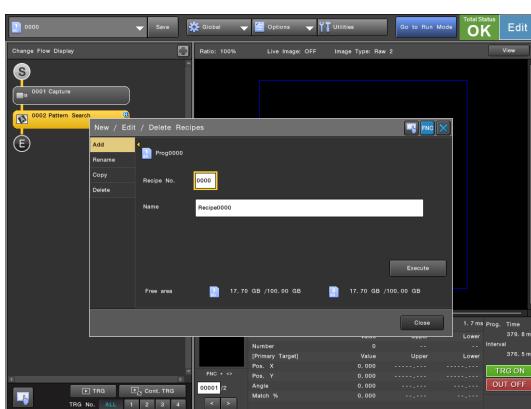
Once you have completed creating the inspection flow on the program setting, add recipe settings and edit the setting values in accordance with each product type.

- 1 Select the setting number display field on the top left of the screen and then select [New/Edit/Del Recipes].**

The [New/Edit/Delete Recipes] screen is displayed.

- 2 Select [Add].**

The [Add] screen appears.



- 3 Select [Recipe No.] and then specify the recipe setting number.**

Point You cannot specify a recipe number that already exists.

- 4 Select [Name].**

The [Rename Recipe] screen appears.

- 5 Enter the recipe setting name and then select [OK].**

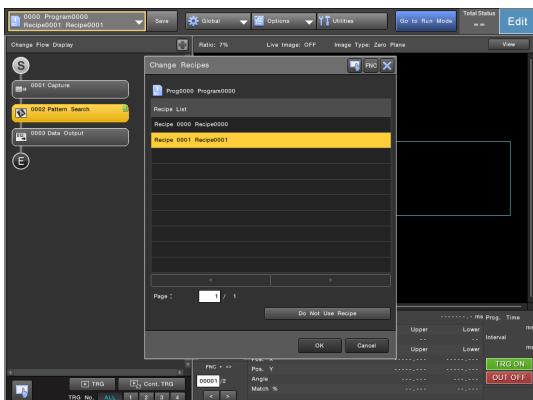
- 6 Select [Execute].**

The recipe setting is added and subsequent setting operations are reflected in the added recipe setting.

Changing Recipe Settings

- 1 Select the setting number display field on the top left of the screen and then select [Change Recipes].

The [Change Recipes] screen appears.



- 2 Select the recipe setting that you wish to change to and then select [OK].

The setting changes to the selected recipe setting.

Reference

You can also change the recipe settings from an external location by using the RPW and RPT commands.

For more details, see the XG-X2000 Series Communications Control Manual.

Point

- Changing the recipe settings takes about the same length of time as changing the program settings. Note that even if you use the Recipe function, the time taken to change the settings does not decrease.
- If you change the recipe settings on the [Change Recipes] screen, the next time you start the device, it starts with the Recipe No. after changing recipe settings.
- If you change the recipe settings from an external location with the RPW and RPT commands, to start the device the next time it starts up with the recipe setting number after it has been changed, you need to specify [Save the Changed Recipe No.] when transmitting the commands. For more details, see the XG-X2000 Series Communications Control Manual.

Editing Recipe Settings

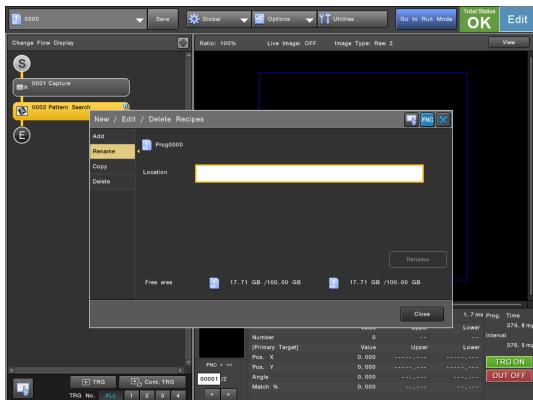
Changing the Name of the Recipe

- Select the setting number display field on the top left of the screen and then select [New/Edit/Del Recipes].

The [New/Edit/Delete Recipes] screen is displayed.

- Select [Rename].

The [Rename] screen appears.



- Select the recipe setting that you wish to rename and then select [Rename].
- Enter the recipe setting name and then select [OK].
- Select [Close].

The recipe setting name changes.

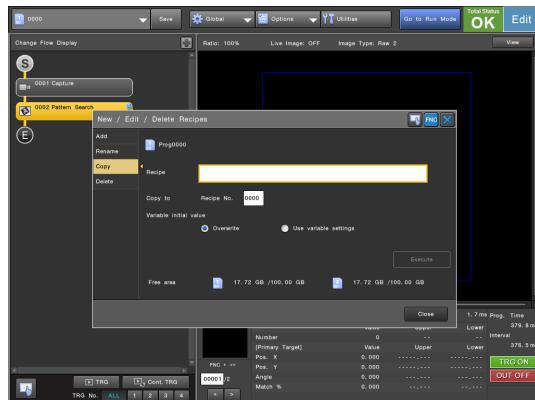
Copying Recipe Settings

- Select the setting number display field on the top left of the screen and then select [New/Edit/Del Recipes].

The [New/Edit/Delete Recipes] screen is displayed.

- Select [Copy].

The [Copy] screen appears.



- Select [Recipe] and then select the recipe setting whose content it is that you wish to copy and use in another setting.
- Select [Copy to] and then select [Recipe No.].
- Where necessary, change [Variable initial value] from [Overwrite] (default setting) to [Use variable settings].
 - Overwrite** (default setting): Overwrites all the initial variable values with the content of the copied setting.
 - Use variable settings**: Does not overwrite the initial value of variables with [Keep initial value when loading program] selected in the copied variable settings. The settings regarding the retention of variable initial value in the program setting of the copy source are applied to the copy destination. Reference



For more details about the retention of initial variable values, see the XG-X VisionEditor Reference Manual.

- Select [Execute].

The settings are copied and [File(s) copied.] is displayed.



If the copy destination recipe setting number already exists, a message is displayed asking you to confirm if you want to overwrite the settings.

- Select [Close].

To cancel copying, select [Close] instead of [Execute] at Step 6.

Copying a Unit's Setting Values

You can copy a unit's recipe setting values and paste them into the recipe settings of other units.

- 1 Move the cursor to the unit that you wish to copy the setting values from and display the Edit Flowchart menu.**
- 2 Select [Edit] - [Recipe Operation] - [Copy to Program/Other Recipes].**
The [Select Unit Parameter] screen appears.
- 3 Check the setting values that you wish to copy (maximum of 256 items), and then select [OK].**
The [Select Program/Recipe] screen appears.
- 4 In the [Copy to] field, specify the Recipe No. that you wish to paste the copied setting values to.**

Reference If you specify [Program], the copied setting values are pasted into the program setting.

- 5 Select [OK].**
The confirmation screen appears.
- 6 Select [OK].**
The settings are copied and [Finished.] appears.
- 7 Select [OK].**

What happens if pasting fails?

For example, if you attempted to paste just the radius of a Circle region to the settings of a Rectangle region, an error will occur and pasting will fail (if the region shape is selected at the same time, the shape will be changed first so an error will not occur).

Point When pasting fails, the following log files are generated in [Program Setting Folder/error].

- inspect_error.log: Log file for when pasting to the program setting fails
- R****_error.log: Log file for when pasting to Recipe No.**** fails

Deleting Recipe Settings

Point

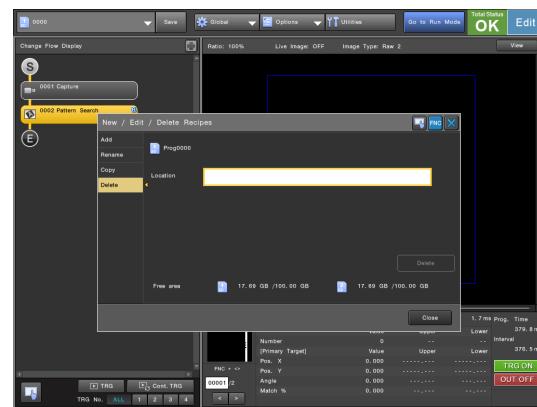
- Once deleted, a recipe setting cannot be restored.
- When a recipe setting is deleted, all files under the recipe setting are deleted.
- A recipe setting that is in use cannot be deleted. Change to another recipe setting and then delete the recipe setting.

- 1 Select the setting number display field on the top left of the screen and then select [New/Edit/Del Recipes].**

The [New/Edit/Delete Recipes] screen is displayed.

- 2 Select [Delete].**

The [Delete] screen appears.



- 3 Select [Location] and then select the recipe setting that you wish to delete.**

- 4 Select [Delete].**

A confirmation screen appears.

- 5 Select [OK].**

The recipe setting selected in Step 3 is deleted.

- 6 Select [Close].**

Temporarily Disabling Recipe Settings

You can temporarily disable recipe settings and use program settings for measurement.



- Point**
- Even if you disable recipe settings, the content of the recipe target and the recipe settings themselves will be saved. You can use the settings again by changing the recipe settings.
 - If you turn off the controller with [Do Not Use Recipe] set, the controller will start up in a state where recipe settings are not used the next time that you turn on the device.

1 Select the setting number display field on the top left of the screen and then select [Change Recipes].

The [Change Recipes] screen appears.

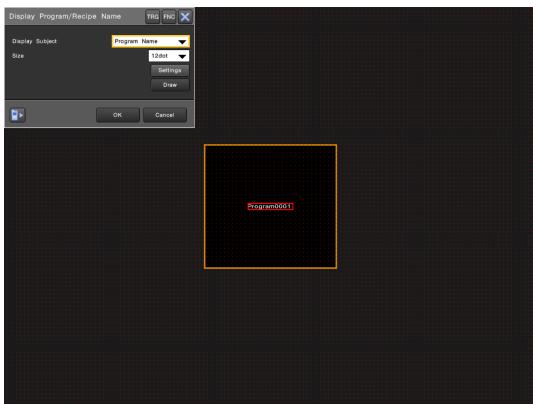
2 Select [Do Not Use Recipe] and then select [OK].

The recipe settings will temporarily be disabled and the setting values of the program setting will be applied to the setting parameters of each unit in the flowchart.

Other Functions Related to Recipes

Display Program/Recipe Name

For [Display Program/Recipe Name] (Page 4-59), a standard part that can be used on the Screen Editor, you can select the Recipe Name as a display target.



System Variables: Recipe No.

%RecipeSettingNo that stores the Recipe No. being measured can be used as a measurement related system variable.

Batch Check Log

In the XG-X VisionEditor, if an error is detected when [Check Multiple Recipes] is being executed, the detected error is displayed in a setting list and a log file of the result is created.

- Program Setting Folder/check/inspect_check.log
(for Program Settings)
- Program Setting Folder/check/R****_check.log
(for Recipe Settings)

The details of the check result are equivalent to the normal check result displayed in Check View. For more details, refer to the XG-X VisionEditor Reference Manual.

Error Log

In the XG-X VisionEditor, if an error occurs when the Recipe Operation [Copy to Program/Other Recipes] is executed, a list of the settings where error occurred is displayed and the error log files are created.

- Program Setting Folder/error/inspect_error.log
(for Program Settings)
- Program Setting Folder/error/R****_error.log
(for Recipe Settings)

Other Precautions

Renaming variables

- The names of variables that are recipe targets cannot be changed.
- In the XG-X VisionEditor, while the names of variables that are not recipe targets can be changed, if the changed variable is referenced by another unit, change of the reference variable name that is linked to the renaming is performed only in the recipe setting or program setting that is currently in use. If you do not individually correct the reference variable names in accordance with the renamed variable for the other recipe settings and the program setting where the reference variable name was not changed accordingly, variable reference will not function correctly when recipe settings are changed or temporarily disabled.

Save Program Command (SS Command)

If the Save Program command is issued while a recipe setting is being used, then after the unit processing that is currently being run finishes, the transition to the next unit is temporarily paused, and the Save Program command is then applied. Note that this affects the processing time.

Chapter

9

Appendix

Appendix

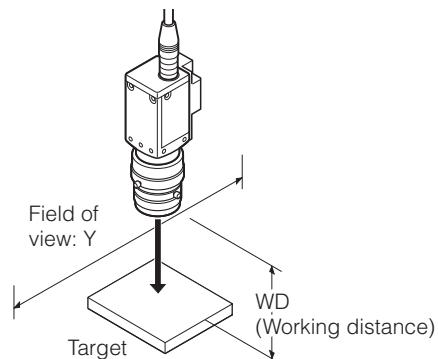
Documentation for the installation and configuration methods of the controller, software, and CAD data can be downloaded from the following URL.

www.keyence.com/xgx_support

Selecting the Lens

Select a lens according to the size of the target (field of view (FOV): Y) and the distance (working distance (WD)) from the tip of the lens attached to the camera until the target.

Select a suitable lens referencing the FOV chart.



Confirm the Working Distance from the FOV Chart.

- The numbers in the FOV chart represent the thickness required for the close-up ring. Install the close-up ring between the lens and the camera when required.
 - The asterisk (*) symbol in the FOV chart indicates the type of lens.
- Point**
- For more details about the close-up ring, see "Using the Close-up Rings" in the XG-X2000 Series Setup Manual.
 - The numerical numbers shown in the FOV chart are typical values. Fine adjustment is needed during installation.

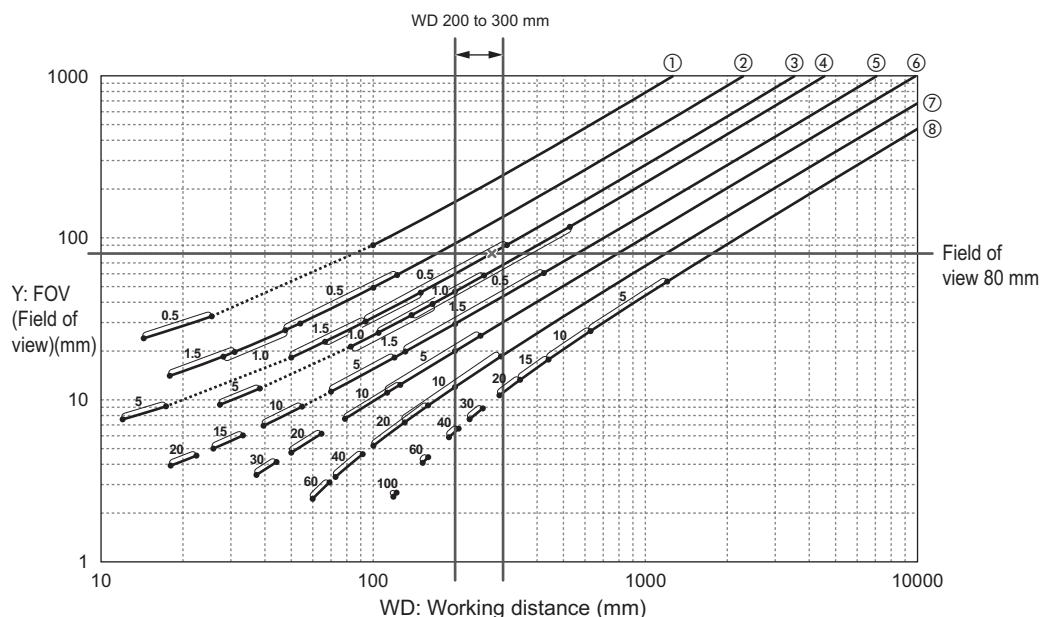
Lens selection example

The following describes the flow of selecting a lens when using a 310,000 pixel color camera (XG-035C) and a high precision lens (CA-LH*(G)) with the below conditions as an example.

Conditions

- With a target size of 60 mm and a conveyance error of ± 10 mm, the FOV must be 80 mm.
- WD must be kept within a range of 200 to 300 mm.

Select a lens that matches the conditions from the FOV chart when using a 310,000 pixel color camera (XG-035C) and a high precision lens (CA-LH*(G)).



① CA-LH4 ② CA-LH8(G) ③ CA-LH12(G) ④ CA-LH16(G) ⑤ CA-LH25(G) ⑥ CA-LH35(G) ⑦ CA-LH50(G) ⑧ CA-LH75

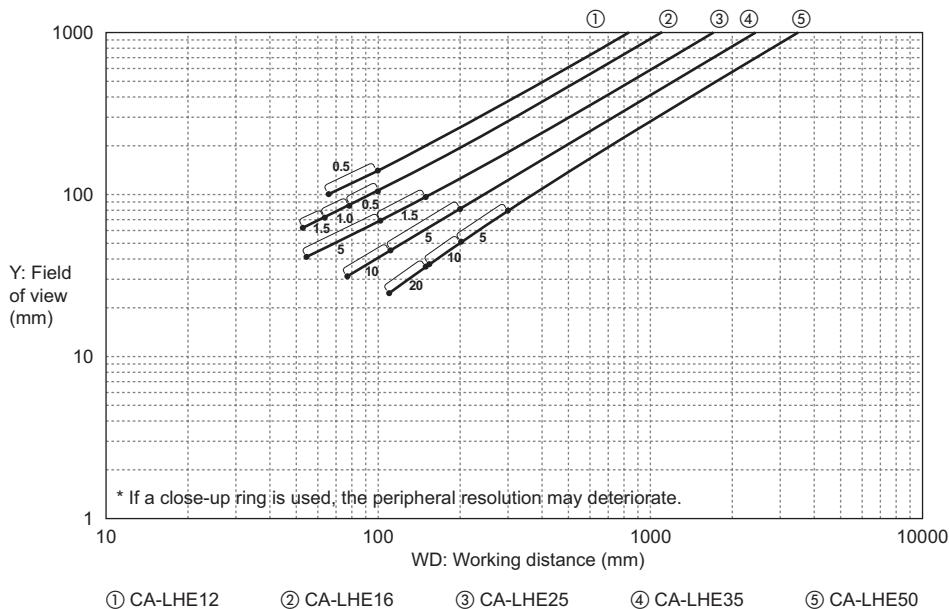
On the FOV chart, look for points that satisfy the necessary FOV within the required WD range.

For the above conditions, (3) CA-LH12 (close-up ring of 0.5 mm) satisfies the conditions.

Using a 21 megapixel Camera (CA-H2100C/CA-H2100M)

When a 4/3"-compatible, ultra high-resolution lens (CA-LHE*) is used:

When using the CA-LHE16 on the CA-H2100C with a required field of view of 200 mm, the chart shows that the working distance should be set close to 200 mm.



If a close-up ring is used with an ultra high-resolution lens (CA-LHE Series), the inherent peripheral resolution performance of the lens may not be satisfied.

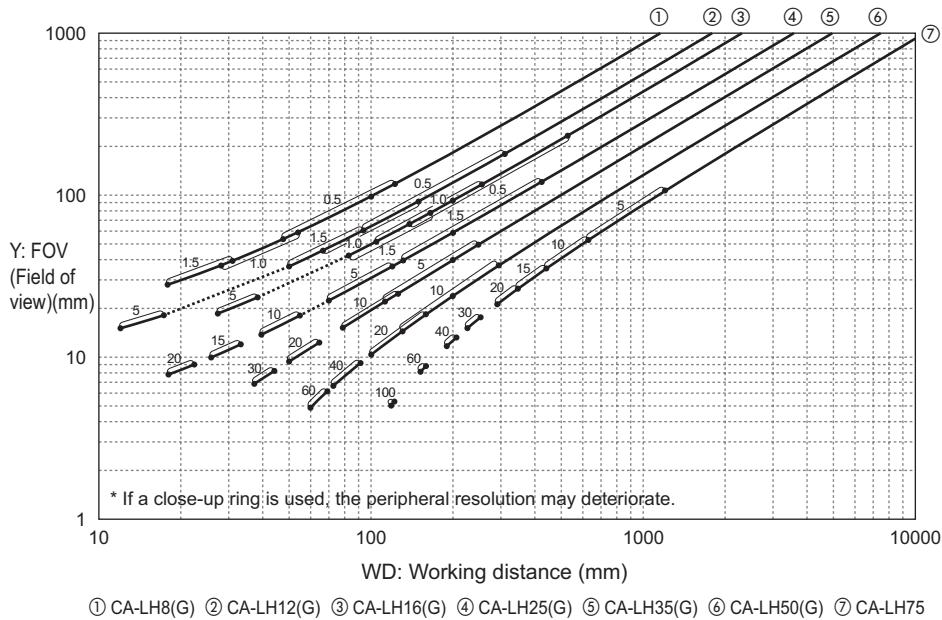


See "Using a 5 megapixel Camera (XG-H500C/XG-H500M)" (Page 9-4) for using the 21 megapixel camera (in 5 megapixel mode).

Using a 5 megapixel Camera (XG-H500C/XG-H500M)

When a high-resolution lens (CA-LH*(G)) is used:

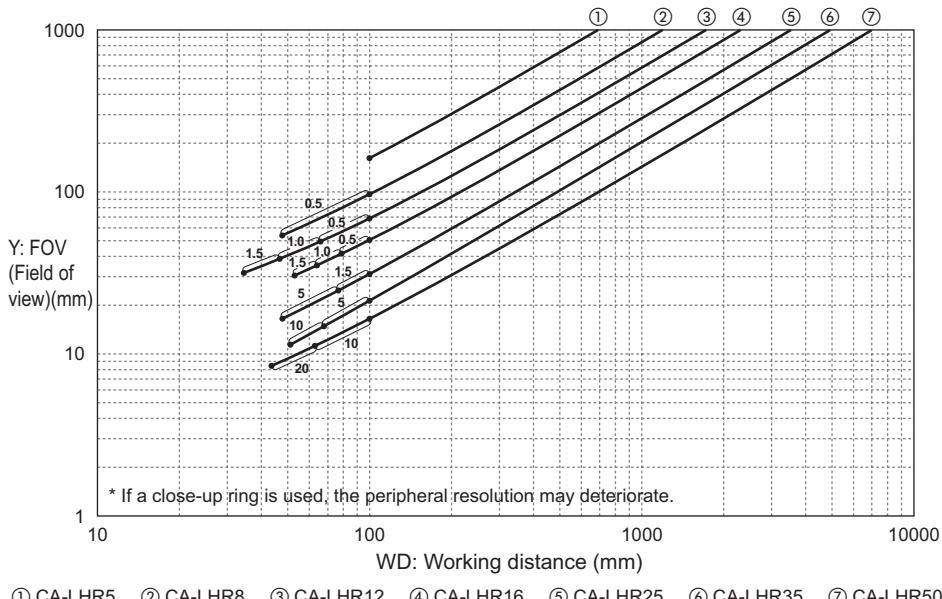
When using the CA-LH16 on the XG-H500C with a required field of view of 50 mm, the chart shows that the working distance should be set close to 100 mm and the 1.5 mm close-up ring should be used.



Point

- The standard CV-L lens cannot be used with XG-H500C/H500M high-speed 5 megapixel cameras due to vignetting.
- If a close-up ring is used with a high-resolution lens (CA-LH*(G)), the inherent peripheral resolution performance of the lens may not be satisfied.

When an ultra high-resolution lens (CA-LHR*) is used:

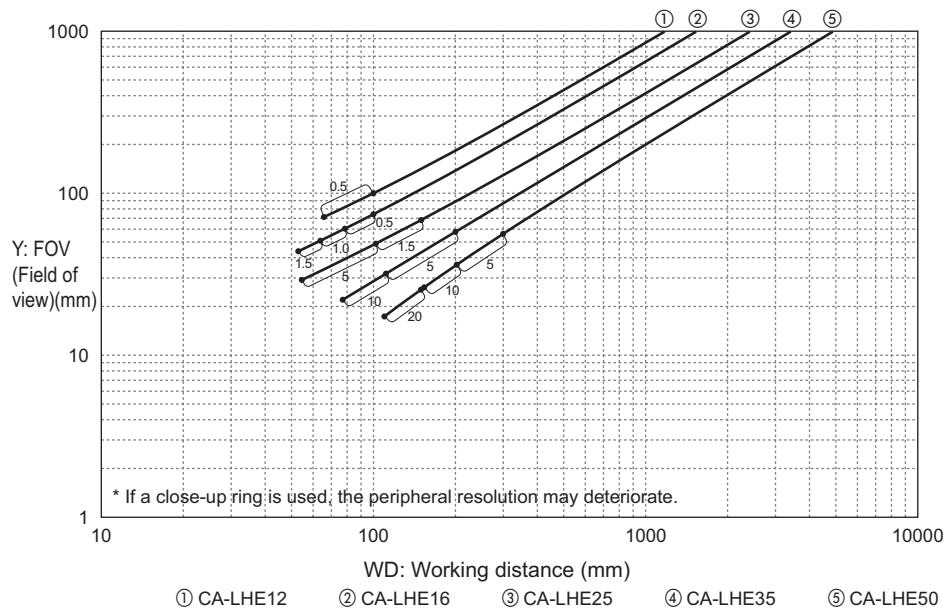


If a close-up ring is used with an ultra high-resolution lens (CA-LHR Series), the inherent peripheral resolution performance of the lens may not be satisfied.

Using a 5 Megapixel Camera (CA-HX500C/CA-HX500M)

When a 4/3"-compatible, ultra high-resolution lens (CA-LHE*) : 2432 x 2040 pixels (5 megapixel mode) is used

When using the CA-LHE16 on the CA-HX500C with a required field of view of 100 mm, the chart shows that the working distance should be set close to 150mm.



If a close-up ring is used with a 4/3"-compatible, ultra high-resolution lens (CA-LHE Series), the inherent peripheral resolution performance of the lens may not be satisfied.

