



YAMAHA ROBOT Vision System

RCXiVY2 +

User's Manual

RCX340 / RCX320

Ver. 1.00

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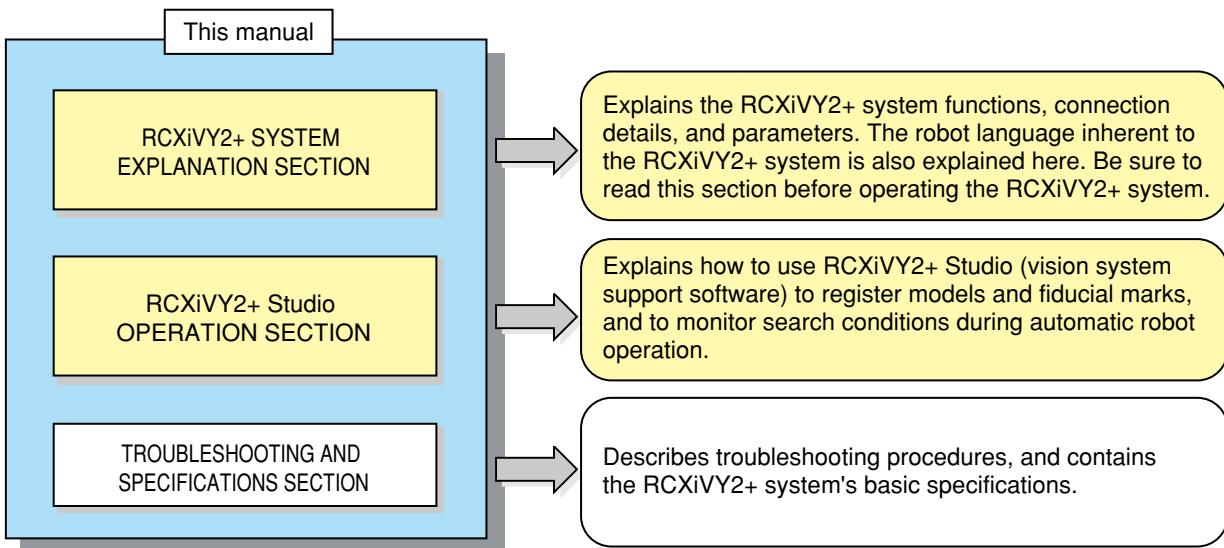
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Introduction

Thank you for purchasing the RCXiVY2+ YAMAHA Robot Vision System. Please read this manual carefully before using the RCXiVY2+ system in order to ensure correct and safe operation.

About this manual

This manual comprises 3 main sections: the RCXiVY2+ SYSTEM EXPLANATION SECTION, the RCXiVY2+ Studio OPERATION SECTION, and the TROUBLESHOOTING AND SPECIFICATIONS SECTION. To use the RCXiVY2+ system in an efficient manner, refer to the sections which apply to the purpose at hand. Moreover, the manual should be stored in a location where it can be easily referenced when necessary, and the manual must always be forwarded to the end-user.



When performing RCXiVY2+ system installation, operations, and adjustments, etc., use one of the following methods to ensure easy referencing to the contents of this manual.

1. Install, operate or adjust the robot and controller while viewing the manual on your computer screen.
2. Install, operate or adjust the robot and controller while referring to a printout of the necessary pages from the manual.
3. Install, operate or adjust the robot and controller while referring to the printed version of the manual (available for an additional fee).

TIP

Manuals are available by downloading from our website (Member Site). Registering is required for accessing the member site:
https://www2.yamaha-motor.co.jp/Robot/Member/loginagain/lang_div/en

Although care has been taken to ensure the accuracy of this manual content, please contact your distributor if content errors are found.

Refer to the relevant user's manuals for information regarding the robot, and regarding subjects other than the installation, operations, and adjustments inherent to the RCXiVY2+ system. Refer to the YAMAHA Robot Controller RCX3 series Programming Manual for robot language information beyond basic items such as the robot language command statement format, variables, and constants, and for information outside the scope of the RCXiVY2+ system's inherent robot language.

Safety cautions and marks

This manual uses the symbol marks shown below to indicate safety instructions which must be heeded, and to specify handling cautions, prohibitions, instructions, and important procedural points, etc. Please familiarize yourself with the meanings of these symbols before reading the manual.

	DANGER	This indicates an immediately hazardous situation which, if not avoided, will result in death or serious injury.
	WARNING	This indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
	CAUTION	This indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury, or damage to the equipment.

Examples	Meaning
  Fire hazard Electric shock hazard	These warning symbols indicate a caution or warning you must heed. The specific caution or warning is often indicated by a pictorial sign. Always follow these instructions to ensure correct and safe product use.
  No disassembly No wet hands	These symbols indicate a prohibited action. The specific prohibited action is often indicated by a pictorial sign. Never attempt the prohibited action.
  Mandatory action Cut off power	This symbol indicates a mandatory action. The specific instruction is often indicated by a pictorial sign. Read the instructions carefully and always use the specified procedure.

This manual also uses the following marks to indicate key points and tips for operation.

	NOTE	Explains the key point in the operation in a simple and clear manner.
	TIP	Gives supplementary information related to robot controller operation.

Warranty

Warranty

For information on the warranty period and terms, please contact our distributor where you purchased the product.

■ This warranty does not cover any failure caused by:

1. Installation, wiring, connection to other control devices, operating methods, inspection or maintenance that does not comply with industry standards or instructions specified in the YAMAHA manual;
2. Usage that exceeded the specifications or standard performance shown in the YAMAHA manual;
3. Product usage other than intended by YAMAHA;
4. Storage, operating conditions and utilities that are outside the range specified in the manual;
5. Damage due to improper shipping or shipping methods;
6. Accident or collision damage;
7. Installation of other than genuine YAMAHA parts and/or accessories;
8. Modification to original parts or modifications not conforming to standard specifications designated by YAMAHA, including customizing performed by YAMAHA in compliance with distributor or customer requests;
9. Pollution, salt damage, condensation;
10. Fires or natural disasters such as earthquakes, tsunamis, lightning strikes, wind and flood damage, etc;
11. Breakdown due to causes other than the above that are not the fault or responsibility of YAMAHA;

■ The following cases are not covered under the warranty:

1. Products whose serial number or production date (month & year) cannot be verified.
2. Changes in software or internal data such as programs, points, calibration, or registered models that were created or changed by the customer.
3. Products whose trouble cannot be reproduced or identified by YAMAHA.
4. Products utilized, for example, in radiological equipment, biological test equipment applications or for other purposes whose warranty repairs are judged as hazardous by YAMAHA.