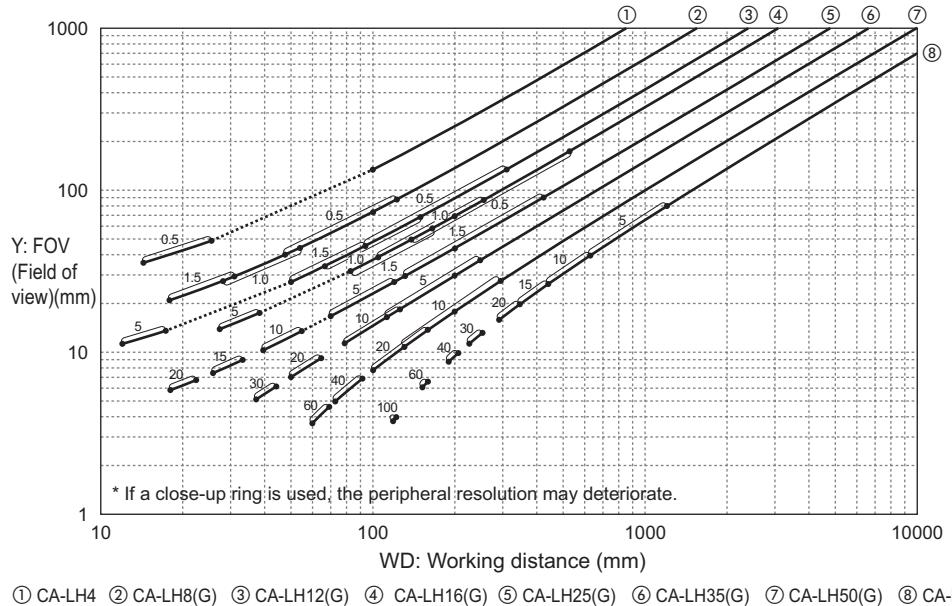


When using 1600 x 1200 pixels (2 megapixel mode), see "Using a 2 Megapixel Camera (CA-HX200C/CA-HX200M)" (Page 9-9).

Using a 2 Megapixel Camera (XG-200C/XG-200M) or a High-speed 2 Megapixel Camera (XG-H200C/XG-H200M)

Using a high-resolution lens (CA-LH*(G)): 1600 x 1200 pixels (2 megapixel mode)

When using the CA-LH16 on the XG-200C in 2 megapixel mode with a required FOV of 40 mm, the chart shows that the working distance should be set close to 100 mm and the 1.5 mm close-up ring should be used.

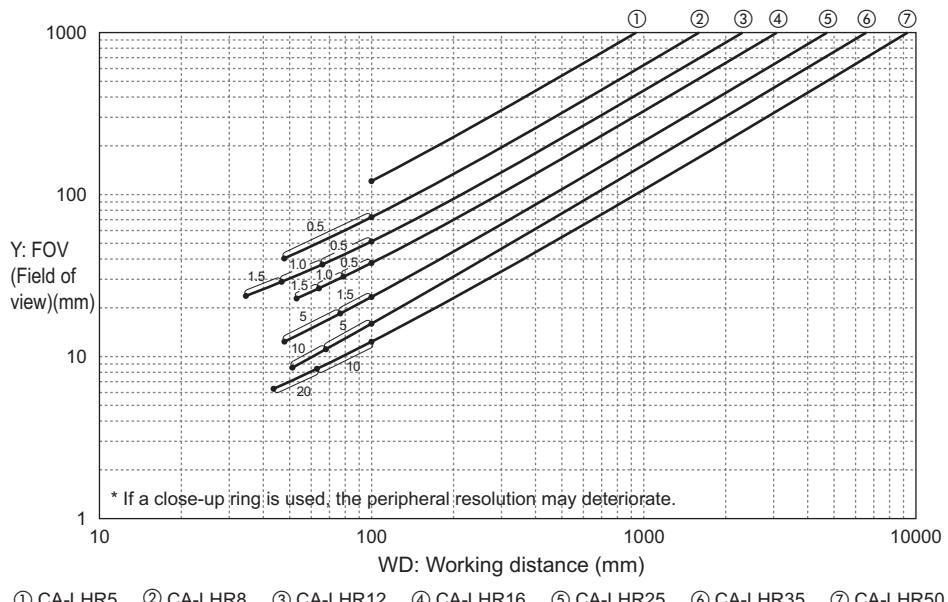


Appendix



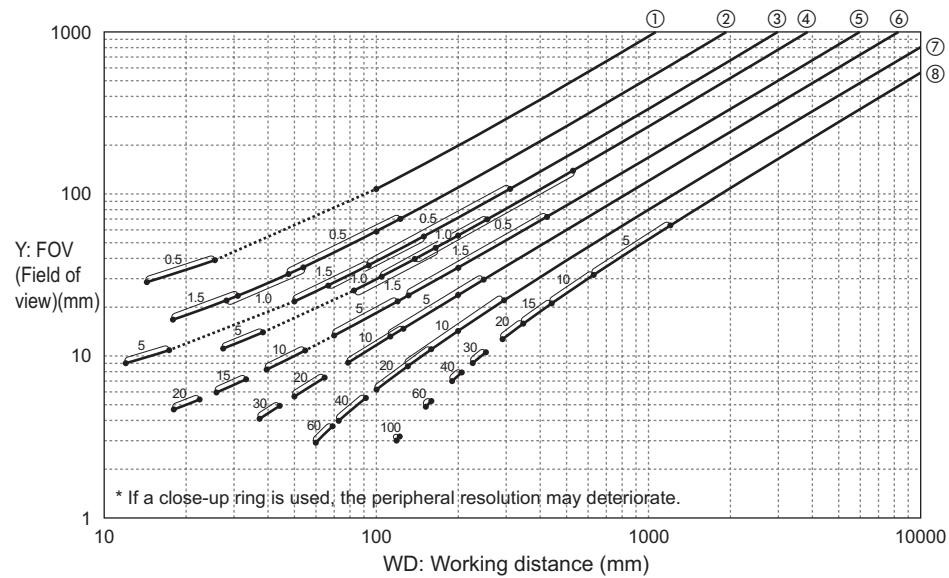
If a close-up ring is used with a high-resolution lens (CA-LH*(G)), the inherent peripheral resolution performance of the lens may not be satisfied.

When an ultra high-resolution lens (CA-LHR*) : 1600 x 1200 pixels (2 megapixel mode) is used



If a close-up ring is used with an ultra high-resolution lens (CA-LHR Series), the inherent peripheral resolution performance of the lens may not be satisfied.

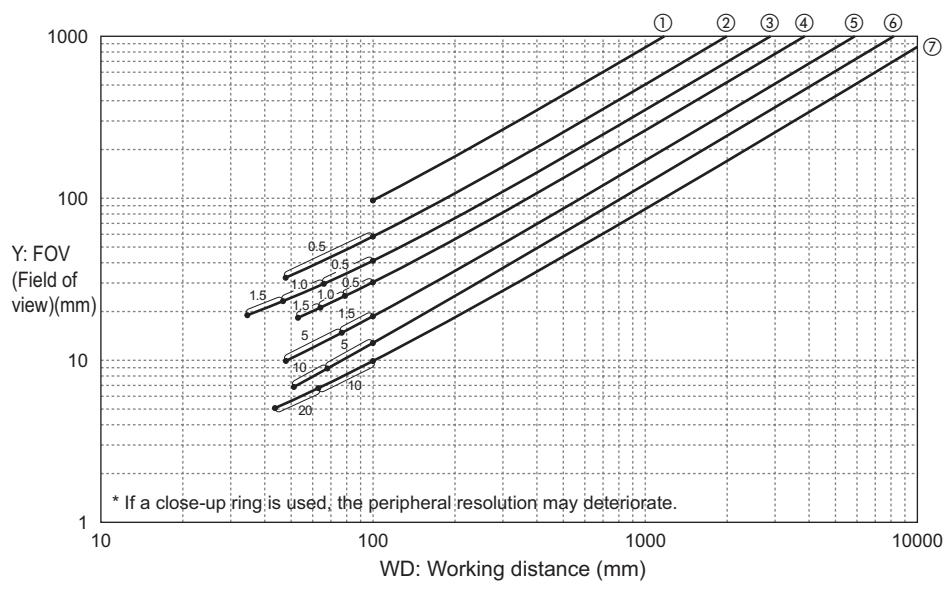
When a high-resolution lens (CA-LH*(G)) : 1024 x 960 pixels (1 megapixel mode) is used



Point

If a close-up ring is used with a high-resolution lens (CA-LH*(G)), the inherent peripheral resolution performance of the lens may not be satisfied.

When an ultra high-resolution lens (CA-LHR*) : 1024 x 960 pixels (1 megapixel mode) is used

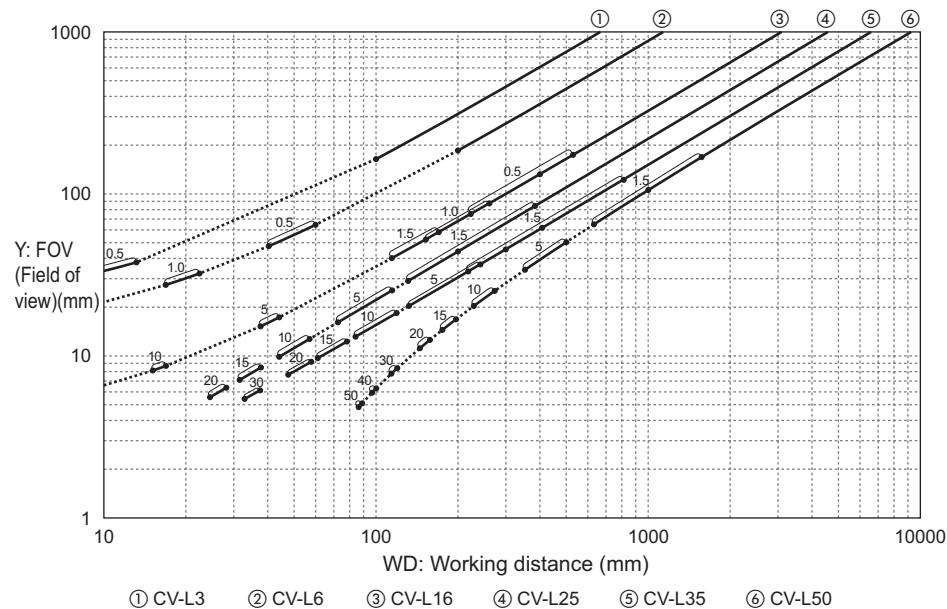


Point

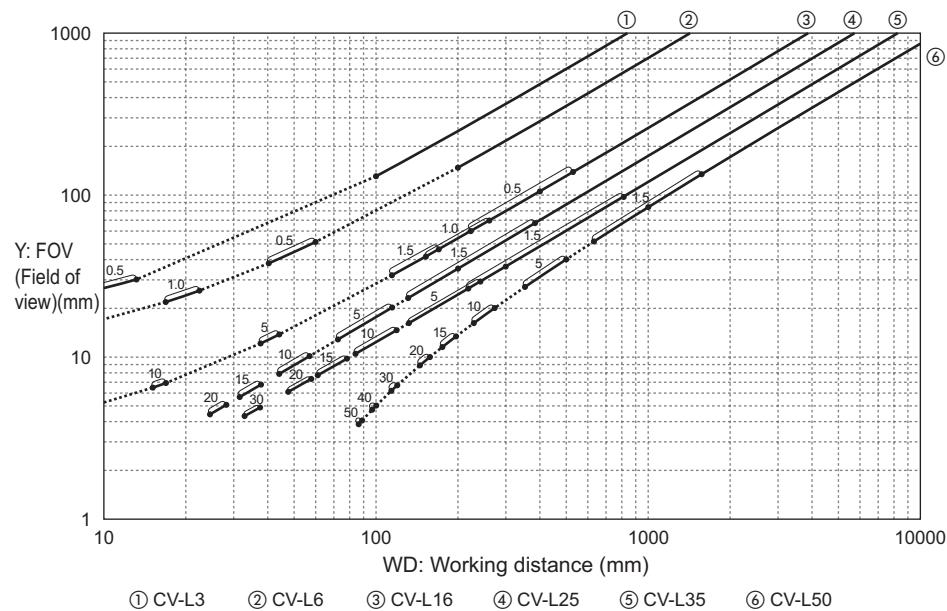
If a close-up ring is used with an ultra high-resolution lens (CA-LHR Series), the inherent peripheral resolution performance of the lens may not be satisfied.

Selecting the Lens

When a standard lens (CV-L*) : 1600 x 1200 pixels (2 megapixel mode) is used



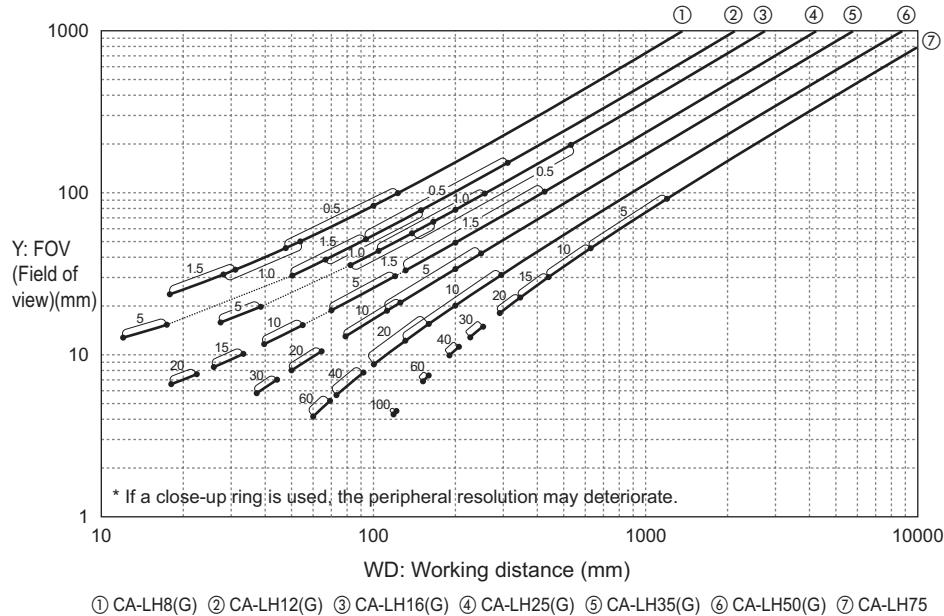
When a standard lens (CV-L*) : 1024 x 960 pixels (1 megapixel mode) is used



Using a 2 Megapixel Camera (CA-HX200C/CA-HX200M)

When a high-resolution lens (CA-LH*(G)) is used:

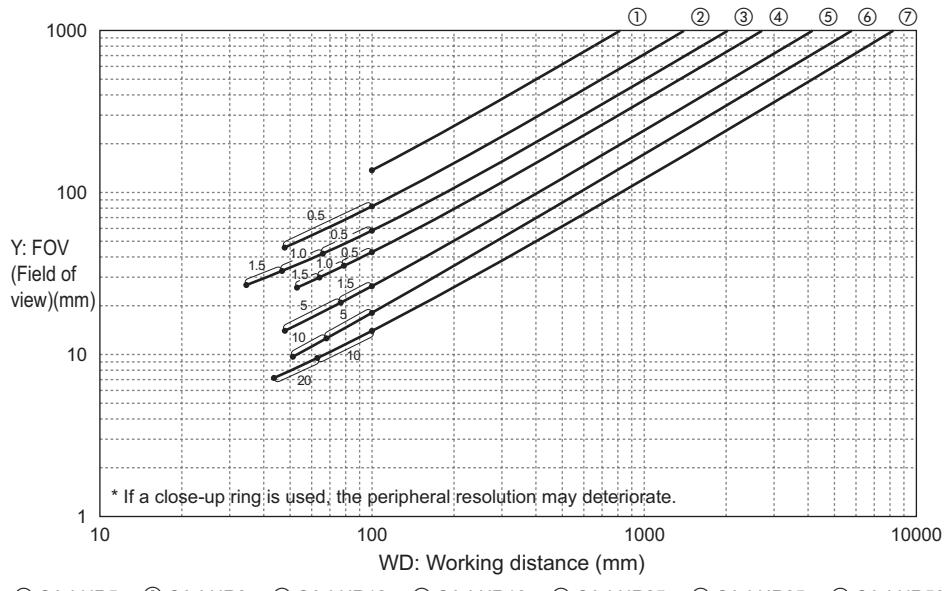
When using the CA-LH16(G) on the CA-HX200C with a required field of view of 300 mm, the chart shows that the working distance should be set close to 800 mm.



Point

- The standard CV-L lens cannot be used with CA-HX200C/CA-HX200M high-speed 2 megapixel cameras due to vignetting.
- If a close-up ring is used with a high-resolution lens (CA-LH*(G)), the inherent peripheral resolution performance of the lens may not be satisfied.

When an ultra high-resolution lens (CA-LHR*) is used:



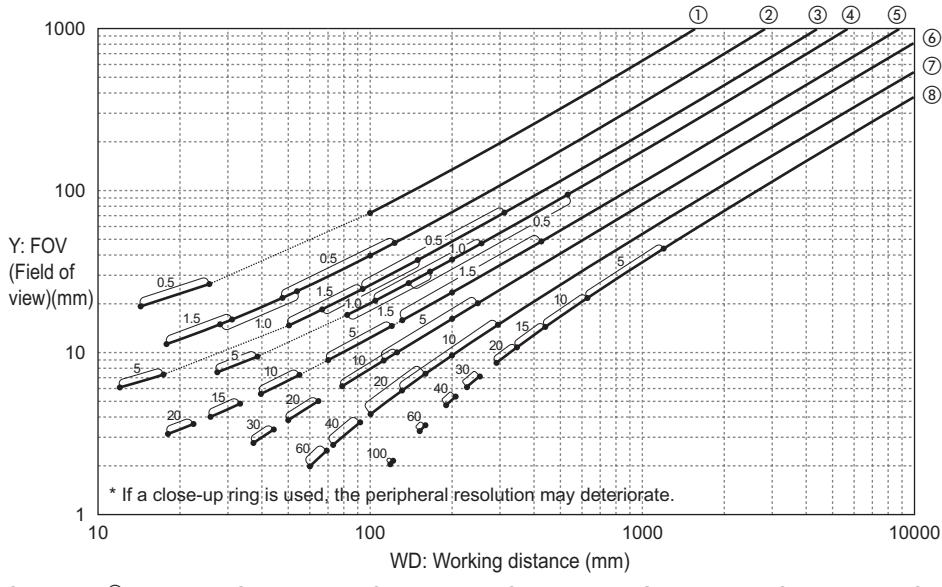
Point

- If a close-up ring is used with an ultra high-resolution lens (CA-LHR Series), the inherent peripheral resolution performance of the lens may not be satisfied.

Using a 470,000 pixel Camera (CA-HX048C/CA-HX048M)

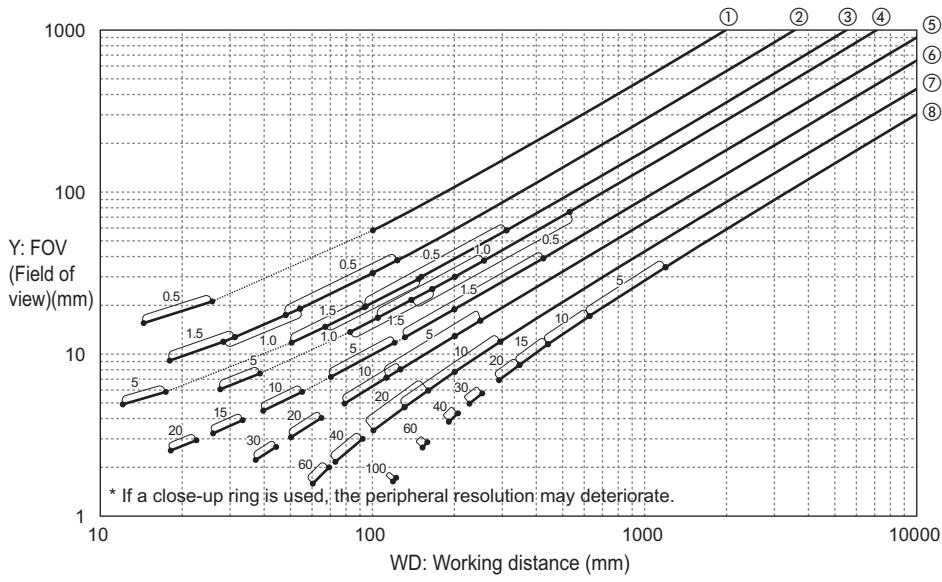
When a high-resolution lens (CA-LH*(G)) : 784 x 596 pixels (480,000 pixel mode) is used

When using the CA-LH16(G) on the CA-HX048C with a required field of view of 70 mm, the chart shows that the working distance should be set close to 400 mm and the 0.5 mm close-up ring should be used.



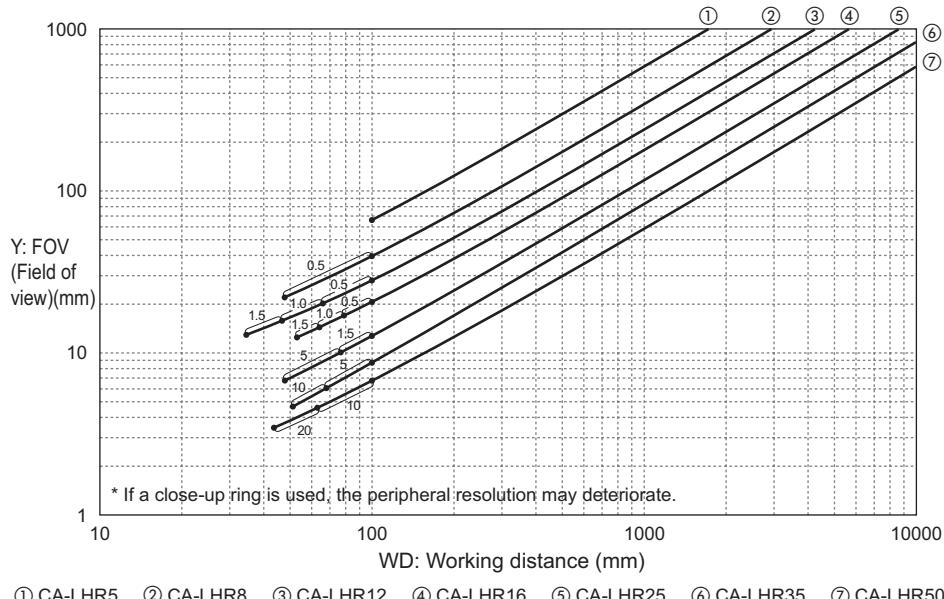
If a close-up ring is used with a high-resolution lens (CA-LH*(G)), the inherent peripheral resolution performance of the lens may not be satisfied.

When a high-resolution lens (CA-LH*(G)): 640 x 480 pixels (310,000 pixel mode) or 512 x 480 pixels (240,000 pixel mode) is used



If a close-up ring is used with a high-resolution lens (CA-LH*(G)), the inherent peripheral resolution performance of the lens may not be satisfied.

When an ultra high-resolution lens (CA-LHR*) : 784 x 596 pixels (480,000 pixel mode) is used

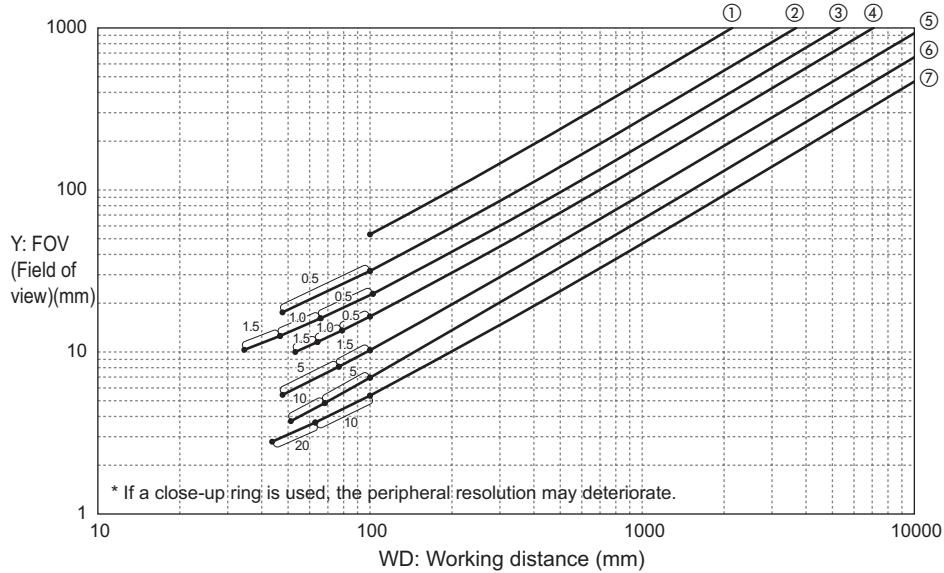


① CA-LHR5 ② CA-LHR8 ③ CA-LHR12 ④ CA-LHR16 ⑤ CA-LHR25 ⑥ CA-LHR35 ⑦ CA-LHR50



If a close-up ring is used with an ultra high-resolution lens (CA-LHR Series), the inherent peripheral resolution performance of the lens may not be satisfied.

When an ultra high-resolution lens (CA-LHR*) : 640 x 480 pixels (310,000 pixel mode) or 512 x 480 pixels (240,000 pixel mode) is used



① CA-LHR5 ② CA-LHR8 ③ CA-LHR12 ④ CA-LHR16 ⑤ CA-LHR25 ⑥ CA-LHR35 ⑦ CA-LHR50

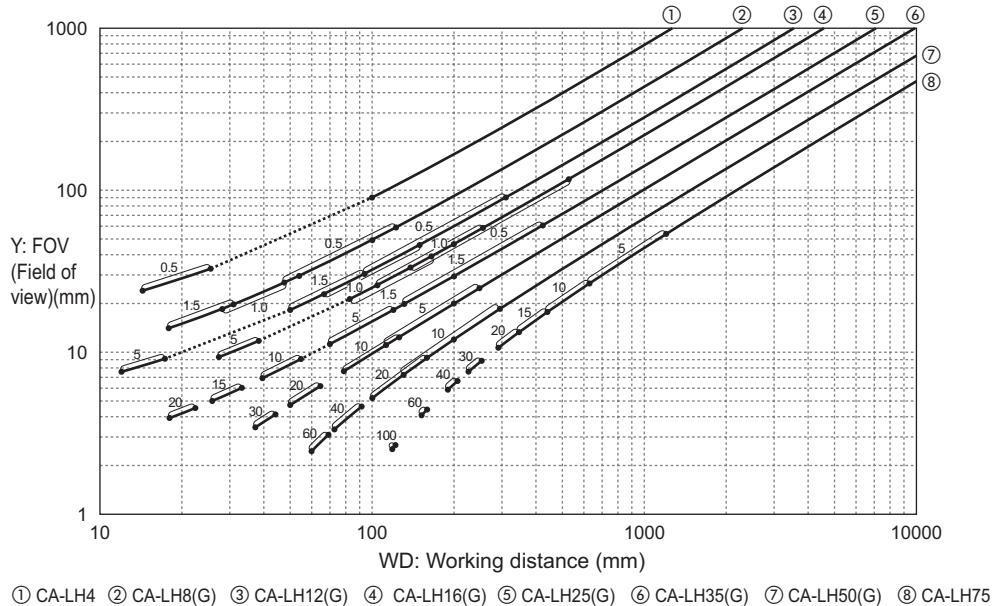


If a close-up ring is used with an ultra high-resolution lens (CA-LHR Series), the inherent peripheral resolution performance of the lens may not be satisfied.