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1. Overview

1.1 Features and functions

1.1.1 RCXiVY2+ system features

The RCXiVY2+ YAMAHA Robot Vision System is a dedicated unit which is installed in the RCX340/RCX320 robot controller for the purpose of processing information obtained from cameras, and it allows the robot to search for workpieces, pick them up, verify their positions, and install them. The RCXiVY2+ system in effect gives the robot an "eye", thereby greatly reducing the man-hours which were previously required for robot handling preparations (teaching, arranging the parts to be supplied, positioning, etc.).

■ Easy calibration

"Calibration" refers to the process in which the coordinates (camera coordinates) of the image acquired by the camera are aligned with the robot coordinates. The RCXiVY2+ system features an interactive operation format at the RCX-Studio which both simplifies and speeds up troublesome calibrations.

■ Dedicated high-speed bus line connection

A direct bus connection to the robot controller CPU board enables much faster data transmissions than is possible by commercially available serial communication formats.

■ No coordinate data conversion program required

The workpiece coordinates acquired from the camera image can be output as robot point data, eliminating the need for creating a coordinate conversion program at the robot controller.

■ Various operations controlled in the robot language

The RCXiVY2+ system's dedicated robot language lets you perform various types of control, such as control of the camera and the lighting.

The RCXiVY2+ system is a unit that is installed in the RCX340 / RCX320 robot controller.

RCX340 / RCX320 robot controller —— **RCXiVY2+ unit**

└ Robot vision function

Lighting control board

Lighting control function to the RCXiVY2+ unit

1.1.2 RCXiVY2+ unit features and functions

The RCXiVY2+ unit can be installed to add a robot vision function to the RCX340 / RCX320 robot controller. The RCXiVY2+ unit offers the following features and functions.

■ Edge (contour) searches

The RCXiVY2+ system performs edge searches based on contour shape information. Conventional machine vision systems often employ a gray search format (normalized correlation search) which is easily affected by the lighting conditions and by missing or soiled workpieces. The edge search format of the RCXiVY2+ system is relatively unaffected by missing and soiled workpieces.

■ Additional function to extend the application range

A measurement function to detect the center of the circle or the edge and a blob analysis to detect an irregular shape object are incorporated. Various applications are supported by these functions.

■ Generous number of registered models

Up to 254 models can be registered and used in searches. This permits easy setup changes simply by changing the model number.

■ RCXiVY2+ Studio permits search conditions to be monitored during automatic robot operation

RCXiVY2 + Studio and external monitor permit monitoring of work search conditions during automatic robot operation, and monitoring of fiducial mark search conditions during calibration setting operations.

1.1.3 Lighting control board features and functions

The lighting control board is used to add a lighting control function to the RCXiVY2+ system. The lighting control board offers the following features and functions.

■ Digitally modulated light format used for PWM

A digitally modulated light format is used for pulse width modulation (PWM), resulting in stable modulated light.

■ Selection of PWM modulated light frequency

The PWM modulated light frequency can be selected as 62.5 kHz or 125 kHz.

If you shorten the camera's exposure time, raising the PWM modulated light frequency will reduce inconsistency in the brightness of the acquired image.

■ Selection of light emission format (continuous light / strobe light) according to the application

The light emission format can be selected according to the application in question.

Continuous light : 100-step modulated light (0 to 100%)

Strobe light : 100-step modulated light (0 to 100%), light emission automatically synchronized to the camera

■ Automatic strobe light synchronization

When the RCXiVY2+ unit is installed, and the RCXiVY2+ unit's setting is either S/W trigger or H/W trigger, executing a robot language statement to acquire an image will illuminate the strobe with automatic synchronization.

■ Supports 12 and 24 VDC lighting specifications (constant voltage type)

Either a 12 VDC or 24 VDC lighting specification can be used to supply power which matches the LED lighting specification in question. LED lighting colors (red, white, green, and blue) are also supported.

■ 2 lighting channels output, with maximum output capacity of 80 W

2 lighting channels can be used simultaneously, provided that the total power consumption for both channels does not exceed 80 W (for 24 VDC. For 12 VDC, the maximum output capacity is 40 W).

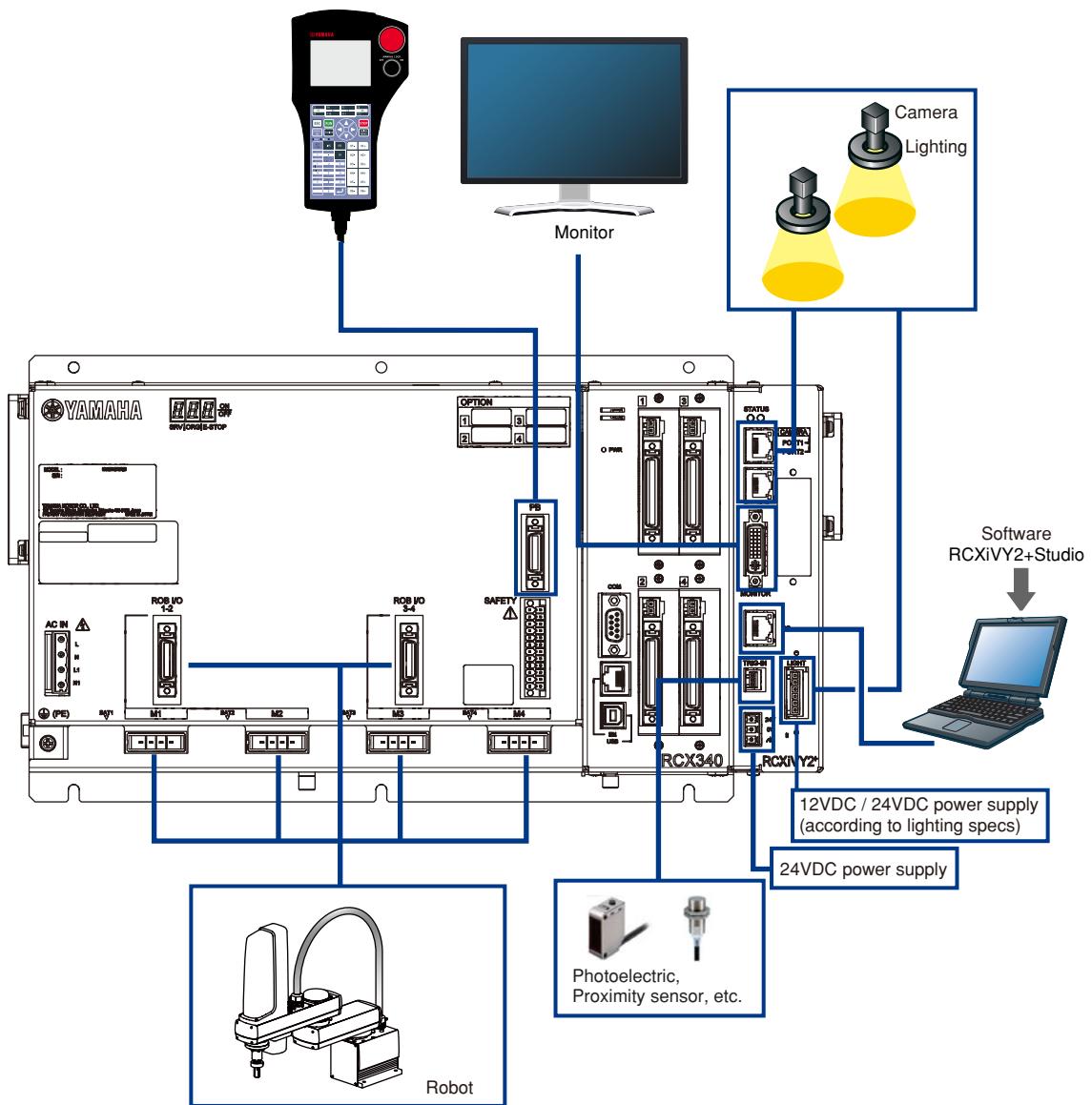
The modulated light and lighting control mode settings can be specified individually.

1.2 System configuration

1.2.1 RCXiVY2+ system configuration

The RCXiVY2+ system enables a system configuration like that shown below.

System configuration (Example)



* The above illustration is an example of system structure for the RCXiVY2+ unit (when the lighting control board option is selected).

* Connections to the STD.DIO, ACIN, and SAFETY connectors are not shown in the above illustration.

1.2.2 Robot configuration when using the RCXiVY2+ system

■ Robot axis configuration when using the RCXiVY2+ system

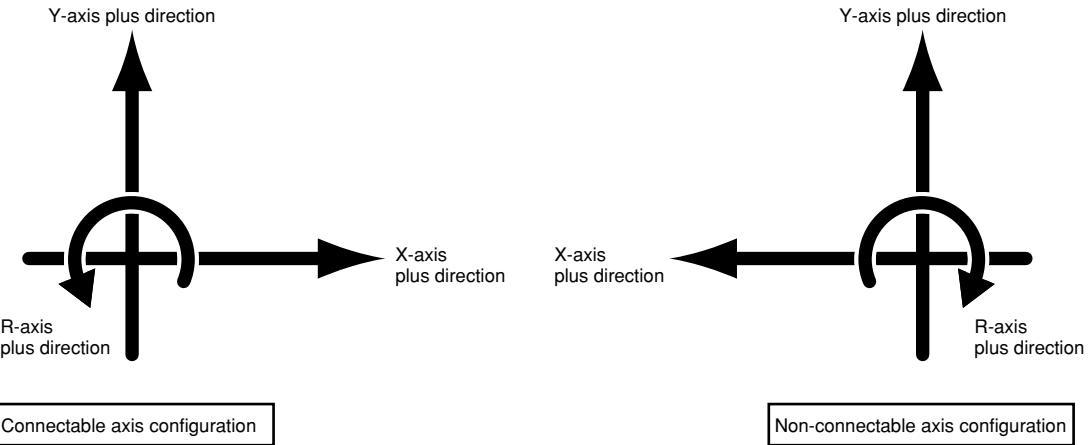
To use the RCXiVY2+ system, the robot axis configuration must be set as follows:

● SCARA robots

As shown in the figure below, the standard coordinates of SCARA robots must be set such that the "Y plus" direction is set at 90-degree counterclockwise with respect to the "X plus" direction. Also, the "R plus" direction must be set counterclockwise.