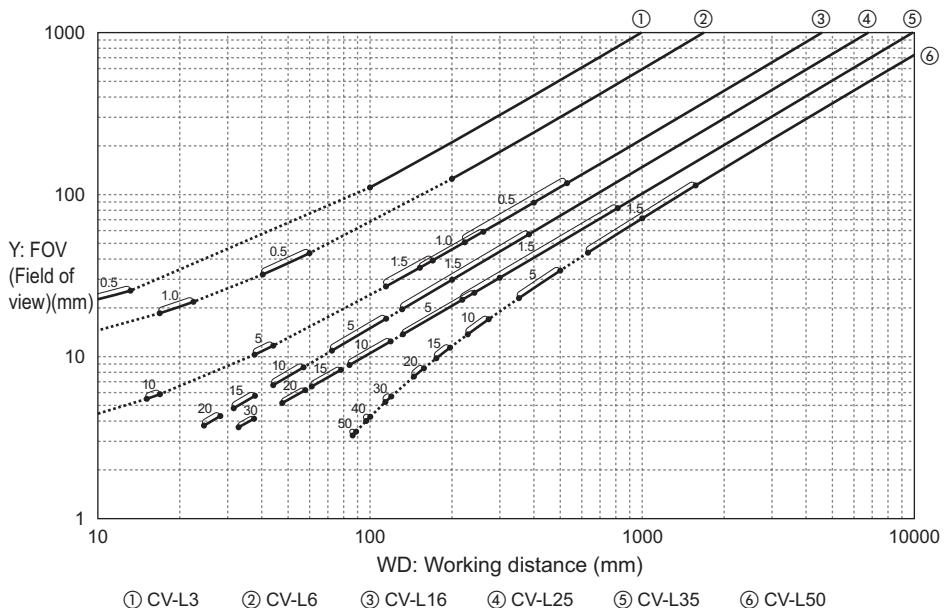
Using a 310,000 pixel Camera (XG-035C/XG-035M) or a High-speed Camera (XG-H035C/XG-H035M)

When a high accuracy lens (CA-LH*(G)) is used :

When using the CA-LH16 on the XG-035C with a required field of view of 200 mm, the chart shows that the working distance should be set close to 900 mm.



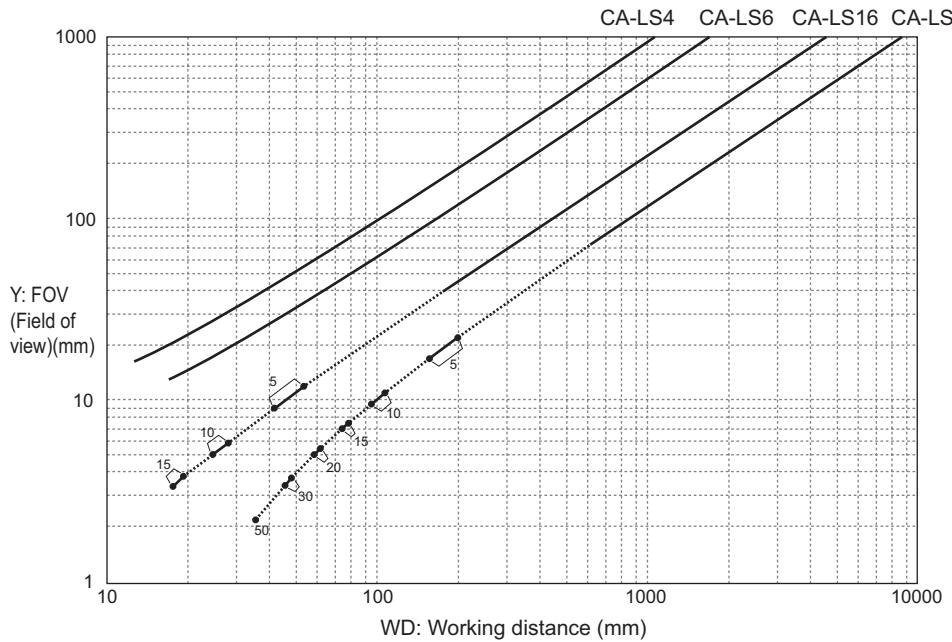
When a standard lens (CV-L*) is used :



Using an Ultra Small 310,000 pixel Camera (XG-S035C/XG-S035M)

When a small camera dedicated standard lens (CA-LS*) is used:

When using the CA-LS16 on the XG-S035C with a required FOV of 10 mm, the chart shows that the working distance should be set close to 100 mm and the 10 mm close-up ring should be used.

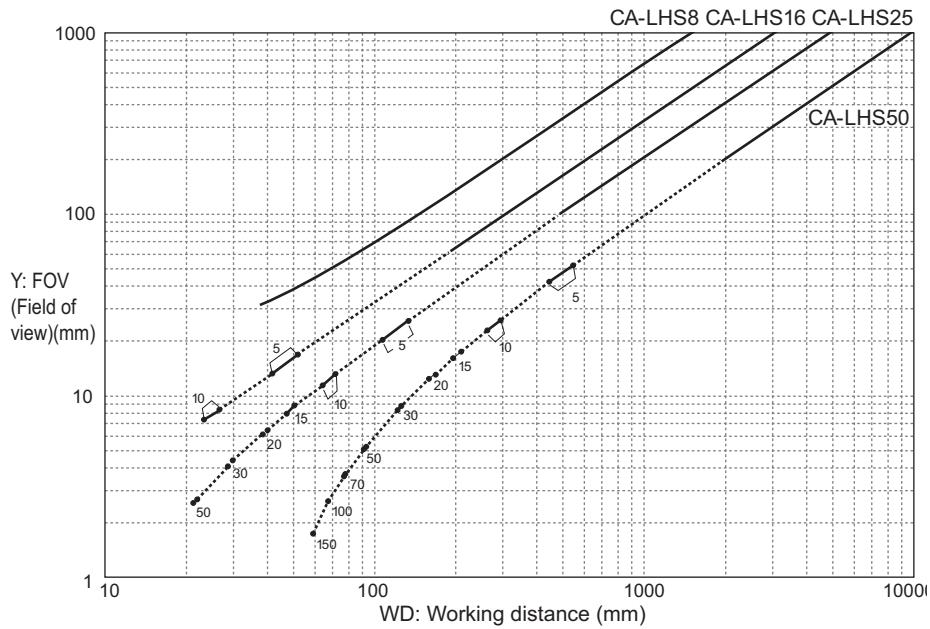


- For more information on installing and adjusting ultra small cameras, refer to the instruction manual provided with the camera.
- When attaching the side view attachment OP-51503, subtract the internal optical length of 15.3 mm from the working distance.

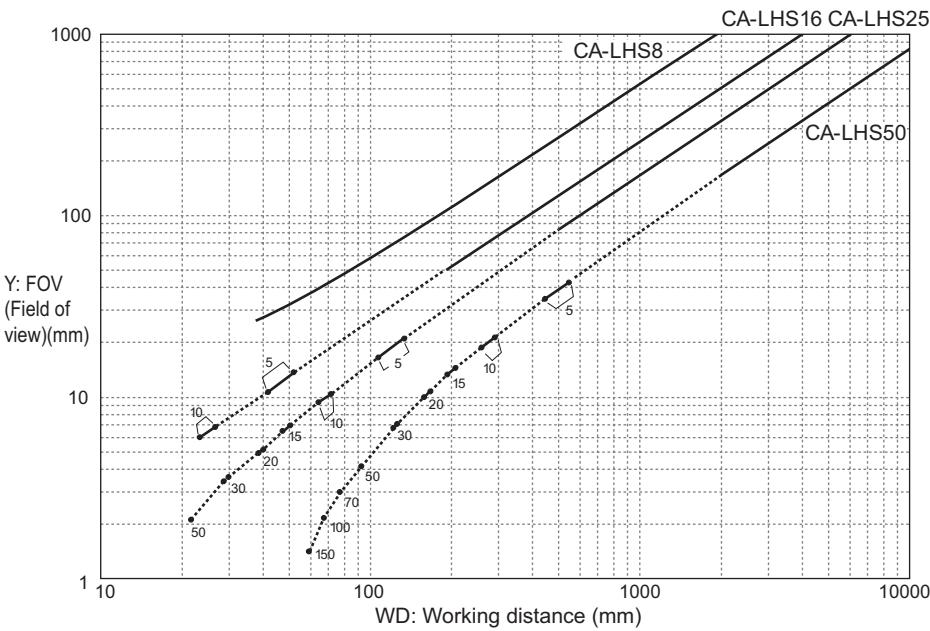
Using an Ultra Small 2 Megapixel Camera (XG-S200C/XG-S200M)

When a small camera dedicated high-resolution lens (CA-LHS*) : 1600 x 1200 pixels (2 megapixel mode) is used

When using the CA-LHS16 on the XG-200C with a required field of view of 100 mm, the chart shows that the working distance should be set close to 300 mm.



When a small camera dedicated high-resolution lens (CA-LHS*) : 1024 x 960 pixels (1 megapixel mode) is used

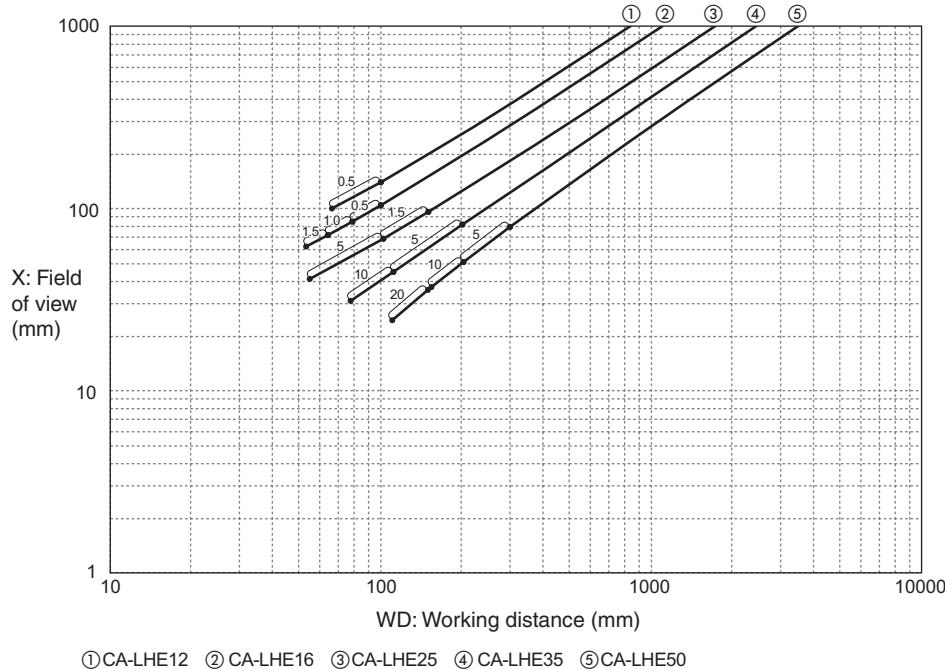


- For more information on installing and adjusting small cameras, refer to the instruction manual provided with the camera.
- When attaching the side view attachment OP-66833, subtract the internal optical length of 25.8 mm from the working distance.

When a 2048-pixel Line Scan Camera (XG-HL02M) or 4096-pixel Line Scan Camera (XG-HL04M) is Used

When using the CA-LHE35 with a required X field of view of 40 mm, the chart shows that the working distance should be set to 100 mm and the 10 mm close-up ring should be used.

When a 4/3"-compatible, ultra high-resolution lens (CA-LHE) is used

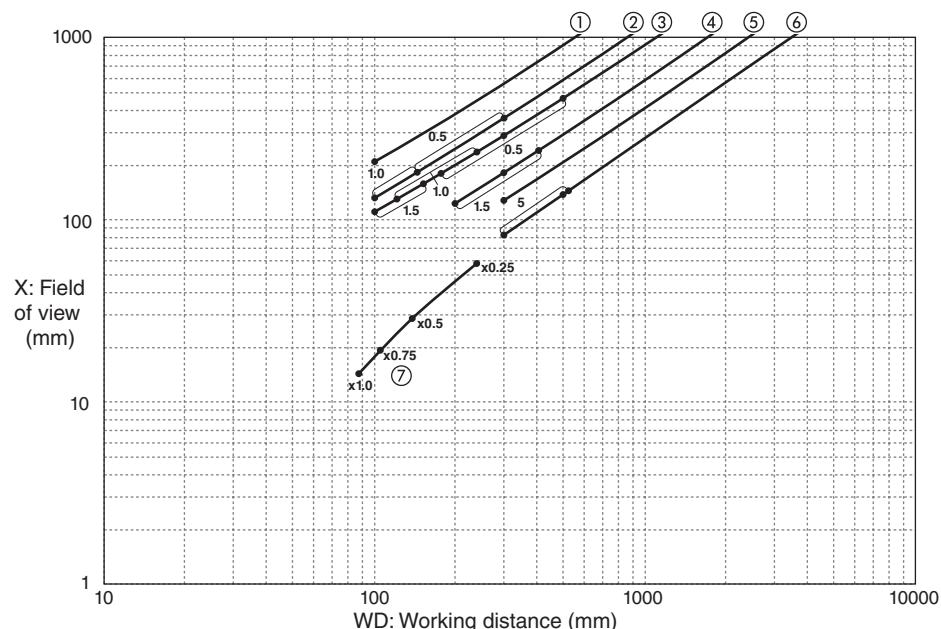


①CA-LHE12 ②CA-LHE16 ③CA-LHE25 ④CA-LHE35 ⑤CA-LHE50



Point If a close-up ring is used with an ultra high-resolution lens (CA-LHE Series), the inherent peripheral resolution performance of the lens may not be satisfied.

When a line scan camera high resolution lens (CA-LHW*) is used



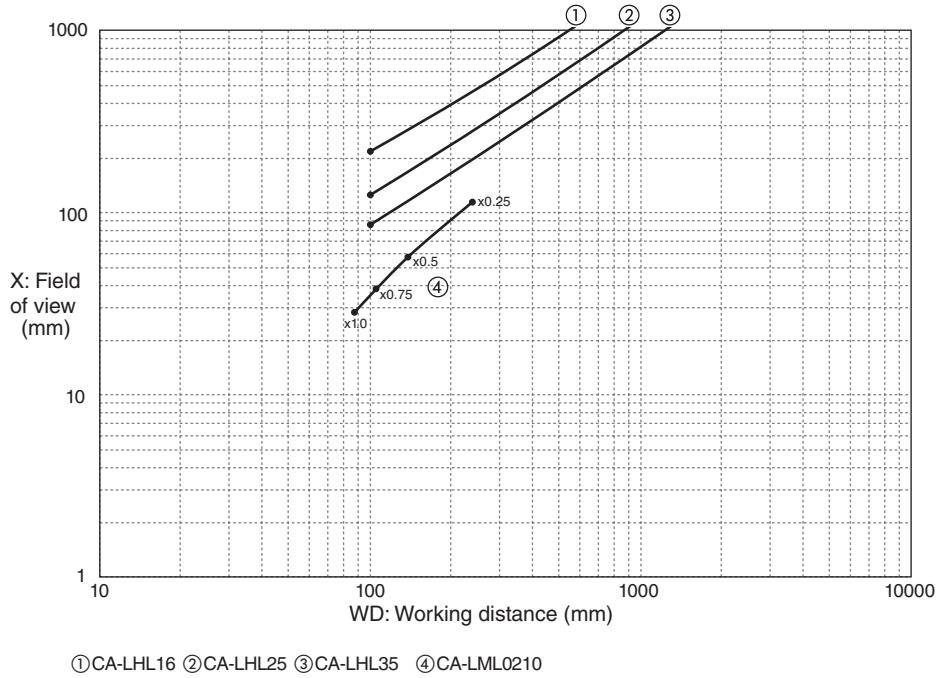
①CA-LHW8 ②CA-LHW12 ③CA-LHW16 ④CA-LHW25 ⑤CA-LHW35 ⑥CA-LHW50 ⑦CA-LM0210



- C-mount lenses other than CA-LHE/CA-LHW cannot be used with a line scan camera.
- If a close-up ring is used with a line scan camera high-resolution lens (CA-LHW Series), the inherent peripheral resolution performance of the lens may not be satisfied.

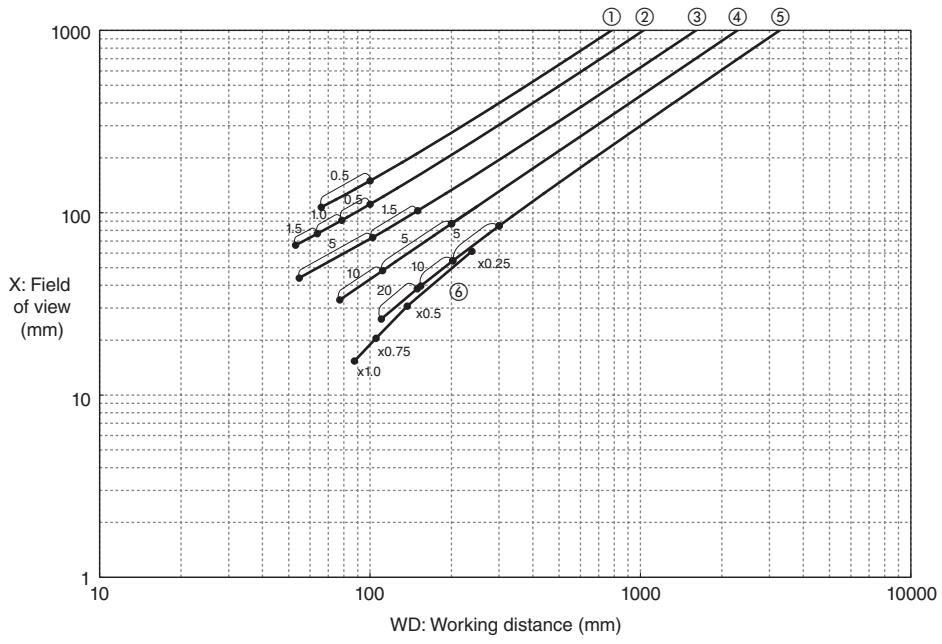
When an 8192-pixel Line Scan Camera (XG-HL08M) is Used

When a line scan camera high resolution lens (CA-LHL*) is used



When a 2048-pixel high-speed Line Scan Camera (CA-HL02MX) or 4096-pixel high-speed Line Scan Camera (CA-HL04MX) is Used

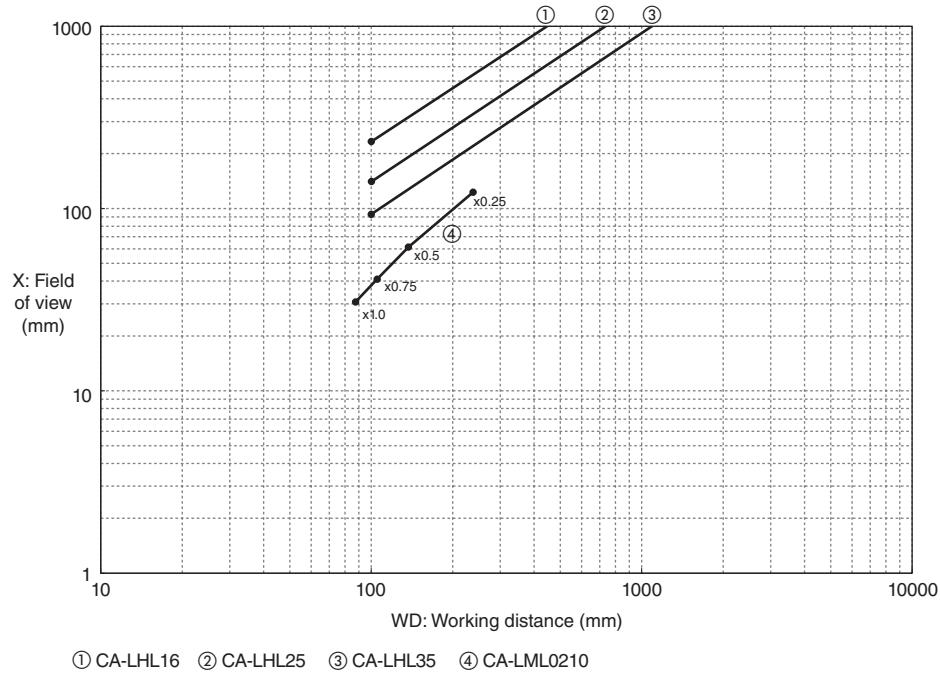
When a 4/3"-compatible, ultra high-resolution lens (CA-LHE*) is used



- Point**
- C-mount lenses other than CA-LHE cannot be used with a high-speed line scan camera.
 - If a close-up ring is used with an ultra high-resolution lens (CA-LHE Series), the inherent peripheral resolution performance of the lens may not be satisfied.
 - The field of view is the same regardless of the valid pixel count settings for the line scan camera.

When an 8192-pixel high-speed Line Scan Camera (CA-HL08MX) is Used

When a line scan camera high resolution lens (CA-LHL*) is used



① CA-LHL16 ② CA-LHL25 ③ CA-LHL35 ④ CA-LML0210



Point The field of view is the same regardless of the valid pixel count settings for the line scan camera.

Main Specifications

Common System Specifications

Number of units		1,000 units maximum per inspection program (depending on system memory capacity)	
Image Acquisition Unit	Capture	<ul style="list-style-type: none"> Supports simultaneous capture for up to four cameras Supports buffered image processing using image buffer memory Supports multiple placement and loop execution Supports HDR capture (cannot be used simultaneously with image capture buffer). Supports LumiTrax Mode (when using CA-HX500C/HX500M/HX200C/HX200M/HX048C/HX048M, and CA-DC50E/DC60E) (cannot be used simultaneously with HDR capture) Supports LumiTrax Specular Reflection Mode (when using CA-HX500M/HX200M/HX048M/HL02MX/ HL04MX/HL08MX, and CA-DC60E) (cannot be used simultaneously with HDR capture) Supports MultiSpectrum Mode (when using CA-HX500M/HX200M/HX048M, and CA-DC60E) (cannot be used simultaneously with HDR capture) Supports variable referencing across a range of setting parameters Supports trigger delay for each camera Allows illumination configuration and intensity adjustment for individual captures (when CA-DC40E/ DC50E/DC60E is used). Supports installation auxiliary function using Z Reference (only when 3D camera is connected) Supports the invalid pixel suppression function (only when 3D camera or LJ-V is connected) Supports scanning method (Progressive/interface selectable) selection function (only when a monochrome camera is connected) For area camera and 3D camera: Capture start/end lines can be set anywhere within the image capture range (XG-H200C and H200M cannot capture fewer than 100 lines) and the capture start line supports changes per capture by referencing variables (area camera only). For Line scan camera and LJ-V: The number of lines can be set to a number that is in the range of the maximum number of lines in response to the pixel count set in a transverse direction for each camera (LJ-V). Sensitivity adjustment, offset and span adjustment (RGB batch/individual and span can be set for each of 16 brightness levels. RGB individual settings are supported when a color camera is connected.) White Balance adjustment (only when a color camera is connected) Image inversion function (left-right mirrored image generation, up-down mirrored image generation, and 180° rotation). Only the 3D camera supports 90° and 270° rotation in addition to the Image inversion function. 	
Vision Tools	Processing	Inspection region (Regions supported depends on unit)	<ul style="list-style-type: none"> Supported region shapes: rectangle, rotated rectangle, circle, oval, ring, arc, polygon (up to 12 sides), and composite (up to 32 individual regions including masks), and array definition range (can specify up to 10,000 rotated rectangles or circles by using array variable reference: only with the Height Measurement unit) Image region (inspection region generated from a binary image) Supported mask regions: 4 per single unit (excluding composite regions). Supports variable referencing for both inspection and mask regions. Allows Multiple Area to be used as a mask region (ShapeTrax3, ShapeTrax2 and PatternTrax only). Supports array-specified region (by reference to the array variable, it is possible to set 10,000 rotated rectangle or circle regions.) (Height Measurement unit only).
		Image Enhance (Image Enhance supported depends on the unit)	<ul style="list-style-type: none"> Available filters: Expand, shrink, average, median, sharpen, Sobel X, Sobel Y, Sobel, Prewitt, Roberts, Laplacian, binary, subtract, Preserve Intensity, contrast conversion, image extraction, shading correction, blur, custom (3 x 3 or 5 x 5), custom (advance) (up to 21 x 21 convolution, expand, shrink), blob, Scratch Defect Extraction, Noise Isolation, Contrast Expansion. Iterations: The same enhancement can be repeated individually up to 9 times. (except: binary, subtract, preserve intensity, contrast conversion, image extraction, shading correction, blur, blob 1 iteration), Stacking: 13 steps, any combination (binary, subtract, blob, Contrast Expansion: can only be applied once in stack) Supports variable referencing across a range of setting parameters Filters available only for the units that directly process 3D data (Height Measurement unit, Profile Measurement unit, Continuous Profile Measurement unit, 3D Geometry unit): Average, Median, Gaussian, Smoothing, Inv. Pixel Suppress, and Spike Noise Cut

Vision Tools (continued)	Processing (continued)	Height extraction function (Only when a 3D camera or an LJ-V is connected)	<ul style="list-style-type: none"> Single point specification, three points specification, real time extraction (average height base/plane base/free-form plane base), from result data Supports variable referencing across a range of setting parameters
		Color extraction (When a color camera is connected)	<ul style="list-style-type: none"> Color to binary, color to grayscale, fine color, grayscale, RGB grayscale, R/G/B grayscale (Color can be specified in HSB terms. Fine color can only be selected when measuring defects.) Supports variable referencing across a range of setting parameters
		Color extraction (When in MultiSpectrum Mode)	Color to binary, color to grayscale, average grayscale, fine color (fine color can only be selected when measuring defects), refer to other unit
		Scaling	<ul style="list-style-type: none"> Individual calibration can be applied to units X, Y and length data (variable referencing allowed). Calibration can be turned ON/OFF for each inspection unit. Unit results, variable referencing allowed.
	Presence / Absence	Area	Counts the number of white or black pixels.
	Position detection	Pattern Search	<ul style="list-style-type: none"> Supports multiple pattern searches for up to 99 patterns oriented throughout 360 degrees. Supports variable referencing for search, pattern and 4 mask regions. Supports variable referencing for detection point offsets. Supports referencing of registered images using image variables for processing.
		ShapeTrax3	<ul style="list-style-type: none"> Edge-based search measurement able to detect up to 2,000 targets Supports 360-degree rotation and 50% - 200% scale changes. Supports variable referencing for pattern regions and detection point offset, and up to 4 mask regions. Allows Multiple Area to be used as a mask region. Supports variable referencing for detection point offsets. Supports generation from images and editing of feature data with the Feature Drawing Tool Supports the rotation direction-added search for angular position determinations Search results are sortable via the detection target selection conditions Supports referencing of registered images using image variables for processing. Supports Target No. Display
		ShapeTrax2	<ul style="list-style-type: none"> Edge-based search measurement able to detect up to 2,000 targets Supports 360-degree rotation and 50% - 200% scale changes. Supports variable referencing for pattern regions and detection point offset, and up to 4 mask regions. Allows Multiple Area to be used as a mask region. Supports variable referencing for detection point offsets. Supports generation from images and editing of feature data with the Feature Drawing Tool Supports referencing of registered images using image variables for processing. Supports Match % and Target No. Display
		PatternTrax	<ul style="list-style-type: none"> Search measurement able to detect up to 2,000 targets based on tone information that changes around boundaries Supports 360-degree rotation Supports variable referencing for pattern regions and detection point offset, and up to 4 mask regions. Allows Multiple Area to be used as a mask region. Supports variable referencing for detection point offsets Supports referencing of registered images using image variables for processing Supports Detection Mark and Target No. Display
		Edge Position	<ul style="list-style-type: none"> Measures up to 3,600 positions simultaneously. Supports angle measurement using ring and arc inspection regions.
		Profile Position	<ul style="list-style-type: none"> Measures the average, maximum, and minimum edge positions in a single inspection region divided into up to 5,000 segments. Supports angle measurement using ring and arc inspection regions. Detects straight lines and circles from a group of detection points using the least-squares method (with correction).
		Blob	Measures the center of gravity and main axis angle (180/360 degrees selectable) for up to 9,999 blobs.

Main Specifications

Vision Tools (continued)	Inspection Tools	Edge Width	Measures the distance between two edges (outer gap, inner gap, specified edges).
		Edge Pitch	Measures the gap pitch and center pitch for up to 1,800 detected edges.
		Edge Angle	Measures the angle between two detected edges.
		Edge Pairs	Measures the gap pitch and center pitch for up to 3,600 detected edges formed into pairs from two scans.
		Profile Width	Measures the average, maximum, and minimum edge widths between two edges (outer gap, inner gap) in a single inspection region that has been divided into up to 5,000 segments.
		Blob (Feature characteristics)	Supports counting the labels up to 9,999, and measuring the center of gravity, main axis angle (180/360 degrees selectable), area, Feret diameter, perimeter, roundness, Blob Axes Box, Minimum Bounding Rectangle, Major/Minor Axes Ratio, Distributed Oval Major Axes, Distributed Oval Minor Axes, and Distributed Oval Aspect Ratio.
		Grayscale Blob	<ul style="list-style-type: none"> Directly measures the intensity information in a grayscale image and detects features. In addition to blob measurement items (except Minimum Bounding Rectangle), also supports feature measurement based on intensity. Supports image contrast display.
		Defect	<ul style="list-style-type: none"> Detects flaws and defects inside a region by comparing the average intensity of segments. Supports detection of defects based on the difference from the registered image by using the Subtract filter concurrently. Supports multiple detection of up to 99 groups using the defect grouping function, detected position and feature characteristics measurements, and filtering based on feature characteristics. Supports direct measurement of the color image using fine color. Supports image contrast display.
		Profile Defect	<ul style="list-style-type: none"> Detects as a defect a part (protrusion or indentation) that deviates greatly in shape with respect to a model line based on detected edge points of a target profile. Supports flaw detection using straight lines, circles, ovals, and free-form curves as model lines.
		Multi-Profile Defect	<ul style="list-style-type: none"> Calculates the model line for each of the several inspection regions that were set, and detects as a defect the part (protrusion or indentation) that deviates greatly from the model line in shape Supports lines correspond to the lines, circles, ovals and free curve lines as a model line in each of the regions By extending the inspection region up to the model line intersection, corner vicinity defect inspection is possible Supports burr/flaw inspection at corners
		Intensity	<ul style="list-style-type: none"> Measures the pixel intensity value. Required as the reference unit for the preserve intensity filter.
		Color (when a color camera is connected or in MultiSpectrum Mode)	<ul style="list-style-type: none"> Supports RGB and HSB measuring (when a color camera is connected) Supports measuring of each lighting color image (when using MultiSpectrum)
		Color Grouping (When in MultiSpectrum Mode only)	Calculates the area value of each color group and determines which group no. has the greatest area by means of the multiple color information which was registered as the color groups in advance.
		OCR	<ul style="list-style-type: none"> Supports character recognition of alphanumeric characters and some symbols for up to 2 lines of 20 characters (40 total) identified automatically or from a fixed region. Supports libraries where up to 200 character patterns can be registered, including 20 types of user-defined characters (the library can be specified individually by program or shared among programs). Supports a calendar tolerance function (with zero suppression and offset function). Supports encrypted date and time and shift codes.
		OCR2	<ul style="list-style-type: none"> Supports character recognition of alphanumeric characters and some symbols for up to 2 lines of 20 characters (40 total) identified automatically or from a fixed region. When the Recognition block mode is used, character recognition for a maximum of 1 line of up to 40 characters is supported. Supports a built-in library and user-definable user libraries where up to 600 character patterns can be registered, including 20 types of user-defined characters (the library can be specified individually by program or shared among programs). Supports a calendar tolerance function (with zero suppression and offset function) Supports encrypted date and time and shift codes.
		2D Code Reader	<ul style="list-style-type: none"> Supports reading of 2D codes (QR code: Model 1/Model2, Micro QR, DataMatrix, Rectangle DataMatrix: ECC200, PDF417, MicroPDF417, and composite code (CC-A, CC-B, and CC-C)) of up to 512 characters, and split data reading in up to 8 divisions. Supports up to 16 registered character patterns and a calendar tolerance function (with zero suppression and offset function). Print quality verification function (relative evaluation according to ISO/IEC 15415, AIM DPM-1-2006, SAE AS9132)
		1D Code Reader	<ul style="list-style-type: none"> Support reading of up to 128 characters, and split data reading in up to 8 divisions of 1D codes (Code39, Code128, EAN/JAN/UPC, GS1 Databar, Omnidirectional, GS1 Databar Truncated, GS1 Databar Stacked, GS1 Databar Stacked Omnidirectional, GS1 Databar Limited, GS1 Databar Expanded, ITF, Codabar/NW7, PharmaCode). Supports up to 16 registered character patterns and date & time tolerances (with zero suppression, offset function). Print quality verification function (relative evaluation based on ISO/IEC 15416)

Vision Tools (continued)	Only when a 3D camera or an LJ-V is connected	Height Measurement	<ul style="list-style-type: none"> Supports the measurement of maximum/minimum/average height, concave/convex area, concave/convex volume, and number of valid pixels based on the 3D information of the height image. Supports the average height, real time three-point specification, best fit, numerical values, free-form and from result data specification as a way to specify the reference plane (zero plane).
		Profile Measurement	<ul style="list-style-type: none"> Supports the measurement of a maximum of 32 items based on height image profiles: Height/Level difference/Position/Center position/Width/Angle from horizontal/Angle formed by two lines/Radius of circle/Cross-section area/1-line cross-section area/2-line cross-section area/Points distance/Point/line distance/Count/Defect detection Supports the average height, 3 points real-time, best fit plane, value specification, and result data reference as ways of specifying the reference plane (zero plane) Supports measured value correction
		Continuous Profile Measurement	<ul style="list-style-type: none"> Supports the measurement of a maximum of 32 items based on height image profiles: Height/Level difference/Position/Center position/Width/Angle from horizontal/Angle formed by two lines/Radius of circle/Cross-section area/1-line cross-section area/2-line cross-section area/Points distance/Point/line distance/Count/Defect detection Supports the profile measurements of a maximum of 16384 profiles for one measurement region Supports the average height, 3 points real-time, best fit plane, value specification, and result data reference as ways of specifying the reference plane (zero plane) Supports measured value correction
		3D Geometry	<ul style="list-style-type: none"> Distance Calculation: Points Distance, Point/Line Distance, Point/Plane Distance, Lines Distance, Line/Plane Distance, Planes Distance Angle Calculation: Angle Between Two Lines, Angle Between Line and Plane, Angle Between Two Planes Point Calculation: Point, Intersection of Two Lines, Intersection of Line/Plane, Midpoint of Points, Point Between Point and Line, Point Between Point and Plane, Intersection of Point/Line, Intersection of Point/Plane Line Calculation: Line, Line Defined by Two Points, Center Line Between Point and Line, Line Projection onto Plane, Line Between Planes Plane Calculation: Plane, Center Plane Between Two Points, Center Plane Between Point and Plane, Plane Determined by Point and Line, Plane Determined by Two Lines Sphere Calculation: Sphere Supports measured value correction
Position Adjustment Unit		<ul style="list-style-type: none"> Provides 1- or 2-point position correction for X, Y, and θ (± 180 degree) orientation of inspection, image operation and On-Screen Graphics units. Supports referencing by all or individual measurement units. Supports batch reference registration using a registered image. 	
Control Units	Branch/Join	<ul style="list-style-type: none"> Supports up to 64 flow branches per unit based on a reference (unit results, variable reference). Supports controlled branching specification 	
	Loop function	Supports multiple unit execution control based on the number of loops (fixed or variable reference) specified.	
	Break	Forced exit from loops.	
	End	Ends the flow processing.	

Main Specifications

Operation Units	Calculation	<ul style="list-style-type: none"> Allows multiple calculation processing separated by line feeds. Can contain up to 5000 characters including comments. Supports Timeout-based and answer-based (ANS) unit judgment. Arithmetic operators: Add, subtract, multiply, divide, remainder, power. Logic operators: NOT, AND, OR, XOR. Comparison operators: equal, not equal, greater than, less than, more than inclusive, less than inclusive. Arithmetical functions: Abs, AsCircle, AsLine, AsPoint, As3DPoint, AsPlane, Atoi, Ave, Ave2 (array), AveR (range), AveR2 (array, range), Ceil (round up), Deg (radian to degree), Exp, Foor, Int (round off), Ln, Log, Max, Min2 (array), MaxN (index), MaxN2 (index, array), Min, Min2 (array), MinN (index), MinN2 (index, array), Pi, Degree to Radian, Round (round up), Sort (numerical array/position type array/3D position type array), Sqr, Sqrt, Sum (array), Stdev, Stdev2 Trigonometric functions: Sin, Cos, Tan, Asin, Acos, Atan, Atan2 (P1/P2) Geometric functions: AngC, Angle, AngleTrans, AngW, Circle3 (3 points), CircleLs (array), CircleTangent, ConvCrd, ConvCrd2, Dist, ISect, I2Circle, ILineCircle, Line (2 points), LineLs (array), LLAngle, LnAngle, LnDist, LnDistP (sign), LnDistXY, VMidLine, MidXY, Rotate, RotCenter, MidLine, ConvPixToWld, ConvWldToPix, MultiPtCalib, MultiPtCalib2, AddVector, SubVector, OuterProd, InnerProd, CalibInfo, ConvXYtoUVW, I4XY, I4Line Geometric functions (3D position, plane): PlaneLs, P1Dist, P1DistP, Dist3D, PlanePassPt, P1DistN, P1DistPN, AddVector3D, SubVector3D, ILine3DPlane, I2Plane, Line3DDist, Line3DDistXYZ, P1DistXYZ, LnLn3DDist, Plane2Angle Calendar functions: ShiftDay, ShiftMonth, ShiftYear Bit functions: B_And, B_Not, B_Or, B_Xor, Bind Statements: FOR, STEP, NEXT, EXIT FOR, IF, ELSE IF, END IF, DO WHILE (undefined loop), EXIT DO (undefined loop), comments, continue to next line Others: CopyVariableArray (scalar/position type/line type/circle/3D position type/plane type), ClearVariableArray, Calculation results Supports ResetVariableArray, displays and highlights calculation errors.
	Image operation	<ul style="list-style-type: none"> Creates images based off of a feature extracted from one or multiple images, or an image with enhanced intensity differences. Operation: Processing across multiple images. Supports a combination of 1:1, n:1, n:n (max n is 32) images Conversion: Operation processing performed on one image. Operation types: Add, Subtract, AbsoluteDifference, Average, Multiply (with normalization), Multiply (without normalization), Max, Min, AND, OR, XOR, NAND, NOR, XNOR Conversion types: Add, Subtract, AbsoluteDifference, Multiply, Rotation, Translation, Zoom, Trapezoid Correct, Pixel Val. Conv., Blob, NOT, AND, OR, XOR, NAND, NOR, XNOR, Right Bit Shift, Left Bit Shift
Contour Region Generator		Generates a binary image from a workpiece's contours for use for Processed Image Region.
Defect Extraction Operation		Extracts defects from a maximum of three images and composes them in to one image.

Operation Units	C Plug In	<ul style="list-style-type: none"> C language source files can be compiled for both controller and PC simulation environments.(Supported compilers: For the controller: Texas Instruments C6000 Code Generation Tools 7.4.4, For the PC: Microsoft Visual Studio 2008/2010/2013, Visual C++ 2008/2010/2013 Express Edition.) Supports access to pixel values from the specified image variable. Local variables, global variables, and system variables values can be passed for referencing and rewriting (rewriting not supported for system variables). Visual Studio debugging.
	Calibration	<ul style="list-style-type: none"> Lens and trapezoidal distortion can be corrected by teaching a calibration pattern. Supports two forms of correction, based off of the image itself, and by calculating the coordinates. Multiple calibration patterns can be used during teaching. User defined calibration patterns available for printing.
	Image Stitching	Positioning and stitching of up to four images to one resultant image variable is possible.
Timing Units	Pause	Pause flow for specified time (0 ms to 1 hour: fixed or variable reference)
	Timer Start	Start user timer (0 to 7)
	Timer End	Pause flow until time in user timer (0 to 7) expires.
	Terminal I/O Delay	<ul style="list-style-type: none"> Pause flow based on AND/OR evaluation of up to 20 terminals for state changes (edge/level, ON/OFF, rising/trailing edge). Supports CC-Link bit devices, EtherNet/IP, PROFINET or EtherCAT output data (received by the controller) bit assignment
	Variable Delay	Pause flow based on AND/OR evaluation from comparing results of variables (max 8) and reference values (max 2).
	User Menu	Pause flow from the time a dialog is open to the time it is closed.
Display Unit	On-Screen Graphics	Displays graphic objects and characters linked to variables and step results. Graphic objects: rectangle, rotated rectangle, circle, oval, ring, arc, point (rotating crosshair), line, characters: text, values, active text, decimal to ASCII.
Output Units	Parallel Terminal Output	<ul style="list-style-type: none"> Outputs user-defined inspection results to the I/O terminals. Supports time-delayed separated outputs of up to 8 times and one-shot output Skips data output for unexecuted units. Output priority can be set for processing images or outputs.
	Data output	<ul style="list-style-type: none"> User-defined inspection results (256 maximum) can be output to either the SD card, RS-232C, Ethernet, CC-Link, EtherNet/IP, PROFINET, EtherCAT, PLC-Link, PC Program, FTP server or USB-HDD. Supports use of up to 16 custom-formatted output strings. Skips data output for unexecuted units. User defined output folder and file naming rules (when outputting to the SD card, FTP or PC program (VisionTerminal / Active X)) Number of output of array result data can be adjusted according to the detected number. Number of output data can refer to the variable using user-defined array variables. Output priority can be set for processing images or outputs.
	Image output	<ul style="list-style-type: none"> Outputs image data for an image variable to the SD card, PC Program (VisionTerminal / ActiveX), FTP server, or USB-HDD. (BMP / JPG selectable file format) User defined output folder, folder spanning (by no. of images or date), and file naming rules. Output priority can be set for processing images or outputs.
Execute Command Unit	Command Execution	Any command can be issued to the controller during Run mode from the image processing flow.
Robot Vision Units	Robot Coordinate Conversion	Can convert detected positions into robot coordinates based on calibration information
	Robot Coordinate Operation	Can calculate coordinates based on multiple detected positions
Common Outputs	Unit Total status	<ul style="list-style-type: none"> Outputs the logical OR of the results of selected units as the total status. The camera judgments from each camera unit's judgment conditions results can be output
	Unit Total error	Outputs the logical OR of unit errors of selected units as the total error.
	Scaling function	Supports calibration and scaling for X, Y, and length for each camera. Scaling also supported based on measurement and calculation
	Shading correction (line scan camera only)	The shading correction is set for each camera from the Graph Viewer.

Main Specifications

System Settings		Controller Name, Date & Time, Language, Registered Image File Type, Menu Opacity, Startup Settings (Startup Mode, Startup Screen), Startup Program No. (Drive, Program No.), Mouse Settings, Calibrate CA series Touch Panel, Parallel Unit Execution, Light Configuration, White Balance, Linescan Calibration, 3D Camera Maintenance (3D Calibration, LED Intensity Adjustment) (Only when a 3D camera or an LJ-V is connected), Communications & I/O settings (Terminal Block & Parallel Port, Ethernet, FTP, RS-232C, PLC-Link, CCLink, EtherNet/IP, PROFINET, EtherCAT, VNC, VisionDatabase, Robot Connection Settings, SNTP, Encoder, Error Handling, Busy Signal), Library Specification, OCR Encryption, Robot Vision Settings, Custom Instruction Settings, Handheld Controller Function, Touch Panel Menu, File Output, Modification Log, Security Settings, Account Settings, New Program Options
Screen interface	Number of screen configurations	Supports 100 screens per program with external switching possible. Display control according to user account.
	Number of frames	99 frames per screen with, external switching possible.
	Number of image displays	<ul style="list-style-type: none"> • 8 individually customizable (layout and size) image displays per screen. • Display the current image from a user-specified camera, a registered image, as well as any user-specified archived image stored in the system's image memory. • Zoom capability linked to inspection regions of user-specified vision tools or primary targets. • Selection with external control.
	Screen parts	<ul style="list-style-type: none"> • Image display, base frame, page frame • Basic parts: value, text, active text, horizontal line, vertical line, point, rectangle, circle, polygon, table. • Standard parts: Display program/recipe name, inspection date, inspection time, display camera & image information, display area & magnification, Total Status Pass / Fail, Logo Image (BMP), Unit Details (Vision Tools), Unit Details (Non-Vision Tools), Variable List, Unit Pass / Fail Graphic, Unit Result Summary List.
Dialog menus	Number of dialogs	<ul style="list-style-type: none"> • Maximum of 900 per program with, external switching possible. • Supports dialog based menus that can be used to change or set various parameters while the controller is in Run mode. (Menu transparency can be changed to 100%, 90%, 75%, 50%, or 25%) • Screens can be linked to menus being used. Menus can be displayed or hidden based on the user account logged in.
	Basic Elements	Text, numerical input, drop down menus, button.
	Standard Menu	<ul style="list-style-type: none"> • Inspection Region Menu, Register Image Menu, Color Extraction Menu, Library Menu • Inspection Region, Color Extraction, library menus support changes based on login permissions. • Inspection Region Menu can reference the amount of correction provided by the reference unit. • Unit properties menu can be used for all units except the C Plugin unit menus. • Holding default variable values can be enabled for Variables and New / Edit / Delete Programs menus.
	Unit Properties	<ul style="list-style-type: none"> • Supports changes to settings of pre-configured units (Vision Tools, Position Adjustment, Operations, Functions, Timing, Display, Output, Execute Command). • Supports the updating of registration reference values from registered images.
User variable	Local variables	<ul style="list-style-type: none"> • Max 10,000 variables/program (depends on the controller's memory capacity). • Supports array structure with up to 10,000 elements for scalar, position, line, circle, 3D position, and plane type variables respectively. • Supports initializing the variable when resetting and saving, and selecting to keep the initial variable value of the controller (can be set as a default). • Supports variable comment input.
	Global variables	<ul style="list-style-type: none"> • Max 1,024 variables/controller • Same specifications as those of local variables. Can be shared for referencing among programs.
	Image Variable	<ul style="list-style-type: none"> • Max 512 variables/program • Supports array structure with up to 512 elements. • Image variable which can change the size within a range of width from 512 to 4864 and of height from 480 to 4864 can be defined. • Supports variable comment input.

Support functions	Statistics Data points	Maximum of 100,000 data points per item and maximum of 256 items (can be saved onto an SD card in a single operation).
	Statistics Data	Maximum, minimum, average, deviation (3σ), total status OK/NG count
	Image Archive	<ul style="list-style-type: none"> • Simultaneous processing of up to 8 archives with different content. • Archive images as single or multiple images. Choice of buffer control either by overwriting the buffer each time or by processing until the buffer is full. • Supports storage of result data to allow reproduction of measurement conditions at the time the image was recorded (The result display in the image archive display in the controller, or the archive playback in the VisionEditor can be used). • Supports archived data output to SD card, PC Program, FTP, or USB HDD server for each archive. • Retesting in the controller can be done for archived image archives
	Variables Update Settings	<ul style="list-style-type: none"> • Allows local variables, global variables, or system variables to be checked and changed during operation. (System variables can be checked only.) • Supports group settings and screen display selection.
	Target Classification Settings	<ul style="list-style-type: none"> • Allows Defect, Blob and Grayscale Blob measurement results and images to be classified according to the set conditions, recorded, and subjected to upper/lower limit judgment of the quantity. • Supports file output of results data, and image extraction for output of an image file within the selected range around the detected position, to an SD card or FTP server. • Possible to assign maximum three variables or result data as the output data.
	Recipe Setting	Can support multiple product types with the same program setting by retaining setting data information that is dependent upon the product type as recipes and switching recipe numbers
	Robot Settings	<ul style="list-style-type: none"> • Can specify the target robot and the communication mode, turn ON/OFF the Robot Operation, and perform validation checks with Robot Connection Settings in system settings • Can create, copy, delete, change names of, and edit calibration data • Can perform robot operations such as jogging, etc. from the controller.
	VisionDatabase functions	Utilizes the image processing system database software VisionDatabase CA-H1DB (sold separately) to support the Results/Images database management, Automatic setting back up function, etc..
	Image Capture Buffer Settings	<ul style="list-style-type: none"> • Allows setting of the number of images which can be captured independently of flowchart operation. • Either a fixed or overwriting buffer can be set.
	Password function	<ul style="list-style-type: none"> • Allows a password set for the XG-X VisionEditor to be applied to program files so that attempts to display/edit settings from the XG-X VisionEditor can be locked when the password does not match. • If the password which was set via the security setting and the same password are set via the VisionEditor Settings, then the contents can be read and edited with this XG-X VisionEditor.