● Cartesian robots

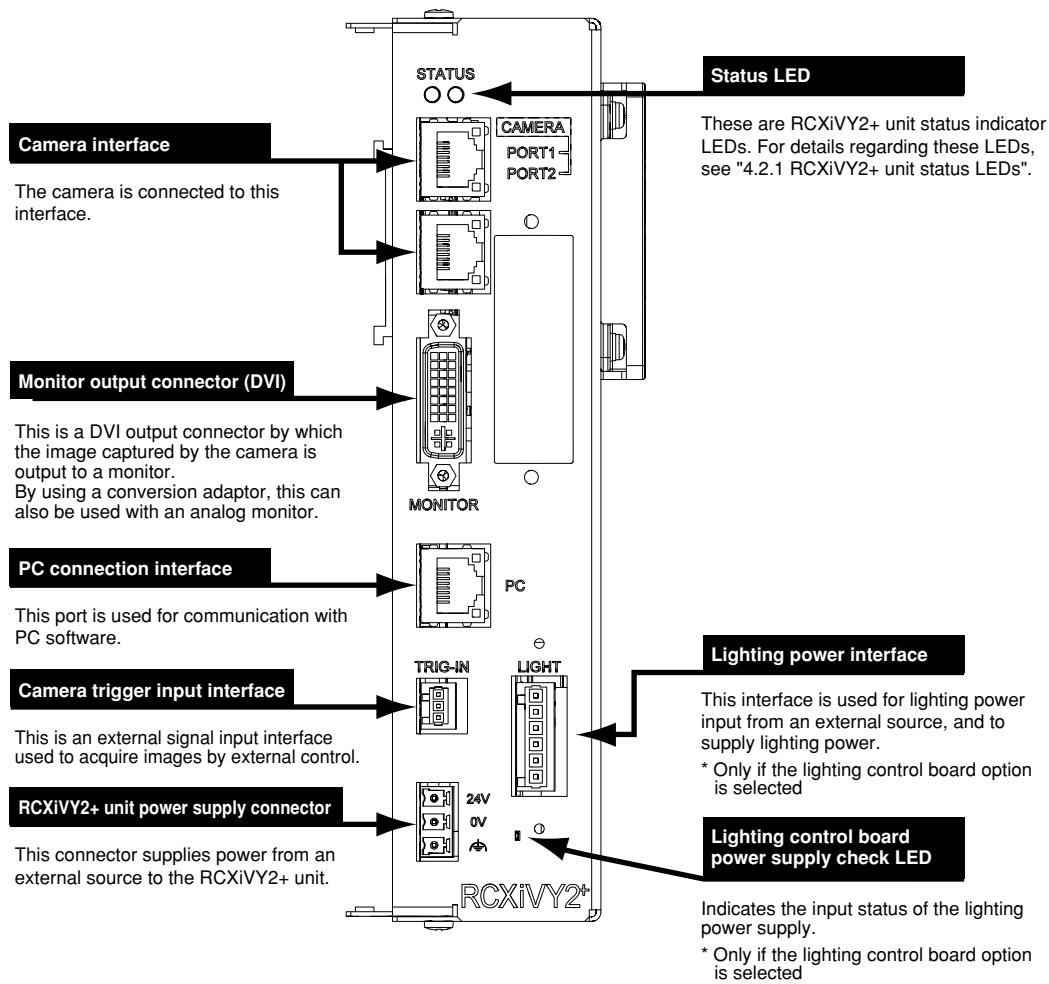
As shown in the figure below, the standard coordinates of Cartesian robots must be set such that the Y-axis plus direction is set at 90-degree counterclockwise with respect to the X-axis plus direction. Also, the R-axis plus direction must be set counterclockwise if the robot has an R-axis.



1.3 Component names and functions

This section explains the names and functions for each component of the RCXiVY2+ unit.

Names and functions of RCXiVY2+ unit components



1.4 Required items and options

1.4.1 Required items

The following items are required in order to use the RCXiVY2+ system.

1.4.1.1 YAMAHA controller vision unit (RCXiVY2+ unit)

The RCXiVY2+ unit is used to add a robot vision function to the RCX340 / RCX320 robot controller, and is installed in the RCX340 / RCX320 robot controller which the customer has purchased.

[RCXiVY2+ unit accessories]

Camera trigger input cable connector

Type: KX0-M657L-00 1 piece

Dedicated tool

Type: KX0-M657M-00 1 piece

Type: KCF-M5382-00 1 piece

} Set type: KX0-M657K-00

24V power supply connector

Type: KCF-M5382-00 1 piece

1.4.1.2 Vision system support software (RCXiVY2+ Studio)

This RCXiVY2+ system support software is connected to the RCXiVY2+ unit in order to register models and fiducial marks, and to monitor search conditions during automatic robot operation.

1.4.2 Options

The following options are available for use in the RCXiVY2+ system.

1.4.2.1 Lighting control board for RCXiVY2+ unit

The lighting control board adds a lighting control function to the RCXiVY2+ system. The lighting control board is installed in the RCXiVY2+ unit.

[Lighting control board accessories]

Lighting power cable connector

Type: KX0-M657L-10 1 piece

Wiring lever

Type: KX0-M657M-10 1 piece

} Set type: KX0-M657K-10

1.4.2.2 Camera cable

These cables are used to connect the camera to the RCXiVY2+ unit.

Type:	5 m	KCX-M66F0-00
	10 m	KCX-M66F0-10
	15 m	KCX-M66F0-20

For details on connections, refer to "3.2.1.2 Wiring to the camera connector".

1.4.2.3 Camera

Type:	400,000 pixels	KCX-M6541-00
	1,600,000 pixels	KCX-M6541-10
	3,200,000 pixels	KCX-M6541-20
	5,000,000 pixels	KCX-M6541-30

For the dimensions of the camera, refer to C TROUBLESHOOTING AND SPECIFICATIONS SECTION "3.2 Camera".

1.4.2.4 Lens

Type:	8 mm	KCX-M7214-00
	12 mm	KCX-M7214-10
	16 mm	KCX-M7214-20
	25 mm	KCX-M7214-30
	8 mm megapixel support	KCX-M7214-40
	12 mm megapixel support	KCX-M7214-50
	16 mm megapixel support	KCX-M7214-60
	25 mm megapixel support	KCX-M7214-70

For the dimensions of the lens, refer to C TROUBLESHOOTING AND SPECIFICATIONS SECTION "3.3 Lenses".

1.4.2.5 Close-up ring

Type:	0.5 mm	KX0-M7215-00
	1.0 mm	KX0-M7215-10
	2.0 mm	KX0-M7215-20
	5.0 mm	KX0-M7215-30