Controller Specifications

XG-X2700/X2500/X2200/X2000

	XG-X2700	XG-X2500	XG-X2200	XG-X2000
Camera input	<ul style="list-style-type: none"> • 2 color/monochrome cameras • A maximum of up to four are connectable by connecting one optional area camera input unit CA-E100 			
Trigger input	Simultaneous capture by up to 4 cameras/individual capture can be selected. (when CA-E100 is not connected, simultaneous capture is by up to 2 cameras)			
Supported cameras/ Number of pixels	With XG-035C/S035C/H035C/035M/S035M/H035M connected 310 k pixel mode: 640(H) x 480(V), approx. 310,000 pixels 240 k pixel mode: 512(H) x 480(V), approx. 240,000 pixels	With CA-HX048C/HX048M connected 470 k pixel mode: 784(H) x 596(V), approx. 470,000 pixels 310 k pixel mode: 640(H) x 480(V), approx. 310,000 pixels 240 k pixel mode: 512(H) x 480(V), approx. 240,000 pixels	With XG-200C/S200C/H200C/200M/S200M/H200M connected 2 mega-pixel mode: 1600(H) x 1200(V), approx. 1.92 mega-pixels 1 mega-pixel mode: 1024(H) x 960(V), approx. 980,000 pixels	
		With CA-HX200C/HX200M connected 2 mega-pixel mode: 1600(H) x 1200(V), approx. 1.92 mega-pixels		
		With XG-H500C/H500M connected 5 mega-pixel mode: 2432(H) x 2050(V), approx. 4.99 mega-pixels		
		With CA-HX500C/HX500M connected 5 mega-pixel mode: 2432(H) x 2040(V), approx. 4.96 mega-pixels 2 mega-pixel mode: 1600(H) x 1200(V), approx. 1.92 mega-pixels		
	With CA-H2100C/H2100M connected 21 mega-pixel mode: 5104(H)x4092(V), approx. 20.89 mega-pixels 5 mega-pixel mode: 2432(H)x2050(V), approx. 4.99 mega-pixels			
Main image processor	DSP (High-speed)	DSP		
Number of program setting registrations	SD cards 1 and 2 can each hold 1000 programs (depending on the size of the SD card and the size of the programs) External switching is possible			
Number of registered screens	Maximum of 1000 screens per camera for each program (depending on SD card size), Image compression function, position adjusted image registration and partial image registration supported, external switching via variable referencing possible.			
SD card	<ul style="list-style-type: none"> • SD card slot x 2 • Compatible with OP-87133 (512MB), CA-SD1G (1GB: installed standard to SD1 slot), CA-SD4G (4GB), and CA-SD16G (16GB) 		<ul style="list-style-type: none"> • SD card slot x 2 • Compatible with OP-87133 (512MB: installed standard to SD1 slot), CA-SD1G (1GB), CA-SD4G (4GB), and CA-SD16G (16GB) 	

	XG-X2700	XG-X2500	XG-X2200	XG-X2000	
Number of Saved Archived Images	The number of images that can be archived in the controller's image memory is listed below				
	When an area camera is connected. <ul style="list-style-type: none"> • Maximum 12757 images (monochrome camera in 240,000 pixel mode) • Maximum 10221 images (monochrome camera in 310,000 pixel mode) • Maximum 6730 images (monochrome camera in 470,000 pixel mode) • Maximum 1638 images (monochrome camera in 2,000,000 pixel mode) • Maximum 613 images (monochrome camera in 5,000,000 pixel mode) • Maximum 122 images (monochrome camera in 21,000,000 pixel mode) • Maximum 12441 images (color camera in 240,000 pixel mode) • Maximum 9998 images (color camera in 310,000 pixel mode) • Maximum 6609 images (color camera in 470,000 pixel mode) • Maximum 1598 images (color camera in 2,000,000 pixel mode) • Maximum 583 images (color camera in 5,000,000 pixel mode) • Maximum 110 images (color camera in 21,000,000 pixel mode) 	When an area camera is connected. <ul style="list-style-type: none"> • Maximum 12757 images (monochrome camera in 240,000 pixel mode) • Maximum 10221 images (monochrome camera in 310,000 pixel mode) • Maximum 6730 images (monochrome camera in 470,000 pixel mode) • Maximum 1638 images (monochrome camera in 2,000,000 pixel mode) • Maximum 613 images (monochrome camera in 5,000,000 pixel mode) • Maximum 12441 images (color camera in 240,000 pixel mode) • Maximum 9998 images (color camera in 310,000 pixel mode) • Maximum 6609 images (color camera in 470,000 pixel mode) • Maximum 1598 images (color camera in 2,000,000 pixel mode) • Maximum 583 images (color camera in 5,000,000 pixel mode) 	When an area camera is connected. <ul style="list-style-type: none"> • Maximum 4091 images (monochrome camera in 240,000 pixel mode) • Maximum 3277 images (monochrome camera in 310,000 pixel mode) • Maximum 2156 images (monochrome camera in 470,000 pixel mode) • Maximum 520 images (monochrome camera in 2,000,000 pixel mode) • Maximum 3985 images (color camera in 240,000 pixel mode) • Maximum 3200 images (color camera in 310,000 pixel mode) • Maximum 2111 images (color camera in 470,000 pixel mode) • Maximum 490 images (color camera in 2,000,000 pixel mode) 	When an area camera is connected. <ul style="list-style-type: none"> • Maximum 2181 images (monochrome camera in 240,000 pixel mode) • Maximum 1747 images (monochrome camera in 310,000 pixel mode) • Maximum 1148 images (monochrome camera in 470,000 pixel mode) • Maximum 2122 images (color camera in 240,000 pixel mode) • Maximum 1702 images (color camera in 310,000 pixel mode) • Maximum 1120 images (color camera in 470,000 pixel mode) 	
Interface	Controlled input (compatible with arbitrary assignment)	<ul style="list-style-type: none"> • 20 inputs (including four high speed input terminals that can be allocated for trigger input) • Input rating 26.4 V or lower, 2 mA or greater (3 mA or greater for high speed input terminal) 			
	Controlled output (compatible with arbitrary assignment)	<ul style="list-style-type: none"> • 28 outputs (including four high speed output terminals that can be allocated for FLASH outputting linked to external trigger) • Photo MOSFET *1 Maximum 50 mA (30 V or less) 			
	Monitor output	Analog RGB Output, XGA (1024 x 768, 24 bit color)			
	Operation indicators	LED display for Power ON and ERROR			
RS-232C		<ul style="list-style-type: none"> • Can be switched to be used for performing numerical value output and control input/output, or be used for the CA series touch panel interface function (Cannot be used in conjunction with PLC-Links using the RS-232C port) • Supports a max. baud rate of up to 230400 bps 			
PLC link		<ul style="list-style-type: none"> • Can output numerical values and perform control input/output using the Ethernet or RS-232C port (Cannot be used in conjunction with CC-Link, EtherNet/IP, PROFINET and EtherCAT.) • The following PLCs are supported via link unit:^{*2} <ul style="list-style-type: none"> - KEYENCE: KV-7000 Series, KV-5000/3000 Series, KV-1000/700 Series, KV Nano Series - Mitsubishi Electric: MELSEC iQ-R/L/Q Series, MELSEC A Series (RS-232C only), MELSEC iQ-F Series, MELSEC FX Series (RS-232C only) - OMRON: SYSMAC CJ2/CJ1/CS1 Series, SYSMAC C Series (RS-232C only), SYSMAC CP1 Series - YASKAWA Electric Corporation: MP2000 Series, MP900 Series (RS-232C only) 			
Ethernet		<ul style="list-style-type: none"> • Numerical value output, and control input/output possible. • By the connection of KEYENCE PC application software, in addition to the function described above, uploading and downloading of program settings, simulations, sending/receiving of various data, including image data, and remote desktop are possible. • Supports FTP client/server function. • Supports VNC server function (for clients other than a PC, only monitor screen display is supported). • Supports BOOTP function. • 1000BASE-T/100BASE-TX/10BASE-T 			

Main Specifications

	XG-X2700	XG-X2500	XG-X2200	XG-X2000
Interface (continued)	<ul style="list-style-type: none"> By the connection of KEYENCE PC application software, in addition to numerical value output and control input/output, uploading and downloading of program settings, simulations, sending/receiving of various data, including image data, and remote desktop are possible. USB2.0 			
CC-Link	<ul style="list-style-type: none"> By connecting the optional CC-Link unit CA-NCL20E, numerical value output and control input/output are possible. (Cannot be used in conjunction with PLC Link, EtherNet/IP, PROFINET and EtherCAT.) Compatible to the Ver.1.10 remote device station, Ver.2.00 remote device station 			
EtherNet/IP	<ul style="list-style-type: none"> Numerical value output, and control input/output by using the Ethernet port are possible. (Cannot be used in conjunction with PLC Link, CC-Link, PROFINET and EtherCAT.) Supports cyclic communication (max. 1436 byte), and message communication Maximum number of connections 32 Compliant with the conformance test Version.CT12 			
PROFINET	<ul style="list-style-type: none"> Numerical value output, and control input/output by using the Ethernet port are possible. (Cannot be used in conjunction with PLC Link, CC-Link, EtherNet/IP and EtherCAT.) Supports cyclic communication (max. 1408 byte) Supports aperiodic (recorded data) communication Compliant with the Conformance Class A 			
EtherCAT	<ul style="list-style-type: none"> By connecting the optional CA-NEC20E EtherCAT unit, numerical value output and control input/output are possible (Cannot be used in conjunction with PLC link, CC-Link, Ethernet/IP, and PROFINET) Supports cyclic communication (process data object communications) (Input: max. 536 byte; Output: max. 532 byte) Supports non-cyclic communication (mailbox communications) Supports CoE Explicit Device Identification Compliant with the conformance test V2.1.0.2 			
SNTP	By connecting to an SNTP server, you can automatically calibrate the date and time for the controller			
USB Console	<ul style="list-style-type: none"> By the optional USB handheld controller (OP-87983), various menu can be operated Supports operation assignment settings to the handheld controller buttons 			
Mouse	Possible to control various menus via an optional dedicated mouse (OP-87506)			
Touch Panel	<ul style="list-style-type: none"> Setting operation from the CA Series touch panel used by the RS-232C port is possible (When RS-232C is used, the nonprocedural communication and PLC-Links that use the RS-232C port cannot be used.) Supports the dedicated touch menu and the operation buttons 			
USB HDD	By connecting a HDD (maximum 2 TB) to the dedicated USB port (USB 3.0 compliant and bus powered compatible: rated output 900 mA), various kinds of data including image data can be output			
Display language	Japanese/English/Simplified Chinese/Traditional Chinese/German selectable (Choose the default language to be used when the controller is started up for the very first time)			
Illumination control	By connecting the optional illumination expansion unit CA-DC40E/DC50E/DC60E, the lighting and light intensity of the LED illumination can be controlled.*3			
Cooling fan	Cooling fan unit CA-F100 is standard equipment	None		
Rating	Power source voltage	DC24V±10%		
	Consumption current	4.3A	4.1A	4.0A
Environmental resistance	Ambient operating temperature	0 to 45°C (DIN rail mounted)/0 to 40°C (Bottom mounted)		
	Ambient operating humidity	35 to 85% RH (no condensation)		
Weight	Approx. 1800 g	Approx. 1600 g		

*1 Either positive common connecting which is compatible with NPN input instruments, or negative common connecting which is compatible with PNP input instruments is feasible.

*2 Models equipped with the Ethernet port in the CPU unit also support Ethernet port direct connection.

*3 Connect up to 8 illumination expansion units (note that the eight units can include only a maximum of two CA-DC50E units and two CA-DC60E units).

XG-X2900/X2800/X2800LJ

Model type	XG-X2900	XG-X2800	XG-X2800LJ
Camera input*1	<ul style="list-style-type: none"> With area camera input unit CA-E100 connected 2 color/monochrome cameras per one CA-E100, up to 4 cameras via a maximum of 2 units can be connected With line scan camera input unit CA-E100L connected 2 line scan cameras per one CA-E100L, or 2 color/monochrome cameras, up to 4 cameras via a maximum of 2 units can be connected With high-speed line scan camera input unit CA-E200L connected Up to 2 high-speed line scan cameras can be connected per one unit of CA-E200L, and up to 4 cameras can be connected when 2 units of CA-E200L are used. With 3D camera input unit CA-E100T connected 1 3D camera per one CA-E100T, up to 2 cameras via a maximum of 2 units can be connected With LJ-V input unit CA-E100LJ/E110LJ connected 2 identical models of the LJ-V series heads per one CA-E100LJ/E110LJ, up to 4 heads via a maximum of 2 units can be connected 		<ul style="list-style-type: none"> With LJ-V input unit CA-E100LJ connected Up to 2 identical models of the LJ-V series heads per one CA-E100LJ can be connected
Trigger input	Selection is possible between simultaneous capture by up to 4 cameras and individual capture (simultaneous capture by up to 2 cameras is possible when one camera input unit is connected).		Simultaneous capture by up to 2 heads is possible
Supported cameras / Number of pixels	<ul style="list-style-type: none"> With XG-035C/S035C/H035C/035M/S035M/H035M connected 310 k pixel mode: 640(H) x 480(V), approx. 310,000 pixels 240 k pixel mode: 512(H) x 480(V), approx. 240,000 pixels With CA-HX048C/HX048M connected 470 k pixel mode: 784(H) x 596(V), approx. 470,000 pixels 310 k pixel mode: 640(H) x 480(V), approx. 310,000 pixels 240 k pixel mode: 512(H) x 480(V), approx. 240,000 pixels With XG-200C/S200C/H200C/200M/S200M/H200M connected 2 mega-pixel mode: 1600(H) x 1200(V), approx. 1.92 mega-pixels 1 mega-pixel mode: 1024(H) x 960(V), approx. 980,000 pixels With CA-HX200C/HX200M connected 2 mega-pixel mode: 1600(H) x 1200(V), approx. 1.92 mega-pixels With XG-H500C/H500M connected 5 mega-pixel mode: 2432(H) x 2050(V), approx. 4.99 mega-pixels With CA-HX500C/HX500M connected 5 mega-pixel mode: 2432(H) x 2040(V), approx. 4.96 mega-pixels 2 mega-pixel mode: 1600(H) x 1200(V), approx. 1.92 mega-pixels With CA-H2100C/H2100M connected 21 mega-pixel mode: 5104(H)x4092(V), approx. 20.89 mega-pixels 5 mega-pixel mode: 2432(H)x2050(V), approx. 4.99 mega-pixels 		
Line scan camera	<ul style="list-style-type: none"> With XG-HL08M connected 8192(H) x 8192(L), approx. 67.11 mega-pixels With XG-HL04M connected 4096(H) x 16384(L), approx. 67.11 mega-pixels With XG-HL02M connected 2048(H) x 16384(L), approx. 33.55 mega-pixels 		
High-speed line camera	<ul style="list-style-type: none"> With CA-HL08MX connected 8192(H) x 8192(L), approx. 67.11 mega-pixels With CA-HL04MX connected 4096(H) x 16384(L), approx. 67.11 mega-pixels With CA-HL02MX connected 2048(H) x 16384(L), approx. 33.55 mega-pixels 		
3D Camera	<ul style="list-style-type: none"> With XR-HT40M connected 2048(H) x 2048(V), approx. 4.19 mega-pixels With XR-HT15M connected 1408(H) x 1408(V), approx. 1.98 mega-pixels 		
LJ-V Series Sensor Head*2	<ul style="list-style-type: none"> With LJ-V7020/7020K/7060/7060K/7080/7200/7300 connected 512(H) x 16384(L), approx. 8.39 mega-pixels 1024(H) x 8192(L), approx. 8.39 mega-pixels 2048(H) x 4096(L), approx. 8.39 mega-pixels 		
Main image processor	DSP (High-speed)		
Number of program setting registrations	SD cards 1 and 2 can each hold 1000 programs (depending on the size of the SD card and the size of the programs), external switching possible		
Number of registered screens	Maximum of 1000 screens per camera for each program (depending on SD card size), Image compression function, position adjusted image registration and partial image registration supported, external switching via variable referencing possible.		
SD card	<ul style="list-style-type: none"> SD card slot x 2 Compatible with OP-87133 (512MB), CA-SD1G (1GB), CA-SD4G (4GB: installed standard to SD1) and CA-SD16G (16GB) 	<ul style="list-style-type: none"> SD card slot x 2 Compatible with OP-87133 (512MB), CA-SD1G (1GB: installed standard to SD1), CA-SD4G (4GB) and CA-SD16G (16GB) 	

Main Specifications

Appendix

Model type	XG-X2900	XG-X2800	XG-X2800LJ
Number of Saved Archived Images	The number of images that can be archived in the controller's image memory is listed below		
Area Camera	<ul style="list-style-type: none"> Maximum 29005 images (monochrome camera in 240,000 pixel mode) Maximum 23241 images (monochrome camera in 310,000 pixel mode) Maximum 15306 images (monochrome camera in 470,000 pixel mode) Maximum 3732 images (monochrome camera in 2,000,000 pixel mode) Maximum 1421 images (monochrome camera in 5,000,000 pixel mode) Maximum 307 images (monochrome camera in 21,000,000 pixel mode) Maximum 28297 images (color camera in 240,000 pixel mode) Maximum 22744 images (color camera in 310,000 pixel mode) Maximum 15043 images (color camera in 470,000 pixel mode) Maximum 3675 images (color camera in 2,000,000 pixel mode) Maximum 1386 images (color camera in 5,000,000 pixel mode) Maximum 292 images (color camera in 21,000,000 pixel mode) 	<ul style="list-style-type: none"> Maximum 12757 images (monochrome camera in 240,000 pixel mode) Maximum 10221 images (monochrome camera in 310,000 pixel mode) Maximum 6730 images (monochrome camera in 470,000 pixel mode) Maximum 1638 images (monochrome camera in 2,000,000 pixel mode) Maximum 613 images (monochrome camera in 5,000,000 pixel mode) Maximum 122 images (monochrome camera in 21,000,000 pixel mode) Maximum 12441 images (color camera in 240,000 pixel mode) Maximum 9998 images (color camera in 310,000 pixel mode) Maximum 6609 images (color camera in 470,000 pixel mode) Maximum 1598 images (color camera in 2,000,000 pixel mode) Maximum 583 images (color camera in 5,000,000 pixel mode) Maximum 110 images (color camera in 21,000,000 pixel mode) 	
Line Scan Camera	<ul style="list-style-type: none"> Maximum 185 images (CA-HL02MX Continuous, 2048×16384 pixels) Maximum 387 images (CA-HL02MX/XG-HL02M Continuous, 2048×8192 pixels) Maximum 185 images (CA-HL02MX/XG-HL02M Fixed Length, 2048×16384 pixels) Maximum 88 images (CA-HL04MX Continuous, 4096×16384 pixels) Maximum 182 images (CA-HL04MX/XG-HL04M Continuous, 4096×8192 pixels) Maximum 88 images (CA-HL04MX/XG-HL04M Fixed Length, 4096×16384 pixels) Maximum 85 images (CA-HL08MX/XG-HL08M Continuous, 8192×8192 pixels) Maximum 88 images (CA-HL08MX/XG-HL08M Fixed Length, 8192×8192 pixels) 	<ul style="list-style-type: none"> Maximum 71 images (CA-HL02MX Continuous, 2048×16384 pixels) Maximum 151 images (CA-HL02MX/XG-HL02M Continuous, 2048×8192 pixels) Maximum 71 images (CA-HL02MX/XG-HL02M Fixed Length, 2048×16384 pixels) Maximum 31 images (CA-HL04MX Continuous, 4096×16384 pixels) Maximum 68 images (CA-HL04MX/XG-HL04M Continuous, 4096×8192 pixels) Maximum 31 images (CA-HL04MX/XG-HL04M Fixed Length, 4096×16384 pixels) Maximum 28 images (CA-HL08MX/XG-HL08M Continuous, 8192×8192 pixels) Maximum 31 images (CA-HL08MX/XG-HL08M Fixed Length, 8192×8192 pixels) 	
3D Camera	<ul style="list-style-type: none"> Maximum 1170 images (XR15mm type: save as Height Image, Grayscale Image) Maximum 4729 images (XR15mm type Binning ON: save as Height Image, Grayscale Image) Maximum 540 images (XR40mm type: save as Height Image, Grayscale Image) Maximum 2231 images (XR40mm type Binning ON: save as Height Image, Grayscale Image) 	<ul style="list-style-type: none"> Maximum 494 images (XR15mm type: save as Height Image, Grayscale Image) Maximum 2028 images (XR15mm type Binning ON: save as Height Image, Grayscale Image) Maximum 220 images (XR40mm type: save as Height Image, Grayscale Image) Maximum 953 images (XR40mm type Binning ON: save as Height Image, Grayscale Image) 	
LJ-V Series Sensor Head* ²	<ul style="list-style-type: none"> Maximum 390 images (2048×4096 common for Continuous and Fixed Length) Maximum 390 images (1024×8192 common for Continuous and Fixed Length) Maximum 390 images (512×16384 common for Continuous and Fixed Length) 	<ul style="list-style-type: none"> Maximum 150 images (2048×4096 common for Continuous and Fixed Length) Maximum 150 images (1024×8192 common for Continuous and Fixed Length) Maximum 150 images (512×16384 common for Continuous and Fixed Length) 	

Model type	XG-X2900	XG-X2800	XG-X2800LJ
Interface	<p>Controlled input (compatible with arbitrary assignment)</p> <ul style="list-style-type: none"> • 20 inputs (including four high speed input terminals that can be allocated for trigger input) • Input rating 26.4 V or lower, 2 mA or greater (3 mA or greater for high speed input terminal) 		
	<p>Controlled output (compatible with arbitrary assignment)</p> <ul style="list-style-type: none"> • 28 outputs (including four high speed output terminals that can be allocated for FLASH outputting linked to external trigger) • Photo MOSFET ³ Maximum 50 mA (30 V or less) 		
Encoder input	<ul style="list-style-type: none"> • When connecting CA-E100L/E200L, 2 systems per 1 unit, up to 4 systems via a maximum of 2 units • When connecting CA-E100LJ/E110LJ, 1 system per 1 unit, up to 2 systems via a maximum of 2 units (up to 1 system via a maximum of 1 unit for XG-X2800LJ) • RS-422 line driver output (5 V output supplied: maximum 150 mA, multi-drop compatible in the case of the CA-E100L/E200L), combined with open collector output (CA-E100L/E200L is for 24 V compatible components) 		
Monitor output	Analog RGB Output, XGA (1024 x 768, 24 bit color)		
Operation indicators	LED display for Power ON and ERROR		
RS-232C	<ul style="list-style-type: none"> • Can be switched to be used for performing numerical value output and control input/output, or be used for the CA series touch panel interface function (Cannot be used in conjunction with PLC-Links using the RS-232C port) • Supports a max. baud rate of up to 230400 bps 		
PLC link	<ul style="list-style-type: none"> • Can output numerical values and perform control input/output using the Ethernet or RS-232C port (Cannot be used in conjunction with CC-Link, EtherNet/IP, PROFINET and EtherCAT.) • The following PLCs are supported via link unit:⁴ <ul style="list-style-type: none"> - KEYENCE: KV-7000 Series, KV-5000/3000 Series, KV-1000/700 Series, KV Nano Series - Mitsubishi Electric: MELSEC iQ-R/L/Q Series, MELSEC A Series (RS-232C only), MELSEC iQ-F Series, MELSEC FX Series (RS-232C only) - OMRON: SYSMAC CJ2/CJ1/CS1 Series, SYSMAC C Series (RS-232C only), SYSMAC CP1 Series - YASKAWA Electric Corporation: MP2000 Series, MP900 Series (RS-232C only) 		
Ethernet	<ul style="list-style-type: none"> • Numerical value output, and control input/output enabled. • By the connection of KEYENCE PC application software, in addition to the function described above, uploading and downloading of program settings, simulations, sending/receiving of various data, including image data, and remote desktop are possible. • Supports the FTP client/server function, the VNC server function (for clients other than a PC, only monitor screen display is supported), and BOOTP function. • 1000BASE-T/100BASE-TX/10BASE-T 		
USB	<ul style="list-style-type: none"> • By the connection of KEYENCE PC application software, in addition to numerical value output and control input/output, uploading and downloading of program settings, simulations, sending/receiving of various data, including image data, and remote desktop are possible. • USB2.0 		
CC-Link	<ul style="list-style-type: none"> • By connecting the optional CC-Link unit CA-NCL20E, numerical value output and control input/output are possible. (Cannot be used in conjunction with PLC Link, EtherNet/IP, PROFINET and EtherCAT.) • Compatible to the Ver.1.10 remote device station, Ver.2.00 remote device station 		
EtherNet/IP	<ul style="list-style-type: none"> • Numerical value output, and control input/output by using the Ethernet port are possible. (Cannot be used in conjunction with PLC Link, CC-Link, PROFINET and EtherCAT.) • Supports cyclic communication (max.1436 byte), and message communication • Maximum number of connections 32 • Compliant with the conformance test Version.CT12 		
PROFINET	<ul style="list-style-type: none"> • Numerical value output, and control input/output by using the Ethernet port are possible. (Cannot be used in conjunction with PLC Link, CC-Link, EtherNet/IP and EtherCAT.) • Supports cyclic communication (max. 1408 byte) • Supports aperiodic (recorded data) communication • Compliant with the Conformance Class A 		

Main Specifications

Model type	XG-X2900	XG-X2800	XG-X2800LJ
Interface (continued)	<p>EtherCAT</p> <ul style="list-style-type: none"> By connecting the optional CA-NEC20E EtherCAT unit, numerical value output and control input/output are possible (Cannot be used in conjunction with PLC link, CC-Link, Ethernet/IP, and PROFINET) Supports cyclic communication (process data object communications) (Input: max. 536 byte; Output: max. 532 byte) Supports non-cyclic communication (mailbox communications) Supports CoE Explicit Device Identification Compliant with the conformance test V2.1.0.2 		
SNTP	By connecting to an SNTP server, you can automatically calibrate the date and time for the controller		
USB Console	<ul style="list-style-type: none"> By the optional USB handheld controller (OP-87983), various menu can be operated Supports operation assignment settings to the handheld controller buttons 		
Mouse	Possible to control various menus via an optional dedicated mouse (OP-87506)		
Touch Panel	<ul style="list-style-type: none"> Setting operation from the CA Series touch panel used by the RS-232C port is possible (When RS-232C is used, the nonprocedural communication and PLC-Links that use the RS-232C port cannot be used.) Supports the dedicated touch menu and the operation buttons 		
USB HDD	By connecting a HDD (maximum 2 TB) to the dedicated USB port (USB 3.0 compliant and bus powered compatible: rated output 900 mA), various kinds of data including image data can be output		
Display language	Japanese/English/Simplified Chinese/Traditional Chinese/German selectable (Choose the default language to be used when the controller is started up for the very first time)		
Illumination control	By connecting the optional illumination expansion unit CA-DC40E/DC50E/DC60E, the lighting and light intensity of the LED illumination can be controlled.*5	-	
Cooling fan	Cooling fan unit CA-F100 is standard equipment		
Rating	Power source voltage	DC24V±10%	
	Consumption current	5.3 A	3.1 A
Environmental resistance	Ambient operating temperature	0 to +45°C (DIN rail mounted)/0 to +40°C (Bottom mounted)	
	Ambient operating humidity	35 to 85% RH (no condensation)	
Weight	Approx. 1750 g		

*1 Since the controller unit does not support camera inputs, at least 1 camera input unit (optional) or more is required.

*2 LJ-V Series heads whose models end in "B" are luminance output types. To connect a luminance output type head, the XG-X2800/X2900 and the CA-E110LJ are required.

*3 Either positive common connecting which is compatible with NPN input instruments, or negative common connecting which is compatible with PNP input instruments is feasible.

*4 Models equipped with the Ethernet port in the CPU unit support Ethernet port direct connection.

*5 Connect up to 8 illumination expansion units (note that the eight units can include only a maximum of two CA-DC50E units and two CA-DC60E units).