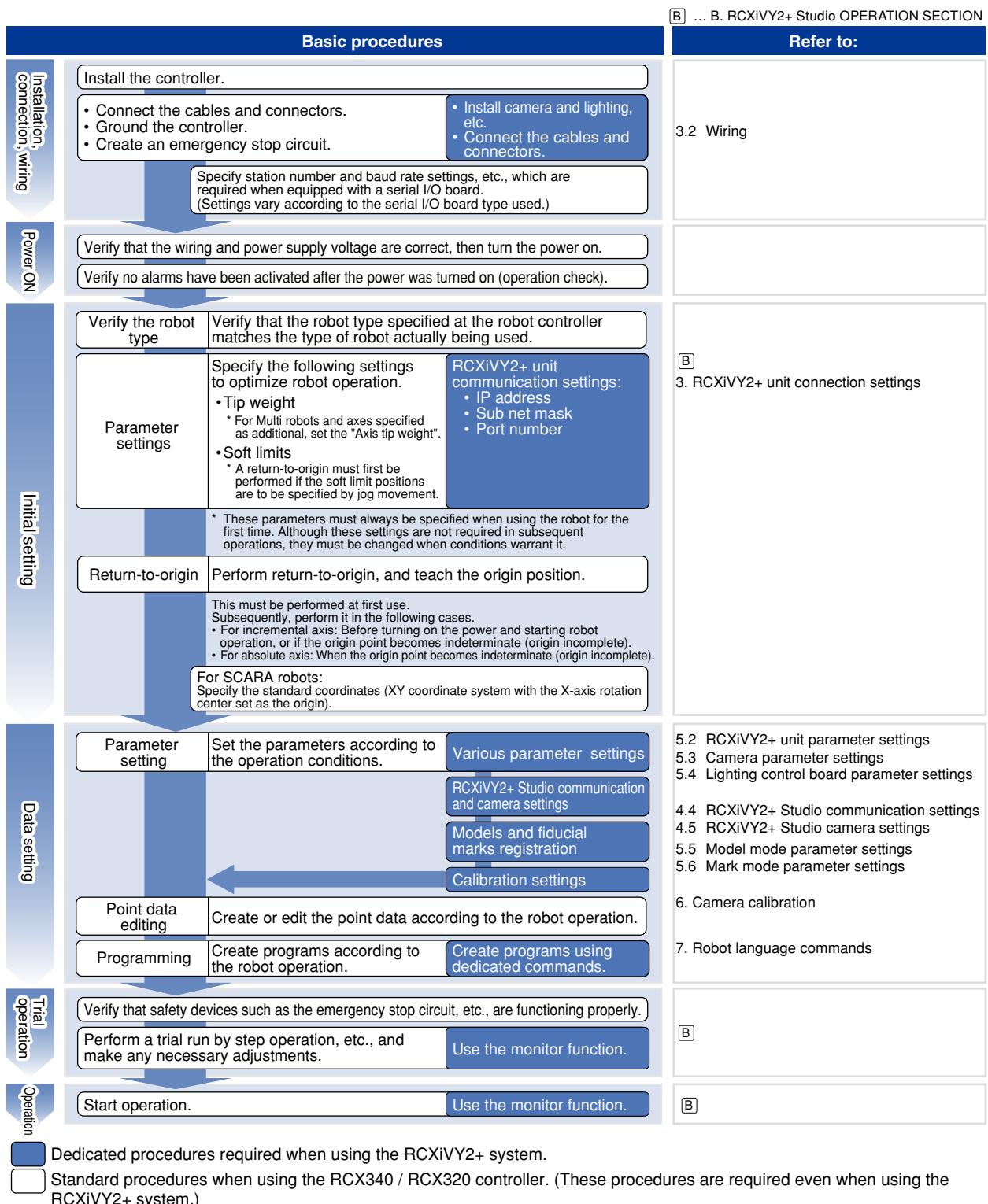
1.4.2.6 Calibration jig

Type: KCX-M7200-00

For the dimension of the jig, refer to C TROUBLESHOOTING AND SPECIFICATIONS SECTION "3.4 Calibration jig".

2. Preparations for RCXiVY2+ system use

This section explains the basic preparation procedures from the point when the RCXiVY2+ system is purchased, until it is operated. The preparation items are as shown in the illustration below. Refer to the relevant user's manuals for information regarding robot operation and regarding subjects other than the installation, operation, and adjustment procedures inherent to the RCXiVY2+ system.



3. Installation

3.1 Installation conditions

■ Controller installation conditions

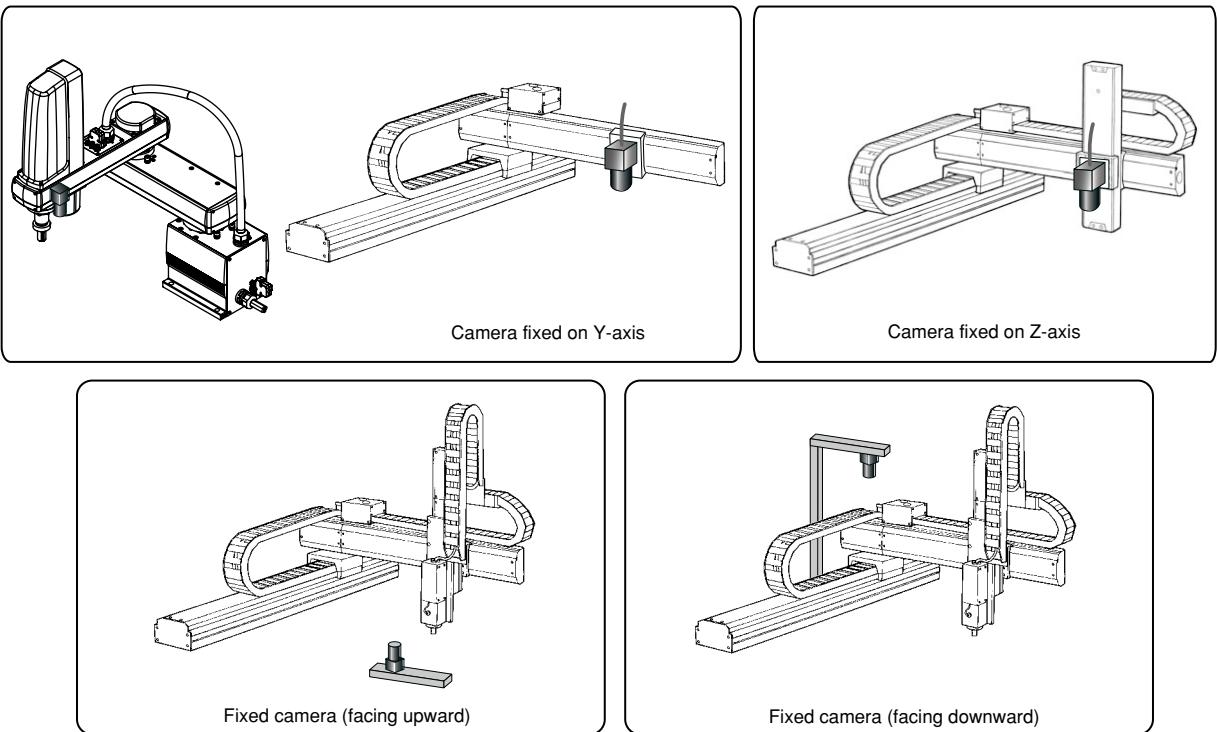
For details about the controller installation conditions, refer to the RCX3 Series User's Manual.

■ Camera installation conditions

The camera can be installed downward, upward, or on the 2nd arm. Install the camera in perpendicular to the plane where the robot is installed. In addition, when the distortion and inclination correction function is used, the camera can be installed obliquely.

It is recommended to install on a metal plate for the heat radiation of the camera.

■ Examples of camera installation

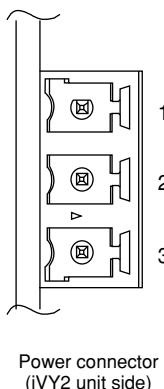


3.2 Wiring

3.2.1 Wiring to the RCXiVY2+ unit

3.2.1.1 Wiring to the 24 VDC power supply

The following shows the terminal layout of the power connector on the RCXiVY2+ unit side.



■ Power connector

Terminal No.	Connection	Function
1	+24V	Power supply for RCXiVY2+ unit
2	0V	Power supply 0 V
3	FG	Frame ground (terminal for D-grade grounding work)



CAUTION

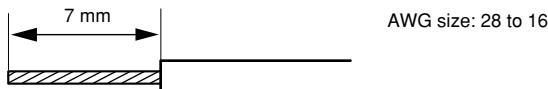
Do not connect the terminals incorrectly. Doing so may cause a malfunction.

■ Wiring to the power connector

Prepare wires to be connected to the 24 VDC power supply and connect the wires to the power connector supplied with the RCXiVY2+ unit.

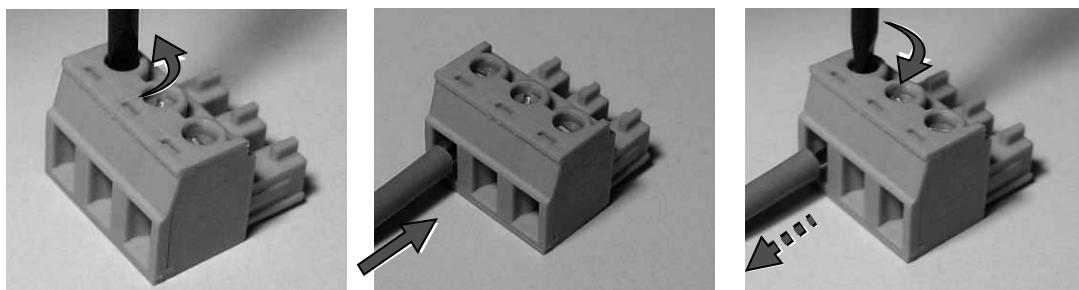
■ Exposing the wire lead

Strip the wire sheath to expose 7 mm of bare lead.



■ Wiring

Follow the steps below to insert the wire lead into the opening in the power connector and make sure that the wire is not disconnected.



(1) Loosen the screw on the top with a small flat-blade screwdriver.

(2) Insert the wire lead stripped into the wire insertion port correctly until it is in contact with the far side.

(3) Tighten the screw on the top with a flat-blade screwdriver. Lightly pull the wire to make sure that it is not disconnected.

Tighten the screw on the top of the power connector with tightening torque shown below.

Tightening torque: 0.22 to 0.25 Nm



WARNING

Connect the grounding line to the frame ground terminal securely to prevent malfunction caused by noise.



CAUTION

- When inserting the wire, pay special attention so that frayed wire leads are not in contact with other conductor.
- If the wire insertion portion deteriorates for some reason, strip the wire and connect it again.

■ Preventive measures for malfunction caused by noise

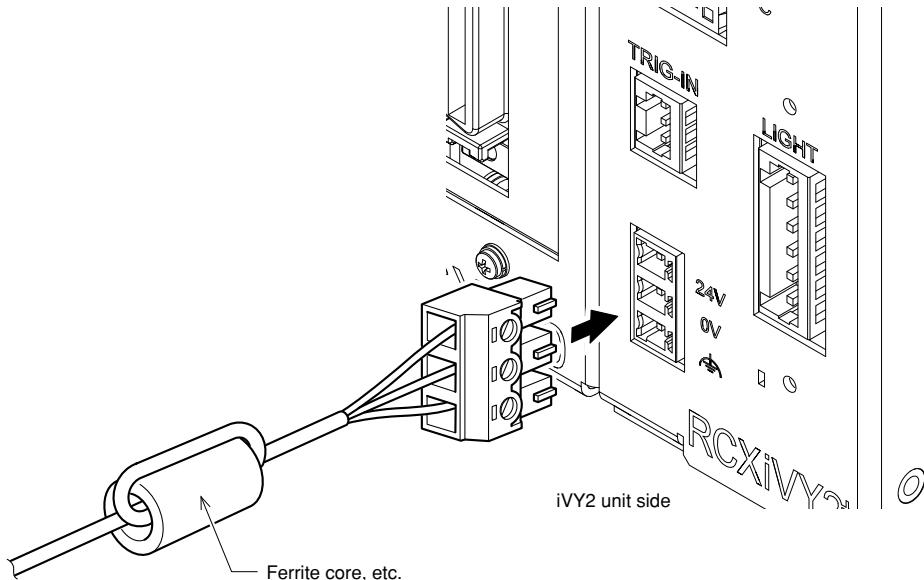
If the RCXiVY2+ unit operation may become unstable due to noise, it is recommended to insert a ferrite core or noise filter into the power supply line.



CAUTION

Locate the ferrite core or noise filter as close to the RCXiVY2+ unit as possible.