Appendix

XG-X VisionEditor Specifications

Runtime Environment	Supported Operating Systems	<ul style="list-style-type: none"> Microsoft Windows 10 Home, Pro, Enterprise (64bit version only) Microsoft Windows 7 Home Premium, Professional, Ultimate, Enterprise (64bit version only) Cannot be used with an OS that is not listed above
	Runtime Environment	<ul style="list-style-type: none"> CPU: Intel® Core™ i3 processor equivalent or higher RAM: 8 GB or more HDD: 8 GB or more available space. <ul style="list-style-type: none"> * Additional available space is required for storing images. Monitor: 1024 x 768 pixels or more (1280 x 1024 pixels or more recommended). USB port: USB port must be 2.0 compatible for USB connection. An Internet connection is required to connect to the HP to apply for activation, and a valid e-mail address is required to receive the activation code.
Activation Function		After installation, users need to apply for an activation code using the user ID displayed at the initial startup of the software and the serial number indicated on the installation DVD.
Included Software	XG-X VisionTerminal	<ul style="list-style-type: none"> XG-X VisionTerminal is included as a dedicated PC application software (License free). When the controller is connected to the PC via Ethernet or USB, this software allows operation of the remote desktop function, saving the result/image output files, saving image archive output files, and acquiring files in the controller.
	Special USB driver	Used to connect the XG-X VisionEditor or XG-X VisionTerminal to the controller via USB (License free).

Troubleshooting

Symptom	Cause	Corrective Action
The controller does not power-up.	The power cable is not connected properly.	Connect the power cable properly.
The monitor screen is blank.	The power used is outside of the specified range.	Supply power within the specified range.
	The monitor cable is not connected.	Connect the monitor cable properly.
	A signal is not being received from the controller.	Turn on the controller.
	The monitor is not adjusted properly.	Adjust the brightness and the color of the monitor.
Only camera images are blank/abnormal (fuzzy, blurry, out of focus, blank).	The lens focus or aperture is not adjusted.	Adjust the focus or the aperture of the lens.
	The shutter speed is not correct for the speed of the target.	Set the shutter speed properly.
	The lens or part of the CCD is dirty.	Clean with an air duster. Do not use anything that will scratch or chemically damage the CCD.
	The camera cable is not connected properly.	<ul style="list-style-type: none"> Turn off the controller, and then connect the camera cable. Make sure to use the proper camera cable for the controller / camera being used.
	The lens cap is on.	Remove the lens cap.
	The lens aperture is closed too far.	Adjust the aperture to allow more light into the camera.
	The camera cable has contact failure.	Check if the lock ring on the cable connector is properly tightened, if the cable is under stress, or there are no other problems (kinks, breaks etc) with the camera cable.
Cannot operate the handheld controller or mouse.	The handheld controller or mouse is not connected properly.	Connect the handheld controller or mouse properly.
The touch panel (CA-MP120T) does not work.	The touch panel is not connected properly.	In addition to the monitor cable, also check that the touch panel modular RS-232C cable (OP-87258 or OP-87259) is connected correctly and that [CA Series Touch Panel] is selected for the port function in the external input/output RS-232C in the system settings.
Communication failure.	The communication cable is not connected properly.	Check the cable type and connect the communication cable correctly.
	The proper communication cable is not being used.	Check the cable type and connect the communication cable correctly.
	The communication settings on the Controller / PLC / PC are not configured properly.	Change the communication settings (IP address, network settings, baud rate etc) of the controller / PLC / PC.
	A voltage potential difference exists between the SG (signal - ground) on the controller and the other device being communicated with.	If a different power supply unit is being used for the controller and the other device, check that the frame ground on both units is grounded properly.
Results and measured values are not being output.	The output circuit is not connected properly.	<ul style="list-style-type: none"> Connect the output circuit properly referring to the output circuit diagram. Use the I/O Monitor & Diagnostics feature (Page 5-23) to check the signal terminal assignments and I/O status.
	The controller is not in RUN mode.	Switch the controller to RUN mode either through the Function menu or with the slide switch on the handheld controller.
	The TEST terminal is ON.	<ul style="list-style-type: none"> Turn OFF the %Test terminal. Use the I/O Monitor & Diagnostics feature (Page 5-23) to check the signal terminal assignments and I/O status.
Trigger inputs not recognized.	The trigger input signal is not connected properly.	<ul style="list-style-type: none"> Connect the input circuit properly referring to the circuit diagram. Use the I/O Monitor & Diagnostics feature (Page 5-23) to check the signal terminal assignments and I/O status.
	The EXT terminal is ON.	<ul style="list-style-type: none"> Turn OFF the %Ext terminal. Use the I/O Monitor & Diagnostics feature (Page 5-23) to check the signal terminal assignments and I/O status.

Troubleshooting

Symptom	Cause	Corrective Action
The screen is not being updated.	The image display is set to show image archive or registered images.	Choose a screen that has an image display set for showing camera images.
Screen updates and the handheld controller operations show slow response.	XG-X VisionEditor or XG-X VisionTerminal are connected and using the remote connection function.	This is normal behavior as the screen display is transmitted to the PC Programs. As separate processors are used for inspections and the control of the screen so processing performance is not affected.
Inspections are being performed but the display results are not updating.	The focus is on an image display showing images from the image archive.	Move the focus to an image display set for showing camera images.
The desired items do not appear on the function menu.	The system settings file is an older version.	Select [System Information] (Page 6-45) in the [Global] menu, and make sure the systems settings are the latest version by checking the [Version Information] section.
"Image Capture Buffer Overflow" is displayed at the bottom right of the screen when using a line scan camera; and missing images will occur.	The image processing takes longer than the image capture.	Create a margin for the capture (by decreasing the line cycle or number of overlap lines, or by increasing the number of lines) or shorten the processing time.

Error Messages

Errors that occur within the controller can either be hardware-related (camera connection errors, etc.), or software-related (illegal settings, etc.). When an error occurs at the controller, the error is detected when the system variable %Error0 (or %Error1) is turned ON (1).

This section explains the errors, causes and corrective actions associated with each system variable.

Reference The assigned relationship between each error and the system variable can be changed in the settings. As necessary, it is also possible to output the error cause No. as %Error0Code or %Error1Code. For more details, refer to "Controller System Settings" in the XG-X VisionEditor Reference Manual.

Error Messages Assigned to System Variable %Error0.

The error messages below are assigned to %Error0 by default.

The errors assigned to %Error0 can be removed or switched to %Error1 as desired.

Error Message	Cause	Corrective Action	Error Code
Program settings are referring to an unconnected camera.	The camera connected does not match the camera specified in the camera settings for the program. (Example: a 2-megapixel camera is connected when the settings refer to a 320,000-pixel camera.)	Confirm the camera type connected matches the settings.	
	The capture unit specifies a camera that is not connected. (Example: no camera is connected on port 2 but Camera2 is specified in capture unit U0001.)	Turn off the controller and connect the specified camera.	
Image capture stopped, invalid camera setting. A trigger has multiple lines.	There is an error in the Capture unit camera settings. Multiple line Nos. are included in the same trigger.	In the Capture unit camera settings, be sure that [No. Lines] of the line scan cameras or LJ-V series head assigned to the same trigger are the same. Or, assign the other camera which is assigned to the same trigger to a different trigger.	
Image capture stopped, invalid camera setting. A trigger has multiple capture functions.	There is an error in the Capture unit camera settings. A sheet-fed and continuous capture line scan camera or LJ-V series head are assigned to the same trigger.	In the Capture unit camera settings, be sure the line scan camera or LJ-V series head capture methods assigned to the same trigger are the same. Or, assign the other camera which is assigned to the same trigger to a different trigger.	16
Image capture stopped, invalid camera setting. A trigger is assigned for both a linescan (continuous) and an area camera.	There is an error in the Capture unit camera settings. A line scan camera (continuous capture) and area camera are assigned to the same trigger.	In the Capture unit camera settings, change the capture methods of the line scan camera or LJ-V series head that is assigned to the same trigger as the area camera to sheet-fed. Or, assign the other camera which is assigned to the same trigger to a different trigger.	
Image capture stopped, invalid camera setting. Set the image capture buffer to a minimum of 3 images and overwriting.	Continuous capture with a line scan camera or LJ-V series head has been selected, however the image capture buffer settings are not correct.	When continuous capture is used with a line scan camera or LJ-V series head, set [Image Capture Buffer Settings] to ON, change the mode to [Overwriting], and set the buffer count to 3 or more.	
A trigger has mixed "Allow Trigger Input During Line Capture" settings.	Settings that allow trigger input during line capture exist in the same trigger.	In [Line Camera Settings] of the capture unit, disable one of the settings assigned to the same trigger. Or, assign the other camera assigned to the same trigger to a different trigger.	

Error Message	Cause	Corrective Action	Error Code
There is a mix of internal trigger and "Allow Trigger Input During Line Capture" setting.	Settings that allow trigger input during line capture exist in the internal trigger.	In [Line Camera Settings] of the capture unit, disable the settings that allow trigger input during line capture. Or change the trigger mode to [External Trigger] in [Trigger Settings].	
"Allow Trigger Input During Line Capture" and "End capture by EXT signal" cannot be enabled simultaneously.	[Allow Trigger Input During Line Capture] and [End Capture By EXT Signal] are both enabled at the same time.	Disable either [Allow Trigger Input During Line Capture] or [End Capture By EXT Signal].	
Image capture stopped, invalid camera setting. A trigger signal that cannot be used is assigned.	Trigger signals on the even-number side of the camera input unit to which the LJ-V Series head is connected cannot be used.	Change to a trigger signal that can be used.	
Image capture stopped, invalid camera setting. An LJ-V camera (Continuous) and an area camera are both assigned to the same trigger.	An error exists in the camera settings of the capture unit. An LJ-V Series head (Continuous Capture) and an area camera are assigned to the same trigger.	In [Camera Settings] of the capture unit, set the capture method of the LJ-V Series head assigned to the same trigger as the area camera to [Fixed Capture]. Or, assign the other camera assigned to the same trigger to a different trigger.	
The following item does not match the Camera Settings. - LJ-V head	The type of LJ-V Series heads specified in [Camera Settings] of the program is different from the type of heads connected.	Check the model of the connected LJ-VSeries head.	
The following item does not match the Camera Settings. - LJ-V head luminance output type	The type of LJ-V Series heads specified in [Camera Settings] of the program is different from the type of heads connected.	Check the model of the connected LJ-VSeries head.	
The following item does not match the Camera Settings. - Number of LJ-V heads	The number of LJ-V Series heads specified in [Camera Settings] of the program is different from the number of heads connected.	Check the number of connected LJ-VSeries heads.	
The following error occurred. - An unrecognizable LJ-V head is connected.	The connected LJ-V Series head does not support the controller.	Check the model of the connected LJ-VSeries head.	
The following error occurred. - The connected LJ-V head cannot be used in the CA-E100LJ.	A head supporting luminance output is connected to CA-E100LJ.	Check the model of the connected LJ-VSeries head.	
The following error occurred. - There is no LJ-V head connected.	The LJ-V Series head is not connected to the camera input unit.	Connect the LJ-V Series head to the camera input unit.	
The following error occurred. - Please connect the LJ-V head to the Head A connector.	The LJ-V Series head is not connected to the Head A connector.	Connect the LJ-V Series head to the Head A connector.	
The following error occurred. - Several differing LJ-V heads are connected	Different LJ-V Series heads are connected to Head A and Head B.	Connect the same LJ-V Series heads to Head A and Head B.	
The following error occurred. - An abnormality occurred inside the LJ-V unit.	The LJ-V Series head is damaged.	Contact your local KEYENCE office.	
The following error occurred. - The CA-E110LJ cannot be used in the XG-X2800LJ.	CA-E110LJ is connected to the XG-X2800LJ controller.	Check the connected camera input unit.	

Error Message	Cause	Corrective Action	Error Code
Camera (1 to 4) has been disconnected. Turn off the controller and check the camera connection.	An error occurred in the connection with the camera.	<ul style="list-style-type: none"> • Make sure that the camera was not removed after the controller was turned on. • Make sure the camera is properly connected. • Make sure the camera cable is not disconnected. 	17
	The camera is being used beyond its rating. (Example: the ambient temperature of the camera is beyond the specification, a non-supported camera cable is being used, or the length of the camera cable is beyond the specification.)	<ul style="list-style-type: none"> • Check the ambient temperature. • Use a camera cable that supports the camera. • If the number of channels used for the CA-HL*MX is two or more, the maximum length of the camera cable will decrease. In such cases, check the maximum camera cable length that can be used. 	
The camera is not supported. Turn off the controller and check the camera model.	The controller does not support the connected camera. (Example: an XG-200C cannot be used with the XG-X2000 controller.)	Confirm the model of the connected camera.	
Camera input unit firmware is not the latest version. Turn off the controller and upgrade the firmware.	The firmware of the connected camera input unit is obsolete.	Turn off the controller and update the controller firmware with the camera input unit inserted.	18
Camera firmware is not the latest version. Turn off the controller and upgrade the firmware.	The firmware of the connected camera is obsolete.	Turn off the controller and update the controller firmware with the camera connected.	
Timeout error has occurred while waiting for encoder input.	Encoder input timeout was detected.	<ul style="list-style-type: none"> • Check the encoder connection. • Change the [Detect Timeout] time for encoder input in the Capture unit trigger settings. 	21
Camera n has been disconnected. Turn off the controller and check the camera connection. *n: Camera No. (1 to 4)	Failed to initialize the communication with the camera.	<ul style="list-style-type: none"> • Turn off the controller and check the connection of the camera input unit. • If the problem cannot be resolved, the expansion unit may be damaged. Contact your local KEYENCE office. 	24
The attitude of the camera has changed since the time of registration. Check the attitude of the camera.	The camera is tilted beyond the allowable angle difference from the registered camera tilt angle.	Register the current tilt angle or tilt the camera to get close to the angle value (registered value).	25
Unable to load previously selected program.	The program file that corresponds to the program specified in the startup settings under system settings does not exist. The last saved program that corresponds to the program (or the program selected from the handheld controller) does not exist. The program file for the specified program could not be found when changing or reloading programs.	<ul style="list-style-type: none"> • Before powering up the controller, make sure the program file that corresponds to this program number exists on the SD card. • Change the program number to a working program. 	32
		Change the program number to a working program.	
Program memory or image memory is full.	Program memory or image memory is full. The program being loaded exceeds the available program memory or image memory.	<ul style="list-style-type: none"> • Change the program to a different working program. • Correct the program in XG-X VisionEditor so it does not exceed the available program or image memory. 	33

Error Messages

Error Message	Cause	Corrective Action	Error Code	
Incorrect program version.	The program loaded at startup is an incompatible version.	<ul style="list-style-type: none"> Change the program to a different working program. Use XG-X VisionEditor to create a compatible version of the program. 	34	
	The program being loaded is an incompatible version.			
Unable to load program due to checksum errors.	The program loaded at startup has a checksum error.	<ul style="list-style-type: none"> Change the program to a different working program. Use XG-X VisionEditor to recreate the program. 	35	
	The program being loaded has a checksum error.			
Unable to load program due to damaged file.	The program loaded at startup is damaged.	<ul style="list-style-type: none"> Change the program to a different working program. Use XG-X VisionEditor to recreate the program. 	36	
	The program being loaded is damaged.			
Image variable name "&Cam(N)Img" is reserved and cannot be used. Please rename with XG-X VisionEditor.	The program file contains a user image variable that is reserved as a system image variable.	Download the program file with XG-X VisionEditor and change the image variable name.	37	
Unable to load system settings.	The system settings file used at startup cannot be found on SD Card 1.	Before powering up the controller, make sure the system settings file exists on the SD card.	40	
	The system settings loaded at startup is from an incompatible version.	<ul style="list-style-type: none"> Use a different system settings file. Use XG-X VisionEditor to create a compatible version of the system settings file. 		
	The system settings file has a checksum error.			
	The system settings file loaded at startup is damaged.			
Unable to load global variables.	Could not find the global variables file.	Make sure the global variables file exists on the SD card.	41	
	The global variables file exceeds the available resource memory.	<ul style="list-style-type: none"> Use a different global variables file. Change the global variables in XG-X VisionEditor so they do not exceed the available resource memory. 		
	The global variables file is from an incompatible version.	<ul style="list-style-type: none"> Use a different global variables file. Use XG-X VisionEditor to create a compatible version of the global variables file. 		
	The global variables file has a checksum error.	<ul style="list-style-type: none"> Use a different global variables file. Use XG-X VisionEditor to recreate the global variables file. 		
	The global variables file is damaged.			
Failed to load the specified recipe setting file.	The recipe setting does not exist or is corrupt.	Replace it with a valid recipe settings file.	43	
A unit error has occurred.	An error occurred with a unit specified in the total error setting in the program (system variable %UnitError changed to 1).	Review the settings of the unit where the error has occurred.	48	
Please insert SD Card 1.	No SD card in SD card slot 1.	Properly insert an SD card into the SD1 slot.	64	
	An unsupported SD card is being used.	KEYENCE does not guarantee operation with commercially available (non-industrial rated) SD cards. Using those cards may cause data loss or setting data damage.		

Error Message	Cause	Corrective Action	Error Code
Failed to access SD Card 1.	A problem occurred while trying to access SD Card 1. SD Card 1 could be faulty.	<ul style="list-style-type: none"> Run the [Check] function of the memory utility that can be found in the [File Management] screen on SD Card 1. If the error persists, format the SD Card. (Note, this will erase all contents on SD Card 1.) If the problem cannot be resolved by any of these remedies, the SD card may be damaged. Contact your local KEYENCE office. 	65
	The controller could not recognize the format of SD Card 1.		
	An unsupported SD card is being used.	KEYENCE does not guarantee operation with commercially available (non-industrial rated) SD cards. Using those cards may cause data loss or setting data damage.	
	The destination file is set to read-only.	Disable the read-only setting on the destination file, or delete it.	
SD Card 1 is full.	There is not enough free space on SD Card 1.	Make space available by deleting or moving unnecessary files.	69
SD Card 1 is write-protected.	The write-protection switch on SD Card 1 is enabled.	Disable the write-protection switch on SD Card 1.	70
Cannot find SD Card 1. Please check SD Card 1 and do not remove while the controller is ON	SD Card 1 was removed while the power was ON.	Do not remove SD Card 1 while the power is ON. Removing an SD card while it is being accessed may damage the SD card and the data saved on it. To check the SD Card for errors and broken files run the [Check] function in the [View Files] menu.	71
Please insert SD Card 2.	No SD card in SD2 slot.	Properly insert an SD card into the SD2 slot.	80
	Run the [Stop SD2 Operation], then re-insert the SD card into the SD2 slot	If the SD card is already inserted, remove it first, and then insert it again.	
	An unsupported SD card is being used.	KEYENCE does not guarantee operation with commercially available (non-industrial rated) SD cards. Using those cards may cause data loss or setting data damage.	
Failed to access SD Card 2.	A problem occurred while trying to access SD Card 2. SD Card 2 could be faulty.	<ul style="list-style-type: none"> Run the [Check] function of the memory utility that can be found in the [File Management] screen on SD Card 2. If the error persists, format the SD Card. (Note, this will erase all contents on SD Card 2.) If the problem cannot be resolved by any of these remedies, the SD card may be damaged. Contact your local KEYENCE office. 	81
	The controller could not recognize the format of SD Card 2.		
	An unsupported SD card is being used.	KEYENCE does not guarantee operation with commercially available (non-industrial rated) SD cards. Using those cards may cause data loss or setting data damage.	
	The destination file is set to read-only.	Disable the read-only setting on the destination file, or delete it.	
SD Card 2 is full.	There is not enough free space on SD Card 2.	Make space available by deleting or moving unnecessary files.	85
SD Card 2 is write-protected.	The write-protection switch on SD Card 2 is enabled.	Disable the write-protection switch on SD Card 2.	86

Error Message	Cause	Corrective Action	Error Code
PC program communication has failed.	A communication error occurred in either the Ethernet or USB connection when outputting data to the PC program specified as the destination for a data output unit, image output unit, or as the output location for the image archive.	<ul style="list-style-type: none"> • Make sure the Ethernet cable or USB cable is connected to the controller and the PC. • Make sure there are no problems (kinks, breaks etc) with the Ethernet or USB cable. • Check the Ethernet cable type (cross, straight). • Check whether the PC at the other end of the connection is ready to transmit/receive data. • Check that the correct PC program is running on the PC and that the PC is connected to the controller. 	97
PLC-Link communication has failed.	An error occurred in the connection with the PLC when the [PLC-Link (RS-232C)] or [PLC-Link (Ethernet)] function was enabled.	<ul style="list-style-type: none"> • Check the connection with the PLC and the settings of the PLC. • If PLC link is not used, change communication mode to [Disable]. • If the error message displayed after a trigger input, check that the data memory destination specified is in the range that meets the PLC format. 	112
Ethernet cable is not connected.	An error occurred with the LAN cable when using Ethernet as the destination for a data output unit.	<ul style="list-style-type: none"> • Make sure the LAN cable is connected to the controller and the PC. • Make sure the LAN cable is not disconnected. • Check the LAN cable type (cross, straight). • Make sure the orange LED indicator (connection) of the Ethernet connector is lit. 	144
Ethernet communication has failed.	An error occurred in the Ethernet connection when using Ethernet as the destination for a data output unit.	<ul style="list-style-type: none"> • Check whether the PC / PLC at the other end of the connection is ready to transmit/receive data. • Check that the communication software for Ethernet is running on the PC / PLC and that the PC / PLC is connected with the controller. 	145
An Ethernet communication time out error has occurred.	Ethernet communication has been down for 10 or more seconds when using Ethernet as the destination for a data output unit.	<ul style="list-style-type: none"> • Check whether the PC / PLC at the other end of the connection is ready to transmit/receive data. • Check that the communication software for Ethernet is running on the PC / PLC and that the PC / PLC is connected with the controller. 	146
An RS-232C communication time out error has occurred.	RS-232C communication has been down for 60 or more seconds when using RS-232C as the destination for a data output unit.	<ul style="list-style-type: none"> • Make sure flow control is not set to [CTS/RTS] in the RS-232C settings. • Check whether the flow controlling is not doing controlling via hardware flows such as the PC/PLC. • Make sure the serial cable is not disconnected. 	162
CC-Link communication has failed.	An error has occurred while starting communication or during communication, and communication cannot be performed correctly.	<ul style="list-style-type: none"> • Check whether the CC-Link cable is connected correctly. • Check whether the terminating resistor is attached properly. • Make sure the cable complies with the specified standards. • Check whether the baud rate is set correctly according to the cable length specifications. • Make sure the settings on the master side have not been changed during the communication session. • Check whether the controller and master were restarted after updating the communication settings. 	177

Error Message	Cause	Corrective Action	Error Code
CC-Link module disconnected.	The CC-Link module is not recognized and the controller cannot use CC-Link communication.	<ul style="list-style-type: none"> • Make sure the CC-Link module is attached correctly. • Make sure the CC-Link module is not damaged. • Do not disconnect the CC-Link module while the controller and module are powered on. 	181
Illumination expansion module is disconnected. Please verify the connection or power source of illumination expansion unit.	The illumination expansion module specified is not recognized, connected or has no power supplied to it.	Make sure the illumination expansion module is attached correctly. Check whether the illumination expansion unit connection state and the power supply to the unit are properly working.	208
Illumination expansion module has been reset. Please check the illumination expansion controller connections.	The power to a known connected illumination expansion module has been cycled while the controller has remained on. Resulting in the resetting of the settings written to the illumination expansion module.	Check the power supply to the controller and the illumination expansion module. Make sure the illumination expansion module is attached correctly.	209
An error occurred in communicating with the illumination expansion unit. Please adjust the FLASH output time and FLASH ON-Delay.	<p>The next FLASH was input while the light emission is active (Communication with the controller cannot be established while the light emission is active).</p>	<ul style="list-style-type: none"> • Set the FLASH output time to 0.1 msec (The lighting time is linked with the camera shutter speed. However, the maximum lighting time is 100 msec). • If the FLASH on-delay is a positive value, make it close to 0. • Increase the trigger interval if the error persists after adjusting the FLASH output time and FLASH on-delay. 	215
The illumination expansion unit set in Illumination Expansion Unit Model Settings is not connected.	The connected illumination expansion unit does not match the illumination expansion unit specified in the Illumination Expansion Unit Model Settings of the capture unit.	Check the model of the connected illumination expansion unit and its settings.	216
	A non-connected illumination expansion unit is specified in the Illumination Expansion Unit Model Settings of the capture unit.	Turn off the controller and connect the specified illumination expansion unit.	
Overcurrent was detected in the connected light. Please check the connected light and power up again.	Excessive current flowed through the illumination expansion unit.	If errors continue to occur after restoring the power, the unit maybe damaged. Contact your local KEYENCE office.	218
The attitude of the light has changed since the time of registration. Check the attitude of the light.	The light is tilted beyond the allowable angle difference from the registered light tilt angle.	Register the current tilt angle or tilt the light to get close to the angle value (registered value).	219
The temperature of Illumination Expansion Unit n's Light m is high. Check the lighting settings and the ambient temperature. *n : Expansion Unit No. (1 to 8) m : Light No. (1 to 2)	As the load on the light is too great, the temperature rating was exceeded due to heat generation. Alternatively, the surrounding temperature is higher than the rating.	<ul style="list-style-type: none"> • Check the light intensity, shutter speed, and emission timing, and decrease the load on the light. • Make sure that the surrounding temperature does not exceed the rating. 	220
As the initialization of the light head was detected, resetting was performed.	As the settings written to the light head were initialized when the light head that could not be recognized was recognized again, the settings were written again.	Check that power is being supplied continuously and properly to the light head and that it is connected correctly.	221
The light head does not support LumiTrax.	A light head that does not support LumiTrax is set as the LumiTrax light.	Check the connected light head and the setting content.	222
The light head does not support MultiSpectrum Mode.	A light head that does not support MultiSpectrum Mode is set as the MultiSpectrum light.	Check the connected light head and the setting content.	