Connecting the power connector



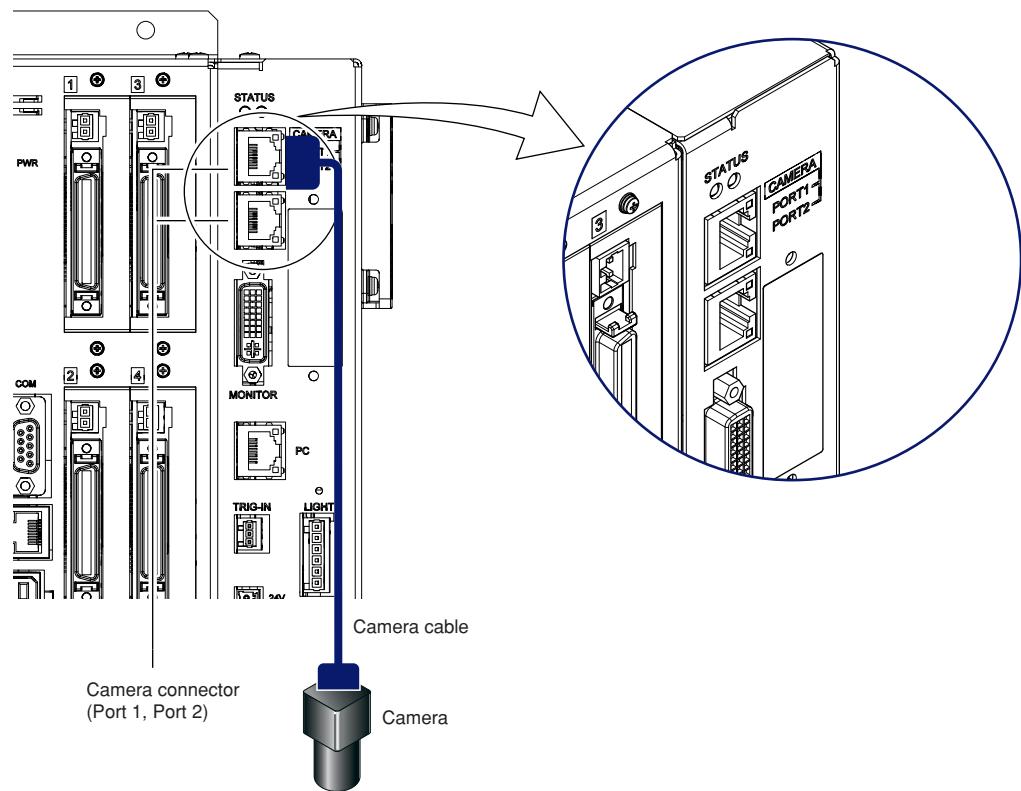
3.2.1.2 Wiring to the camera connector

The camera uses GigE PoE. As the camera cable, use a cable that supports category 5e or higher. When connecting the cable to the camera connector, insert the camera cable into the modular jack until it clicks into place.



CAUTION

- The camera cable is polarized, so do not insert it forcibly. When making the connection, take care to insert it in the correct orientation.
- Do not connect or disconnect the camera cable to the camera connector while the power is on.
- To avoid damaging the camera and the RCXiVY2+ unit, connect or disconnect it only while the power is off.



The camera cable types are shown below.

Camera cable	Types:	5 m	KCX-M66F0-00
		10 m	KCX-M66F0-10
		15 m	KCX-M66F0-20

■ Wiring the camera cable

The camera cable may break if excessive stress is applied to it by bending or twisting continuously. When wiring the camera cable on a movable part, make sure that no excessive stress will be applied to the cable while the robot is moving.

For details regarding the camera cable, refer to "1.4.2 Options", item "2 Camera cable".

■ Noise countermeasures

Cables to be connected to the "M1", "M2", "M3", and "M4" connectors are motor cables for the motor drive.

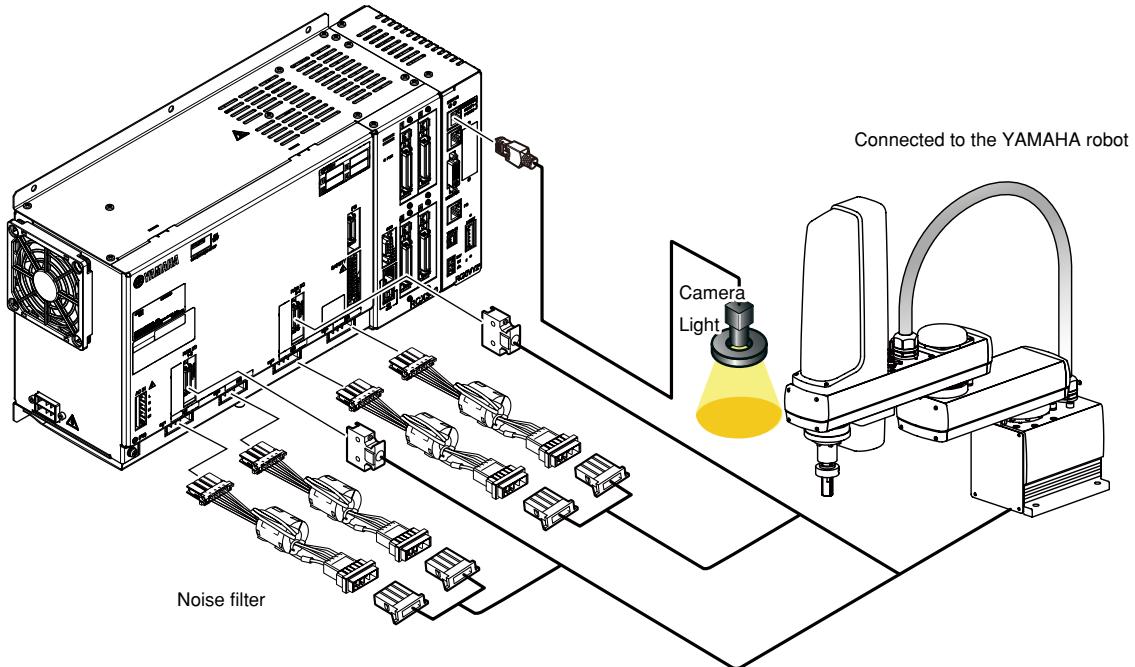
Since the motor cable produces switching noise by motor control, do not wire the camera cable close to the motor cable. Otherwise, the robot may malfunction. In this case, take noise preventive measures described below.

1. Wire the camera cable further away from the motor cable.
2. Install a noise filter in the cable which connects the controller to the robot.