Error Messages

Error Message	Cause	Corrective Action	Error Code
Failed to connect to FTP server.	The FTP server is not operating.	Make sure the PC and FTP server on the NAS (network archived storage) device are configured and operating correctly.	224
	An error occurred in the LAN connection with the FTP server.	<ul style="list-style-type: none"> • Make sure the LAN cable is connected to the controller and the PC or the NAS device (network archived storage) running the FTP server. • Make sure there are no problems (kinks, breaks etc) with the LAN cable. • Check the LAN cable type (cross, straight). • Make sure the orange LED indicator (connection) of the Ethernet connector is lit. 	
	The IP address for the FTP server is incorrect.	Check the IP address settings of the controller and the NAS (network archived storage) device set in the FTP settings (Page 4-23).	
Failed to login to FTP server.	The user ID and/or password for logging in to the FTP server is incorrect.	Make sure the user ID and password specified in the FTP settings matches the same settings defined in the FTP server (Page 4-23).	225
FTP data output time out error has occurred.	The controller logged in and began writing a file but was unable to complete the process within the specified time.	<ul style="list-style-type: none"> • Check the connection between the controller and the NAS device (network archived storage) running the FTP server software. • Make sure the FTP server is operating correctly. 	226
Failed to create file / folder on FTP server.	The controller was able to log into the FTP server, but was not able to create a file.	<ul style="list-style-type: none"> • Make sure the user account has write privileges on the FTP server. • Check the available disk space on the NAS device (network archived storage) running the FTP server software. • Check the connection between the controller and the NAS device (network archived storage) running the FTP server software. • Make sure the FTP server is operating correctly. 	227
	Attempt to output the result data of the defect classification to an FTP server failed.	To output the result data of the defect classification, the FTP server must be compliant with the APPE command.	
VNC client acceptance has failed.	<p>A remote desktop is connected from XG-X VisionTerminal or ActiveX.</p> <p>VNC is connected from the touch panel display.</p> <p>The number of VNC clients connected from the PC has reached the upper limit (4).</p>	<ul style="list-style-type: none"> • Cancel the remote desktop connection. • Cancel the VNC connection from the touch panel display. • Cancel the other connected VNC client connection. 	232
VNC protocol version does not match.	An unsupported protocol version has been selected.	Use VNC clients with protocol versions 3.3 or higher.	233

Error Message	Cause	Corrective Action	Error Code
VNC client authentication has failed.	Password authentication failed.	Check whether or not the password that is set at the controller and VNC client is correct.	234
VNC pixel format does not match.	An unsupported pixel format has been selected.	Select either full color or 16-bit color for the pixel format.	235
VNC encoding types don't match.	An unsupported encoding type has been selected.	Select either Hextile or Raw as the encoding type.	236
The controller was booted using an unsupported firmware. Please turn off the power once and then update the firmware.	The controller was started using a non-supported firmware version.	Update to the firmware supporting the controller.	314
The file for updating does not support this controller. Please remove the SD Card 2 and check the file for updating.	The controller was started by adding a non-supported version of the update file to SD Card 2.	Replace with an update file supporting the controller, and then restart the controller.	315
Failed to read the file for updating.	<ul style="list-style-type: none"> A problem occurred while trying to access SD Card 2. The update file is corrupted. SD Card 2 was inserted during startup. 	<ul style="list-style-type: none"> Execute [Format] on SD Card 2 (Note that all data on the SD Card 2 will be erased). Copy the update file to SD Card 2 again. Start the controller with SD Card 2 containing the update file inserted. 	316
Please connect the USB HDD.	The USB HDD is not connected to the USB HDD connector.	Properly connect the USB HDD to the USB HDD connector.	320
	A USB HDD not supported by the controller is being used.	Make sure that the specification of the USB HDD meets the requirements to support the controller.	
Failed to access USB HDD.	<ul style="list-style-type: none"> A problem occurred while trying to access the USB HDD. There is an anomaly in accessing the USB HDD. A USB HDD not supported by the controller is being used. The destination file is set to read-only. 	<ul style="list-style-type: none"> Make sure that the specification of the USB HDD meets the requirements to support the controller. Check whether the output destination file is set to read-only. Format the USB HDD on the controller (Note that all data on the USB HDD will be erased). If the problem cannot be resolved by any of these remedies, the USB HDD may be damaged. Contact your local KEYENCE office. 	321
USB HDD is full.	There is not enough free space on the USB HDD.	Make space available by deleting data from the USB HDD.	324
USB HDD is write-protected.	You do not have write permission for the USB HDD.	Grant a write permission for the USB HDD.	325
An unsupported USB device was connected. Please remove the USB device connected.	A device other than a mass storage class device (such as a mouse) is connected to the USB3.0 connector.	Remove the connected device.	327
The USB HDD format is incorrect. Please format by using the Memory Utility.	The controller could not recognize the format of the USB HDD.	Execute the [Format] function for USB HDD (Note that all data on the USB HDD will be erased).	328
The internal temperature of the controller is high. As this may cause a breakdown, please check the installation condition and ambient temperature.	The controller is not installed appropriately or the ambient temperature is too high (Example: The ventilation hole is blocked).	<ul style="list-style-type: none"> Make sure the controller is installed in the correct direction and location as specified in the manual. Make sure that the ambient temperature does not exceed the temperature rating. Take measures such as cooling the controller unit. 	336

Error Messages

Error Message	Cause	Corrective Action	Error Code
The system was stopped because the internal temperature of the controller exceeded the rated value. Please turn off the power temporarily and check the installation condition and ambient temperature.	The controller is not installed appropriately or the ambient temperature is too high (Example: The ventilation hole is blocked).	<ul style="list-style-type: none"> Make sure the controller is installed in the correct direction and location as specified in the manual. Make sure that the ambient temperature does not exceed the temperature rating. Take measures such as cooling the controller unit. 	337
Fan rotation could not be detected. It is possible that the fan unit has broken down.	The fan of the fan unit is not operating.	Replace the fan unit (CA-F100).	338
Overcurrent was detected in the connected USB device. Please check the device connected to the USB.	<ul style="list-style-type: none"> A device with high current consumption is connected to the USB port. (Standard - USB2.0: 500mA, USB3.0: 900mA) The cable is short-circuited. 	<ul style="list-style-type: none"> Check the power consumption of the connected device. Make sure the cable is not short-circuited. 	339
The firmware SD card is not inserted. Please turn off the power and reboot after having inserted the firmware SD card.	The firmware SD card is not inserted.	Turn off the controller, insert the firmware SD card and then restart the controller.	340
The configuration of the connected expansion units is invalid. Please turn off the power temporarily and check the configuration of the expansion units.	<ul style="list-style-type: none"> An expansion unit that cannot be used with the controller is connected (Example: A line camera input unit connected to a VGA model). The number of connected expansion units exceeds the maximum usable number of units. 	Check the configuration of the expansion unit.	341
Could no longer recognize expansion unit N. Please turn off the power temporarily and check the connection of the expansion units. *N: Expansion unit No. (1 to 16)	Failed to communicate with the expansion unit.	<ul style="list-style-type: none"> Turn off the controller and check the connection of the expansion unit. If the problem cannot be resolved, the expansion unit may be damaged. Contact your local KEYENCE office. 	342
Failed to initialize the expansion unit. Please turn off the power temporarily and check the connection of the expansion units.	Failed to initialize the expansion unit.	<ul style="list-style-type: none"> Turn off the controller and check the connection of the expansion unit. If the problem cannot be resolved, the expansion unit may be damaged. Contact your local KEYENCE office. 	343
EtherCAT communication has failed.	An error occurred while starting communication or during communication, and communication cannot be performed correctly.	<ul style="list-style-type: none"> Check whether the Ethernet cable is connected correctly. Check whether the controller and master were restarted after updating the communication settings. Review the requested packet interval and timeout settings on the PLC. 	353
EtherCAT module disconnected.	The EtherCAT unit is not recognized and the controller cannot use EtherCAT communication.	<ul style="list-style-type: none"> Make sure the EtherCAT unit is attached correctly. Make sure the EtherCAT unit is not damaged. Do not connect/disconnect the EtherCAT unit while the controller is powered on. 	357

Error Messages Assigned to System Variable %Error1.

The error messages below are assigned to %Error1 by default.

Since %Error1 is not assigned to an output terminal at factory shipment, the error is not output externally even when an error occurs.

The errors assigned to %Error1 can be removed or switched to %Error0 as desired.

Error Message	Cause	Corrective Action	Error Code
Please select "Stop SD2 Operation" before removing the SD card. The card and files may be damaged.	The SD card was removed without using the [Stop SD2 Operation].	Use the [Stop SD2 Operation], to safely remove SD Card 2. Removing an SD card while it is being accessed may damage the SD card and the data saved on it.	87
Please select "Stop USB HDD Operation" before removing the USB HDD. The HDD and files may be damaged.	The USB HDD was removed without executing [Stop USB HDD Operation].	Remove the USB HDD after executing [Stop USB HDD Operation]. Removing the USB HDD while it is being accessed may damage the USB HDD and the data saved on it.	326

Errors Messages not Assigned to System Variables %Error0 or %Error1

These errors by default are not assigned to %Error0 or %Error1 but can be assigned through the XG-X VisionEditor software.

Error Message	Cause	Corrective Action	Error Code
Image archive data was overwritten before being output.	The image archive data in the buffer was overwritten before it could be output.	<ul style="list-style-type: none"> Correct the number of items to archive to allow enough time to output the stored data before the next item overwrites it. To ensure output of all items in the archive, set the buffer mode to [Process until buffer full]. Note, the image archive stops when the number of items is reached. If this happens, the data must be cleared to resume archiving. 	49
Failed to save.	SD Card 1 or 2 has the following errors: connection error, access error, card full error, or write protect error.	Check the SD card which you are saving files to.	50
	No data found available to save when using the Statistics or Image Archive functions.	Try saving after data has been stored.	
Failed to store target classification results.	Failed to save the target classification features data or extracted image data.	Set the image buffer large enough so that the rate of data output exceeds the rate of storage.	51
Unable to write to SD Card 1 output buffer.	SD Card 1 output buffer is full.	Reduce the amount of data to be output to the SD1 card, so the data is output at a faster rate than it builds up. Or extend the time between triggers / processing to allow for data to be output. Note: Results data are not written when the buffer is full.	67
SD Card 1 output buffer is full.	SD Card 1 output buffer is full.	Reduce the amount of data to be output to the SD1 card, so the data is output at a faster rate than it builds up. Or extend the time between triggers / processing to allow for data to be output. Note: Inspections processing can be put on hold until the buffer becomes free.	68
Unable to write to SD Card 2 output buffer.	SD Card 2 output buffer is full.	Reduce the amount of data to be output to the SD2 card, so the data is output at a faster rate than it builds up. Or extend the time between triggers / processing to allow for data to be output. Note: Results data are not written when the buffer is full.	83
SD Card 2 output buffer is full.	SD Card 2 output buffer is full.	Reduce the amount of data to be output to the SD2 card, so the data is output at a faster rate than it builds up. Or extend the time between triggers / processing to allow for data to be output. Note: Inspections processing can be put on hold until the buffer becomes free.	84
Unable to write to PC Program output buffer.	The controller output buffer for outputting to PC Programs is full.	Reduce the amount of data to be output to a PC Program, so the data is output at a faster rate than it builds up. Or extend the time between triggers / processing to allow for data to be output. Note: Results data are not written when the buffer is full.	99
PC Program output buffer is full.	The controller output buffer for outputting to PC Programs is full.	Reduce the amount of data to be output to a PC Program, so the data is output at a faster rate than it builds up. Or extend the time between triggers / processing to allow for data to be output. Note: Inspections processing can be put on hold until the buffer becomes free.	100

Error Message	Cause	Corrective Action	Error Code
Unable to write to PLC-Link output buffer.	The controller output buffer for outputting via PLC-Link is full.	Reduce the amount of data to be output via PLC-Link, so the data is output at a faster rate than it builds up. Or extend the time between triggers / processing to allow for data to be output. Note: Results data are not written when the buffer is full.	115
PLC Link output buffer is full.	The controller output buffer for outputting via PLC-Link is full.	Reduce the amount of data to be output via PLC-Link, so the data is output at a faster rate than it builds up. Or extend the time between triggers / processing to allow for data to be output. Note: Inspections processing can be put on hold until the buffer becomes free.	116
External command error has occurred.	An error occurred when executing a command from one of these devices: <ul style="list-style-type: none">• PC Program• PLC-Link• Ethernet• RS-232C• CC-Link• External terminals• EtherNet/IP• PROFINET• EtherCAT	Review the command being sent, and the program settings.	128
Internal command error has occurred.	An error occurred when executing a command via one of these internal methods: <ul style="list-style-type: none">• Command Unit• Timer command• Buttons on the handheld controller• Menu button	Review the command being issued and the program settings.	129
Unable to write to Ethernet output buffer.	The controller output buffer for outputting via the Ethernet port is full.	Reduce the amount of data to be output via Ethernet, so the data is output at a faster rate than it builds up. Or extend the time between triggers / processing to allow for data to be output. Note: Results data are not written when the buffer is full.	147
Ethernet output buffer is full.	The controller output buffer for outputting via the Ethernet port is full.	Reduce the amount of data to be output via Ethernet, so the data is output at a faster rate than it builds up. Or extend the time between triggers / processing to allow for data to be output. Note: Inspections processing can be put on hold until the buffer becomes free.	148
Unable to write to RS-232C output buffer.	The controller output buffer for outputting via the RS-232C port is full.	Reduce the amount of data to be output via RS-232C, so the data is output at a faster rate than it builds up. Or extend the time between triggers / processing to allow for data to be output. Note: Results data are not written when the buffer is full.	163
RS-232C output buffer is full.	The controller output buffer for outputting via the RS-232C port is full.	Reduce the amount of data to be output via RS-232C, so the data is output at a faster rate than it builds up. Or extend the time between triggers / processing to allow for data to be output. Note: Inspections processing can be put on hold until the buffer becomes free.	164
Unable to write to CC-Link output buffer.	The controller output buffer for outputting via the CC-Link is full.	Reduce the amount of data to be output via CC-Link, so the data is output at a faster rate than it builds up. Or extend the time between triggers / processing to allow for data to be output. Note: Results data are not written when the buffer is full.	179
CC-Link output buffer is full.	The controller output buffer for outputting via the CC-Link is full.	Reduce the amount of data to be output via CC-Link, so the data is output at a faster rate than it builds up. Or extend the time between triggers / processing to allow for data to be output. Note: Inspections processing can be put on hold until the buffer becomes free.	180

Error Messages

Error Message	Cause	Corrective Action	Error Code
Unable to write to the parallel / terminal I/O output buffer.	The controller output buffer for outputting using the parallel / terminal outputs is full.	Reduce the amount of data to be output through the parallel / terminal outputs, so the data is output at a faster rate than it builds up. Or extend the time between triggers / processing to allow for data to be output. Note: Results data are not written when the buffer is full.	195
Parallel / terminal I/O output buffer is full.	The controller output buffer for outputting using the parallel / terminal outputs is full.	Reduce the amount of data to be output through the parallel / terminal outputs, so the data is output at a faster rate than it builds up. Or extend the time between triggers / processing to allow for data to be output. Note: Inspections processing can be put on hold until the buffer becomes free.	196
Unable to write to FTP output buffer.	The controller output buffer for outputting via the FTP is full.	Reduce the amount of data to be output via FTP, so the data is output at a faster rate than it builds up. Or extend the time between triggers/processing to allow for data to be output. Note: Results data are not written when the buffer is full.	228
FTP output buffer is full.	The controller output buffer for outputting via the FTP is full.	Reduce the amount of data to be output via FTP, so the data is output at a faster rate than it builds up. Or extend the time between triggers/processing to allow for data to be output. Note: Inspections processing can be put on hold until the buffer becomes free.	229
EtherNet/IP communication has failed.	The EtherNet/IP connection has been lost. (If possible, the connection will be automatically restored.)	<ul style="list-style-type: none"> Check whether the Ethernet cable is connected correctly. Check whether the controller and master were restarted after updating the communication settings. Review the requested packet interval and time-out settings on the PLC. 	241
Unable to write to EtherNet/IP output buffer.	The controller output buffer for outputting via EtherNet/IP is full.	Change the RPI settings so the data is output faster than it accumulates. Alternatively, extend the time between triggers / processing to allow for data to be output. Note: Results data are not written when the buffer is full.	243
EtherNet/IP output buffer is full.	The controller output buffer for outputting via EtherNet/IP is full.	Change the RPI settings so the data is output at a faster rate than it builds up. Or extend the time between triggers / processing to allow for data to be output. Note: Inspections processing can be put on hold until the buffer becomes free.	244
PROFINET communication has failed.	The cyclic communication was disconnected (It is automatically recovered whenever possible.).	<ul style="list-style-type: none"> Check whether the Ethernet cable is connected correctly. Check whether the controller and master were restarted after updating the communication settings. Review the settings on the PLC including the communication cycle and timeout. Review the flowchart details or the trigger intervals. 	257
Unable to write to PROFINET output buffer.	The controller output buffer for outputting using PROFINET is full.	Reconfigure the RPI so that the data is output to PROFINET at a faster rate than it builds up. Or extend the time between triggers to allow for data to be output (the results data are not written when the buffer is full).	259
PROFINET output buffer is full.	The controller output buffer for outputting using PROFINET is full.	Reconfigure the RPI so that the data is output to PROFINET at a faster rate than it builds up. Or extend the time between triggers to allow for data to be output (When the output buffer is full, the measurement is put on hold until the buffer becomes free).	260
Unable to write to USB HDD output buffer.	The controller output buffer for outputting to the USB HDD is full.	Reduce the amount of data to be output to the USB HDD, so the data is output at a faster rate than it builds up. Or extend the time between triggers to allow for data to be output (the results data are not output when the buffer is full).	322

Error Message	Cause	Corrective Action	Error Code
USB HDD output buffer is full.	The controller output buffer for outputting to the USB HDD is full.	Reduce the amount of data to be output to the USB HDD, so the data is output at a faster rate than it builds up. Or extend the time between triggers to allow for data to be output (When the output buffer is full, the measurement is put on hold until the buffer becomes free).	323
Unable to write to EtherCAT output buffer.	The controller output buffer for outputting using EtherCAT is full.	Reconfigure the update time on the side of the PLC so that the data is output to EtherCAT at a faster rate than it builds up. Or extend the time between triggers to allow for data to be output (the results data are not output when the buffer is full).	355
EtherCAT output buffer is full.	The controller output buffer for outputting using EtherCAT is full.	Reconfigure the update time on the side of the PLC so that the data is output to EtherCAT at a faster rate than it builds up. Or extend the time between triggers to allow for data to be output (When the output buffer is full, the measurement is put on hold until the buffer becomes free).	356

Errors Messages That Cannot Be Assigned to System Variables %Error0 or %Error1

The following errors / error messages cannot be assigned to system variables.

Error Message	Cause	Corrective Action	Error Code
Broken files were found and converted to [FILEXXX.CHK].	The memory utility found broken files during the check process and was able to restore the broken files.	No corrective action is necessary.	–
• SD Card 1 check failed. • SD Card 2 check failed.	The memory utility found corrupted files during the check process but was unable to restore the files.	<ul style="list-style-type: none"> If the error persists after repeating the check process, contact your local Keyence office. In some cases, the error may be resolved by formatting the SD card and running the check again. However, all the data stored on the card will be lost. 	–
Failed to add new program.	The target location (SD Card 1 or SD Card 2) is full.	Make space available by deleting files.	–
Load failed.	The source location (SD Card 1 or SD Card 2) is full.	Make space available by deleting files.	–
Save failed.	The destination location (SD Card 1 or SD Card 2) is full.	Make space available by deleting files.	–
Failed to change program.	<p>The data in the specified program file is corrupted and cannot be used.</p> <p>The data in the specified program is from an incompatible version.</p>	Change the program to a different working program. Create a compatible version of the program file.	–
• Failed to copy file(s) due to write protection. • Failed to move file(s) due to write protection. • Failed to delete file(s) due to write protection. • Failed to rename file or folder due to write protection. • Failed to create folder due to write protection. • Failed to copy file(s) due to write protection on the source SD card. • Failed to copy file(s) due to write protection on the destination SD card. • SD Card 1 is write-protected. • SD Card 2 is write-protected.	The write-protection switch on the SD card is enabled.	Disable the write-protection switch on the SD card.	–
Failed to save the image.	The SD card is not inserted.	Properly insert the SD card into the SD slot.	–
	The SD card is full.	Make space available by deleting or moving unnecessary files.	–
	The write-protection switch on the SD card is enabled.	Disable the write-protection switch on the SD card.	–

Error Message	Cause	Corrective Action	Error Code
The line scan frequency is too fast. Please confirm the settings.	The line scan interval setting is too short.	Adjust the line scan interval or the related settings.	—
No more menus can be opened until others are closed.	There are 16 menus open. There are numerous menus open with too many elements to handle.	Close any unnecessary menus.	—
Failed to access archive data. If the image viewer is open in the PC, please close it and try again.	The Image Acquisition Screen in XG-X VisionEditor is open.	Close the Image Acquisition Screen in XG-X VisionEditor.	—
	An ActiveX control is currently reading the archive data.	Wait for the ActiveX control to finish reading the archive data before using the following menus: Statistics, Image Viewer, Image and Edit Unit menu.	
	A non-protocol archive related command is being executed.	Wait for the non protocol archive related command to finish before using the following menus: Statistics, Image Viewer, Image Archive Settings, and Edit Unit menu.	
An error occurred during linearization. Please check the light settings.	Linearization failed because the light was not connected.	Connect the light correctly, check settings and rerun linearization.	—
	An error has occurred in the internal data of the illumination expansion unit.	<ul style="list-style-type: none"> • Execute linearization again. • If errors continue to occur after restoring power, the module maybe damaged. Contact your local KEYENCE office. 	
Please verify the power supply and connectivity of the illumination expansion module.	Either the illumination expansion module corresponding to the linearized channel has been disconnected or the power is not turned on.	Make sure the illumination expansion module is attached correctly. Make sure the illumination expansion module is not damaged.	—
An error occurred during the initialization of the linearization result. Please check the light.	An error has occurred in the internal data of the illumination expansion unit.	<ul style="list-style-type: none"> • Initialize the linearization result again. • If errors continue to occur after restoring the power, the unit maybe damaged. Contact your local KEYENCE office. 	—
Illumination expansion units of different types can not use the same emission timing.	The user attempted to set the same emission timing or external flash for CA-DC40E/DC50E/DC60E lights.	Set different emission timings for CA-DC40E/DC50E/DC60E lights.	—
OCR library file exceeds size limit.	The number of registered characters in the library has reached the 200-character limit.	The maximum number of characters which can be registered in a single library is 200. Delete any unnecessary characters.	—
Library file not found.	Access to the library failed when trying to select a library index or during editing.	Check the SD card and verify the location and existence of the library file.	—
The number of characters that can be registered for 1 character was exceeded. Cannot register.	You are trying to register more than 200 character patterns for one type of character in the OCR2 unit.	In the OCR2 unit, the maximum number of character patterns that can be registered for one type of character is up to 200 character patterns. Delete any unnecessary character patterns.	—
This menu cannot be accessed as there is a setting error in this unit.	<p>The unit being selected for editing via the Edit Unit menu has errors (except the ones listed below).</p> <ul style="list-style-type: none"> • Non-specification errors: (Region, Pattern Region, Color Extraction, Light Intensity Source Unit, Image Operation operations, Image array operations). • Processing capacity full errors: (Failed to register reference image information, failed to set inspection region, failed to register reference image information for subtraction filter, failed to register a character in the library). • Others: Library file does not exist, library file format is illegal. 	Use XG-X VisionEditor to run a check on the program data. Fix unit errors by using XG-X VisionEditor.	—

Error Messages

Error Message	Cause	Corrective Action	Error Code
An error exists in the calculation / script.	The warning message detailing errors in the calculation unit was closed by selecting on the [OK] button.	Correct errors in the expression, function or script in the calculation unit.	—
The calculation / script has reached the maximum number of characters per line (1000), or number of lines (2000) that can be edited via the controller. Please change accordingly or edit with XG-X VisionEditor software.	Either the expression, function or script in the calculation unit exceeds 1000 characters per line or is over 2000 lines.	Use XG-X VisionEditor to modify the unit so the expression, function or script fits within the limits.	—
Image Capture Buffer Overload !	The image buffer was overwritten while in use because the capture speed is fast (when [Overwriting] is selected for the image capture buffer settings).	Increase the image buffer in the image capture buffer settings. Or, adjust the line scan camera [Number of lines] or [Line Cycle] in the Capture unit capture settings.	—
Encoder settings are invalid. Check the setting.	RS-422 is selected for the encoder 1 type with a model that does not support line scan cameras.	Select open collector for the encoder 1 type in [Global] menu - [Communications & I/O] - [Terminal Block & Parallel Port] - [Input Assignments].	—
To use HDR, select just one camera.	User attempted to select multiple cameras in the Capture unit, however the one or more of the corresponding cameras is set for HDR capture. Attempted to enable HDR exposing for the cameras that are included in the exposing targets with the multiple exposing target cameras.	Enable only one camera in [Camera], or disable HDR capture. Enable only one camera in [Camera], or disable HDR capture.	—
HDR cannot be used with a line scan camera in continuous capture mode.	User attempted to enable HDR capture for a Capture unit in which a line scan camera and continuous capture were set in [Camera Selection].	To enable HDR capture, change the linescan capture to sheet-fed.	—
HDR cannot be used with LJ-V.	The user attempted to enable HDR capture on a capture unit while the LJ-V Series head is set to [Continuous Capture] in [Camera Selection].	To enable HDR capture, change the LJ-V Series head to [Fixed Capture] mode.	—
The image capture buffer cannot be changed due to HDR usage.	User attempted to enable [Custom] for the image capture buffer settings when a Capture unit where HDR capture is enabled exists.	In order to enable [Custom], disable HDR capture in all Capture units.	—
Updating the registered image information every process is not possible due to the image capture area being greater than 26.21 million pixels.	An image area with a maximum area of more than 26.21 million pixels is set in the program, and the user attempted to edit the Pattern Search unit, ShapeTrax3 unit, ShapeTrax2 unit, PatternTrax unit, subtract filter, or other unit using High Speed Mode and set High Speed Mode to OFF.	To turn High Speed Mode OFF, either reduce the camera image area to 26.21 million pixels or less, or else select [User updated (fast)].	—
The image array is not available due to the image capture area being greater than 26.21 million pixels.	User attempted to set an image array in an Image Operation unit when an image area with a maximum area of more than 26.21 million pixels is set in the program.	Set the camera image area to 26.21 million pixels or less.	—
The inspection region must be less than 2432 pixels in width and 2050 pixels in height	The inspection area inside the image area was set to a width of 2432 pixels or more, or a height of 2050 pixels or more, in [Inspection Region] at the OCR unit, OCR2 unit, 2D Code Reader unit, or 1D Code Reader unit.	Reduce the camera image area or set the inspection area to a width of less than 2432 pixels and a height of less than 2050 pixels.	—

Error Message	Cause	Corrective Action	Error Code
Search region is greater than 2431 pixels in width or greater than 2049 pixels in height. Use the large area search mode or reduce the search region.	A search area inside the image area with a width of 2432 pixels or more, or a height of 2050 pixels or more, was set when [Large Area Search] was disabled in the ShapeTrax3 unit or ShapeTrax2 unit search area settings.	Either enable [Large Area Search] or set a search area with width less than 2432 pixels and height less than 2050 pixels.	—
Pattern region is greater than 2431 pixels in width or greater than 2049 pixels in height. Use the large area search mode or reduce the pattern region.	A pattern region inside the image area with a width of 2432 pixels or more, or a height of 2050 pixels or more, was set when [Large Area Search] was disabled in the ShapeTrax3 unit or ShapeTrax2 unit pattern region settings.	Either enable [Large Area Search] or set a pattern region with width less than 2432 pixels and height less than 2050 pixels.	—
The pattern region is too large. Enable the large area mode in Parameters menu. If the pattern region width is greater than 2431 pixels or the height is greater than 2049 pixels use "Mode1". If the pattern region width is greater than 4095 pixels or the height is greater than 4095 pixels use "Mode2".	A pattern region inside the image area was set under the following conditions in the pattern region settings of the Pattern Search unit. <ul style="list-style-type: none"> If [Large Area Search] was disabled: Width 2432 pixels or more, or height 2050 pixels or more If [Large Area Mode] was set to [Mode 1]: Width 4096 pixels or more, or height 4096 pixels or more 	If the pattern region width is 2432 pixels or more, or the height is 2050 pixels or more, use [Mode 1]. If the width is 4096 pixels or more, or the height is 4096 pixels or more, select [Mode 2]. Or, reduce the pattern region size so that the above upper limits are not exceeded.	—
Pattern region height must be less than 8192 pixels.	An inspection region with a height of 8192 pixels or more was set in the pattern region settings of the Pattern Search unit.	Either reduce the camera image area or else set the pattern region height to less than 8192 pixels.	—
The region size is greater than 33.55 million pixels. Please enable large area mode of subtract filter settings.	User attempted to disable the large area mode for the subtract filter when an inspection region with an area of 33.55 million pixels or more was set in the inspection region settings of a vision unit. Or, user attempted to set an inspection region of 33.55 million pixels or more when the large area mode for the subtract filter was disabled.	Either reduce the size of the inspection region or use the large area mode for the subtract filter.	—
Cannot output target classification results because the destination folder is (None).	The output destination folder was set to [None] when target classification extracted image and results were output.	Set the output destination folder in the [Utilities] - [Target Classification Settings] settings to a setting other than [None].	—
Failed to output classification results.	One of the following occurred when target classification extracted image and results were output. <ul style="list-style-type: none"> The destination device is not ready, or is not functioning correctly. Reset occurred during output. 	Check the destination device and correct any problems.	—
Shading correction failed.	The calculation of shading correction value for linescan calibration failed due to one of the following reasons. <ul style="list-style-type: none"> Shading correction value calculation was executed for a black image. The line scan camera is not connected properly. 	<ul style="list-style-type: none"> Perform image capture before executing correction. Check that the line scan camera is connected correctly. 	—
Failed to reset settings.	Failed to clear the shading correction value for linescan calibration.	Check that the line scan camera is connected correctly.	—
Failed to transfer the threshold settings to the camera.	Failed to set the LED threshold values for the line scan camera in linescan calibration.	Check that the line scan camera is connected correctly.	—
An IP address conflict has occurred between the controller and another device on the network.	An IP address conflict has occurred between the controller and another device on the network.	Change the controller IP address.	—

Error Messages

Error Message	Cause	Corrective Action	Error Code
The 21 megapixel camera (21 megapixel mode) and multi-camera image variables cannot be used concurrently. When the camera setting is set, the multi-camera image variables will be disabled.	The user attempted to set a 21-megapixel camera (21-megapixel mode) while a multi-camera type image variable is included in the variable settings.	The multi-camera type image variable is treated as an invalid variable. Also, a unit error occurs for units that refer to the multi-camera type image variable. Change to an image variable that is not the multi-camera type.	—
The 21 megapixel camera(21 megapixel mode) and multi-camera image variables cannot be used concurrently. Please change the settings.	The user attempted to define a multi-camera type image variable when a 21-megapixel camera (21-megapixel mode) is set as the camera type.	Change to an image variable that is not the multi-camera type.	—
The line scan camera and 3D camera cannot be used concurrently. Please change the settings.	The user attempted to change to a setting where a line scan camera and 3D camera are used together.	Change the line scan camera to area camera, or change the 3D camera to a different model.	—
When the "Allow Trigger Input During Line Capture" setting is enabled, the Image Buffer Capacity must be 3 or more and the buffer type set to Overwriting.	[Image Capture Buffer Settings] was set to OFF or configured as shown below when a capture unit with [Allow Trigger Input During Line Capture] enabled exists: <ul style="list-style-type: none">• [Image Buffer Capacity] is set to 2 or smaller• Buffer operation type is set to [Fixed]	Enable the image capture buffer setting, set [Image Buffer Capacity] to 3 or larger and set the buffer type to [Overwriting].	—
In order to select "Specify Encoder", a camera input unit where encoder input is possible must be connected.	The user attempted to select [Specify Encoder] for a camera input unit for which encoder input is not supported.	Connect a camera input unit to which the encoder can be input.	—
An abnormality has occurred in the dedicated encoder. Please check the wiring and restart the dedicated encoder.	An error occurred in the dedicated encoder.	Check the wiring and restart the dedicated encoder.	—
The RS-232C communication setting cannot be changed because PLC-Link (RS-232C) is enabled.	The user attempted to configure a dedicated encoder while using PLC-Link (RS-232C).	To configure the dedicated encoder, disable PLC-Link (RS-232C).	—
An illumination expansion unit (CA-DC50E/60E) where LumiTrax can be used is not connected. Check the connected illumination expansion unit.	<ul style="list-style-type: none">• No CA-DC50E/60E units are set in the illumination expansion unit model settings when LumiTrax Mode is set.• No CA-DC60E units are set in the illumination expansion unit model settings when LumiTrax Specular Reflection Mode is set.	<ul style="list-style-type: none">• Set at least one CA-DC50E/60E unit in the illumination expansion unit model settings when LumiTrax Mode is set.• Set at least one CA-DC60E unit in the illumination expansion unit model settings when LumiTrax Specular Reflection Mode is set.	—
A light that is not connected was selected.	The user attempted to set the light of an illumination expansion unit configured as [Unconnected] in the Illumination Expansion Unit Model Settings for LumiTrax Light/MultiSpectrum Light.	<ul style="list-style-type: none">• Set the light of an illumination expansion unit that is set as CA-DC50E/60E in the Illumination Expansion Unit Model Settings when in LumiTrax Mode.• Set the light of an illumination expansion unit that is set as CA-DC60E in the Illumination Expansion Unit Model Settings when in LumiTrax Specular Reflection Mode/MultiSpectrum Mode.	—
A light that does not support LumiTrax was selected.	The user attempted to set the light of an illumination expansion unit not configured as [CA-DC50E] in the Illumination Expansion Unit Model Settings for [LumiTrax Light].	Set the light of an illumination expansion unit that is set as CA-DC50E in the Illumination Expansion Unit Model Settings.	—
A light that does not support MultiSpectrum was selected.	The user attempted to set the light of an illumination expansion unit not configured as [CA-DC60E] in the Illumination Expansion Unit Model Settings for [MultiSpectrum Light].	Set the light of an illumination expansion unit that is set as CA-DC60E in the Illumination Expansion Unit Model Settings.	—
Cannot enable LumiTrax because HDR capture is enabled.	The user attempted to enable LumiTrax while HDR capture was enabled.	To use LumiTrax, disable HDR capture.	—

Error Message	Cause	Corrective Action	Error Code
Cannot set to MultiSpectrum Mode because HDR capture is enabled.	An attempt was made to set the mode to MultiSpectrum Mode while HDR capture was enabled.	To set the mode to MultiSpectrum Mode, disable HDR capture.	—
Pattern region must be less than 2432 pixels in width and 2050 pixels in height. Enable the large area search mode or set such that the bounding rectangle that contains the pattern region and rotation feature region will not be 2432 or more pixels in width or will not be 2050 or more pixels in height.	The size of the bounding rectangle surrounding the pattern region and the rotation feature region of the rotation direction-added search has exceeded the specified size while the large area mode is OFF in ShapeTrax3.	<ul style="list-style-type: none"> Review the position/size of the pattern region and rotation feature region. Enable [Large Area Search] of the detection conditions. 	—
Failed to format the USB HDD.	Failed to format the USB HDD using the memory utility on the [File Management] screen.	The connected USB HDD is a storage device that cannot be formatted in FAT32 or is damaged.	—
Cannot operate in Run Mode.	The user attempted to perform an operation that is unavailable in Run mode.	Perform the operation in Setup mode.	—
Cannot operate in Setup Mode.	The user attempted to perform an operation that is unavailable in Setup mode.	Perform the operation in Run mode.	—
Cannot execute because "Image Archive Memory" is not selected in Display Target.	The user attempted to execute [Replay] or [Export Archive Image] while [Image Archive Memory] is not selected as the display target of the Image Viewer.	Select [Image Archive Memory] as the display target and try again.	—
Cannot execute because "Master Reference: Pass (OK)" or "Master Reference: Fail (NG)" is not selected in Display Target.	The user attempted to perform deletion from the master image when [Master Reference: Pass (OK)] or [Master Reference: Fail (NG)] is not selected as the display target in the Image Viewer.	Select [Master Reference: Pass (OK)] or [Master Reference: Fail (NG)] as the display target and try again.	—
Cannot execute because "Master Reference: Pass (OK)" is selected in Display Target.	The user attempted to execute [Add to OK Master Ref.] while [Master Reference: Pass (OK)] is selected as the display target in the Image Viewer.	Select a folder other than [Master Reference: Pass (OK)] for the display target and try again.	—
Cannot execute because "Master Reference: Fail (NG)" is selected in Display Target.	The user attempted to execute [Add to NG Master Ref.] while [Master Reference: Fail (NG)] is selected as the display target in the Image Viewer.	Select a folder other than [Master Reference: Fail (NG)] for the display target and try again.	—
3D Observation by the Captured Image cannot be used because there is an error in the Capture unit.	The user attempted to open the 3D observation while there is an error in the capture unit.	Resolve the capture unit error.	—
Failed to import.	The mss file is invalid or cannot be accessed.	Check the mss file.	—
The following parameters cannot be disabled when the LJ-V is in use. • End capture by EXT signal	The user attempted to disable the [End Capture By EXT Signal] setting with a LJ-V Series head configured.	[End Capture By EXT Signal] cannot be disabled when a LJ-V Series head is in use.	—
Could not export because the file to write to is write-protected.	The SD card is read-only.	Disable the write-protection.	—
Could not load a part of the settings. Check the log below. (Log file path)	The import process failed prematurely because the CSV file was described incorrectly.	Check the output log file and see whether out-of-range error, etc. is issued for the values to be set as parameters.	—

Hardware-Related Error Messages

These are error messages that appear when the controller fails to start due to a hardware-related error.

Error Message	Cause	Corrective Action	Error Code
ERROR CODE 100 Firmware SD card is not inserted	The firmware SD card is not inserted.	Insert the firmware SD card.	—
ERROR CODE 101 Firmware SD card is write protected	The firmware SD card is read-only.	Disable the write-protection.	—
ERROR CODE 300 Firmware version is old	The firmware on the firmware SD card does not support this hardware.	Update to the latest firmware.	—
ERROR CODE Other	The hardware is malfunctioning.	Contact your local KEYENCE office.	—

INDEX

Symbols

***.bin, ***.dll 2-3

Numerics

1D Code Reader Tool 2-291
 2D Code Reader Tool 2-274
 3D Calibration 8-167
 3D Camera 8-8, 8-14
 3D Geometry 8-111
 3D Observation 8-156

A

Active Text 4-49
 Area Tool 2-40
 Assigning Variables 4-9

B

Base Frame 4-26, 4-45
 Basic Parts 4-26, 4-46
 Batch Testing 5-10
 Blob Filter 2-502
 Blob Tool 2-143
 Break Unit 2-314

C

C Plugin Unit 2-316
 CA-DC40E 6-9
 CA-H2100C 9-3
 CA-H2100M 9-3
 CA-HL02MX 9-16
 CA-HL04MX 9-16
 CA-HL08MX 9-17
 CA-HX048C 9-10
 CA-HX048M 9-10
 CA-HX200C 9-9
 CA-HX200M 9-9
 CA-HX500C 9-5
 CA-HX500M 9-5
 Calibrate CA series Touch Panel 6-7
 Calibration Unit 2-407
 CAM Judgment 4-3

Camera - Trigger - Light Configuration

 Settings 8-15, 8-23, 8-176
 Camera Common Settings 6-9
 Camera Selection 4-11
 CA-NCL20E 6-23
 CC-Link 6-23
 CC-Link Monitor & Diagnostics 5-28
 Change Camera Image 1-17
 Change Display Type 1-17
 Change Login User 5-41
 Change Programs 3-2, 3-4
 Change Screen 1-16
 Change Unit/Page 1-16
 Check 5-47
 Circle 4-56
 Color Extraction 2-483
 Color Grouping Tool 2-230
 Color stain mode 2-134
 Color to Binary (Color) 2-484
 Color to Grayscale (Color) 2-486
 Color Tool 2-225
 Command Execution Unit 2-465
 Common System Specifications 9-18
 Continuous Profile Measurement 8-80
 Contour Region Generator Unit 2-399
 Controller Name 6-4
 Controller Specifications 9-26
 Correcting 8-167
 Cross Mark 4-55
 Current Resource Allocation 5-49
 Custom Advance Filter 2-500
 Custom Filter 2-499
 Custom Instruction 6-42

D

Data Output Unit 2-449
 Date/Time 6-2, 6-4
 Defect Extraction Operation Unit 2-394
 Defect Grouping Function 2-141
 Defect Tool 2-130
 Display Templates 4-27

E

Edge Angle Tool	2-114
Edge Pairs Tool	2-121
Edge Pitch Tool	2-106
Edge Position Tool.....	2-88
Edge Width Tool	2-97
Edit Flowchart in Run Mode	5-22
Edit Unit Menu	2-14
Encoder	6-13
Encoder Monitor	5-24
End Unit.....	2-315
Entering Characters	1-12
Entering Values	1-9
env.dat	2-3
Error Messages	9-35
Error Output	4-19
EtherCAT.....	6-34
EtherCAT Monitor & Diagnostics	5-29
Ethernet (TCP/IP)	6-14
Ethernet (TCP/IP) Monitor.....	5-24
EtherNet/IP Monitor & Diagnostics	5-26

F

File Management	5-43
Flowchart	2-7
Format.....	5-48
FOV Chart.....	9-2
FTP	4-23, 6-16
Function Menu	2-10, 3-4

G

Global menu.....	6-2
Global Variable.....	4-4, 4-7
Grayscale Blob Tool.....	2-153
Grouping units	2-12
gvar.dat	2-3

H

Height Extraction	8-154
Histogram.....	5-20
Horizontal Line	4-53
HSB Color System	2-488

I/O Monitor & Diagnostics	5-23
Image Archive Settings.....	5-4
Image Capture Buffer Settings	4-12
Image Display	4-26, 4-42
Image Display Information	4-62
Image Extraction Filter.....	2-497
Image Output Unit	2-458
Image Region.....	2-482
Image Variable	4-4, 4-8
Image Viewer	5-3
Image Zoom In/Out	1-14
inspect.dat	2-3
Inspection Date.....	4-60
Inspection Time	4-61
Intensity Tool.....	2-220

J

Judgment Settings	4-3
Jump	2-13

L

LED Intensity Adjustment	8-168
Lens	9-2
Library Menu.....	2-252, 2-270
Lighting Configuration	6-9
Line Camera Setting Navigation	7-45
Line Scan Camera	8-169
Linescan Calibration	8-184
List of Variables	4-68
LJ-V Series Head.....	8-11, 8-22
Load (Program).....	2-20
Local Variable	4-4, 4-6
Lock/Unlock Group-Lock	4-24
Logo Image (BMP).....	4-65
logo.bmp	2-3
Loop Function Unit	2-313
LumiTrax Mode	7-4
LumiTrax Specular Reflection Mode.....	7-5

M

- Main Specifications 9-18
 Mask Region 2-480
 Measured Value List 5-17
 Menu Opacity 1-14, 6-6
 Modification Log (Start/Stop) 5-42
 Mouse 1-10
 Mouse Settings 6-7
 Multi-Profile Defect Tool 2-202
 MultiSpectrum Mode 7-6

N

- New (Program) 2-4
 NG Master Image 5-10

O

- OCR Custom Calendar 2-246, 2-264
 OCR Tool 2-255
 OCR2 Tool 2-235
 OK Master Image 5-10
 On-Screen Graphics Unit 2-432
 OP-87506 1-10
 Operation 3-2
 Options Menu 4-2

P

- Page Frame 4-26, 4-46
 Parallel Terminal Output Unit 2-447
 Pattern Search Tool 2-44
 PatternTrax Tool 2-78
 Pause Unit 2-423
 PLC-Link 6-19
 PLC-Link Monitor & Diagnostics 5-25
 Polygon 4-57
 Position Adjustment Unit 2-306
 Preserve Intensity Filter 2-496
 Profile 8-164
 Profile Defect Tool 2-189
 Profile Measurement 8-49
 Profile Position Tool 2-166
 Profile Width Tool 2-178
 PROFINET 6-31
 PROFINET Monitor & Diagnostics 5-27
 Program 2-3, 2-18
 Program Branch Unit 2-311
 Program Name 4-59

R

- Recipe Function 8-194
 Recipe Name 4-59
 Rectangle 4-52
 ref*_***.bmp/jpg 2-3
 Register Image 2-468
 Registered Image File Type 6-5
 Rename (Program) 2-18
 Replay 5-8
 Resources 5-49
 Resultant Image Variable 4-8
 Retest 5-9
 Retest Images 5-10
 RS-232C 1-13, 6-18
 RS-232C Monitor 5-23
 Run Mode 1-5, 1-6

S

- Save Program 2-17
 Scaling 4-18, 8-165
 Screen Display Style 4-34
 Screen Editor 4-25
 Screen Parts 4-42
 Scroll 1-15
 Setup Mode 1-7
 Shading Correction Filter 2-497
 ShapeTrax2 Tool 2-66
 ShapeTrax3 Tool 2-52
 SNTP 6-38
 Standard Lighting Mode 7-7
 Standard Parts 4-26, 4-59
 Startup Settings 6-6
 Statistics 5-15
 Subtraction Filter 2-494
 System information 6-45
 System Settings 6-4
 System Variable 4-4

T

Table	4-58
Target FTP Server Settings	4-23
Terminal I/O Delay Unit	2-426
Text	4-48
Timer End Unit	2-425
Timer Start Unit.....	2-424
Total Status	4-3
Total Status Pass/Fail	4-64
Touch menu	1-10, 1-18
Trend Graph.....	5-19
Troubleshooting.....	9-33
Types of Settings Files	2-3

U

Unit Edit Startup Settings	4-20
Unit Judgment Results	4-69
Unit Results of All Units	4-70
Unit Results of Non-Vision Tools Units	4-67
Unit Results of Vision Tools Units.....	4-65
Update Reference Position Information.....	4-22
Update Registered Image Information.....	4-21
USB HDD	1-19
User Accounts	5-41
User Menu Unit	2-430
User Variable.....	4-4
Utility.....	5-2

V

Value	4-46
Variable Delay Unit	2-428
Variable Settings.....	4-4
Vertical Line	4-54
VIEW toolbar.....	1-13
VNC.....	6-37

W

White Balance.....	6-2, 6-10
Working Distance	9-2

X

XG-035C	9-12
XG-035M	9-12
XG-200C	9-6
XG-200M	9-6
XG-H035C.....	9-12
XG-H035M	9-12
XG-H200C.....	9-6
XG-H200M	9-6
XG-H500C.....	9-4
XG-H500M	9-4
XG-HL02M	9-15
XG-HL04M	9-15
XG-HL08M	9-16
XG-S035C	9-13
XG-S035M.....	9-13
XG-S200C	9-14
XG-S200M.....	9-14

Z

Zoom Information	4-63
------------------------	------

Revision history

Date printed	Revision number	Revision contents
October 2016	Official release	
February 2017	Revised 1st edition	Edition for version 1.1.0000
October 2017	Revised 2nd edition	Edition for version 1.2.0000
January 2018	Revised 3rd edition	Edition for version 1.2.0003
March 2018	Revised 5th edition	Edition for version 1.3.0000

WARRANTIES AND DISCLAIMERS

- (1) KEYENCE warrants the Products to be free of defects in materials and workmanship for a period of one (1) year from the date of shipment. If any models or samples were shown to Buyer, such models or samples were used merely to illustrate the general type and quality of the Products and not to represent that the Products would necessarily conform to said models or samples. Any Products found to be defective must be shipped to KEYENCE with all shipping costs paid by Buyer or offered to KEYENCE for inspection and examination. Upon examination by KEYENCE, KEYENCE, at its sole option, will refund the purchase price of, or repair or replace at no charge any Products found to be defective. This warranty does not apply to any defects resulting from any action of Buyer, including but not limited to improper installation, improper interfacing, improper repair, unauthorized modification, misapplication and mishandling, such as exposure to excessive current, heat, coldness, moisture, vibration or outdoors air. Components which wear are not warranted.
- (2) KEYENCE is pleased to offer suggestions on the use of its various Products. They are only suggestions, and it is Buyer's responsibility to ascertain the fitness of the Products for Buyer's intended use. KEYENCE will not be responsible for any damages that may result from the use of the Products.
- (3) The Products and any samples ("Products/Samples") supplied to Buyer are not to be used internally in humans, for human transportation, as safety devices or fail-safe systems, unless their written specifications state otherwise. Should any Products/Samples be used in such a manner or misused in any way, KEYENCE assumes no responsibility, and additionally Buyer will indemnify KEYENCE and hold KEYENCE harmless from any liability or damage whatsoever arising out of any misuse of the Products/Samples.
- (4) **OTHER THAN AS STATED HEREIN, THE PRODUCTS/SAMPLES ARE PROVIDED WITH NO OTHER WARRANTIES WHATSOEVER. ALL EXPRESS, IMPLIED, AND STATUTORY WARRANTIES, INCLUDING, WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF PROPRIETARY RIGHTS, ARE EXPRESSLY DISCLAIMED. IN NO EVENT SHALL KEYENCE AND ITS AFFILIATED ENTITIES BE LIABLE TO ANY PERSON OR ENTITY FOR ANY DIRECT, INDIRECT, INCIDENTAL, PUNITIVE, SPECIAL OR CONSEQUENTIAL DAMAGES (INCLUDING, WITHOUT LIMITATION, ANY DAMAGES RESULTING FROM LOSS OF USE, BUSINESS INTERRUPTION, LOSS OF INFORMATION, LOSS OR INACCURACY OF DATA, LOSS OF PROFITS, LOSS OF SAVINGS, THE COST OF PROCUREMENT OF SUBSTITUTED GOODS, SERVICES OR TECHNOLOGIES, OR FOR ANY MATTER ARISING OUT OF OR IN CONNECTION WITH THE USE OR INABILITY TO USE THE PRODUCTS, EVEN IF KEYENCE OR ONE OF ITS AFFILIATED ENTITIES WAS ADVISED OF A POSSIBLE THIRD PARTY'S CLAIM FOR DAMAGES OR ANY OTHER CLAIM AGAINST BUYER.** In some jurisdictions, some of the foregoing warranty disclaimers or damage limitations may not apply.

BUYER'S TRANSFER OBLIGATIONS:

If the Products/Samples purchased by Buyer are to be resold or delivered to a third party, Buyer must provide such third party with a copy of this document, all specifications, manuals, catalogs, leaflets and written information provided to Buyer pertaining to the Products/Samples.

Specifications are subject to change without notice.

KEYENCE CORPORATION

1-3-14, Higashi-Nakajima, Higashi-Yodogawa-ku, Osaka, 533-8555, Japan PHONE: +81-6-6379-2211

www.keyence.com

AUSTRIA

Phone: +43 22 36-3782 66-0

FRANCE

Phone: +33 1 56 37 78 00

BELGIUM

Phone: +32 1 528 1222

GERMANY

Phone: +49 6102 36 89-0

BRAZIL

Phone: +55-11-3045-4011

HONG KONG

Phone: +852-3104-1010

CANADA

Phone: +1-905-366-7655

HUNGARY

Phone: +36 1 802 73 60

CHINA

Phone: +86-21-3357-1001

INDIA

Phone: +91-44-4963-0900

CZECH REPUBLIC

Phone: +420 222 191 483

ITALY

Phone: +39-02-6688220

KOREA

Phone: +82-31-789-4300

MALAYSIA

Phone: +60-3-7883-2211

MEXICO

Phone: +52-55-8850-0100

NETHERLANDS

Phone: +31 40 20 66 100

PHILIPPINES

Phone: +63-(0)2-981-5000

POLAND

Phone: +48 71 36861 60

ROMANIA

Phone: +40 269-232-808

SINGAPORE

Phone: +65-6392-1011

SLOVAKIA

Phone: +421 2 5939 6461

SLOVENIA

Phone: +386 1-4701-666

SWITZERLAND

Phone: +41 43-45577 30

TAIWAN

Phone: +886-2-2721-8080

THAILAND

Phone: +66-2-369-2777

UK & IRELAND

Phone: +44-1908-696900

USA

Phone: +1-201-930-0100

VIETNAM

Phone: +84-24-3772-5555