Noise filters

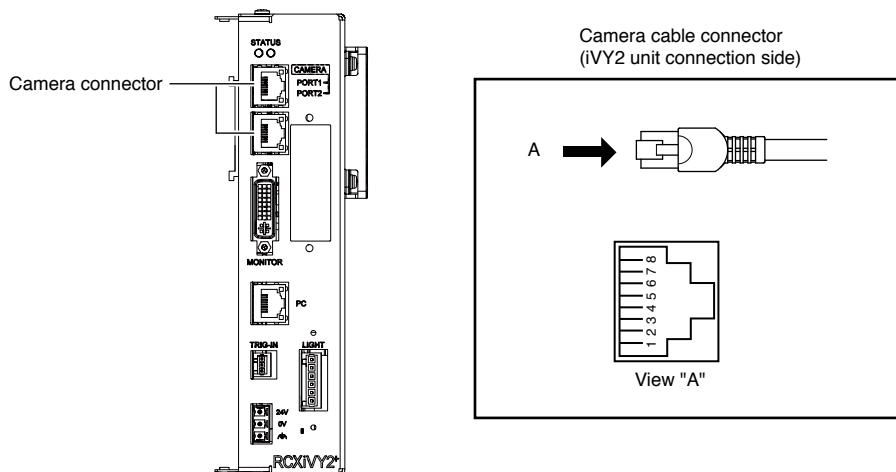
Model: KBG-M6563-00 (for M1 and M3 connectors)

Model: KBG-M6563-10 (for M2 and M4 connectors)



■ Disconnecting the camera cable connector

To remove the camera cable connector from the camera connector, pull it straight out while pressing the tab on the modular jack of the camera cable connector.



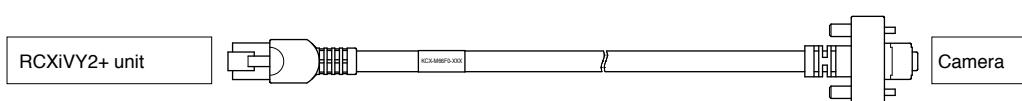
■ Connecting the camera cable connector

On the side of the RCXiIVY2+ unit, insert the modular jack of the camera cable connector until it clicks into place.

On the side of the camera, if the camera cable connector is equipped with locking screws, connect the cable to the camera and use the locking screws to fasten it.

If the camera cable connector is a modular jack, insert the modular jack until it clicks into place.

Example 1) Using a 5-meter cable (KCX-M66F0-00) to connect the RCXiIVY2+ unit and camera



3.2.1.3 Wiring to the camera trigger input interface

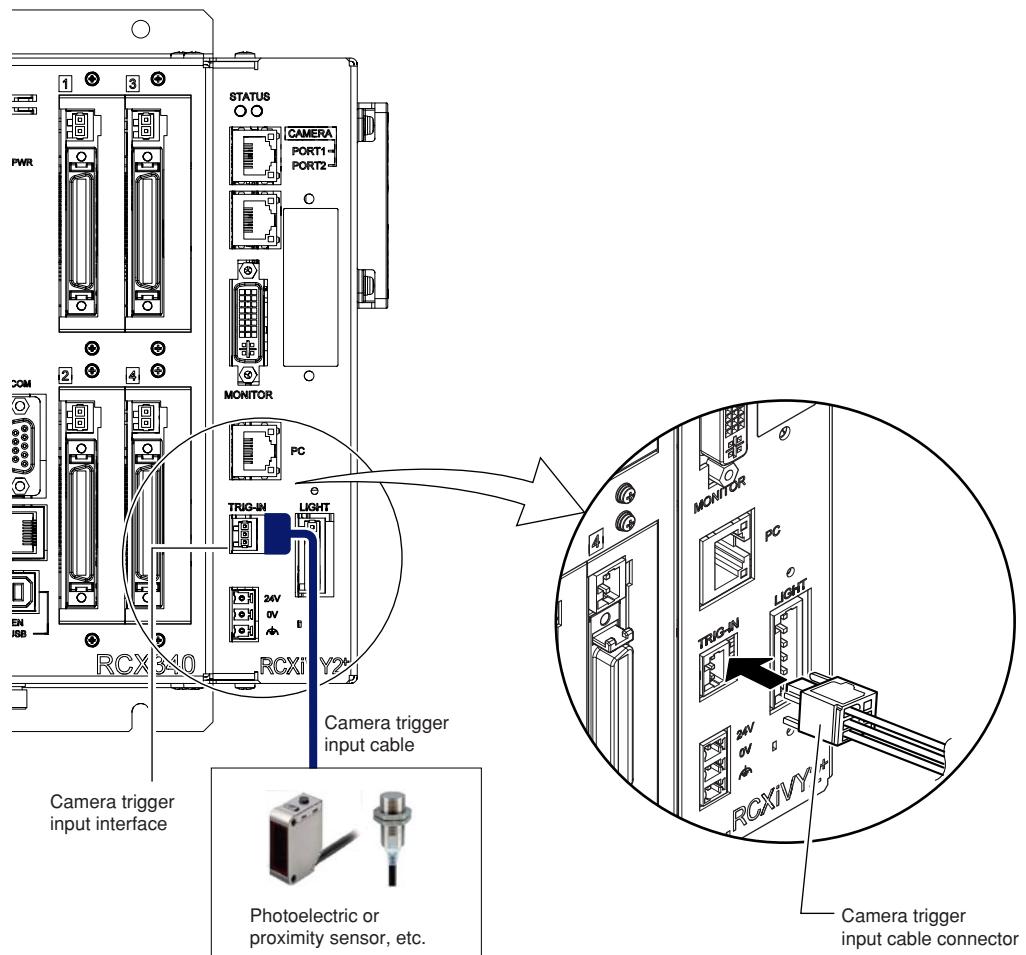
Connect the camera trigger input cable connector to the camera trigger input interface.



DANGER

Be sure that all system power is off when making RCXiVY2+ unit wirings. Failing to do so could result in electrical shocks.

After performing the necessary wire preparation work at the RCXiVY2+ unit's accessory camera trigger input cable connector (see the figure below), connect the cable to the camera trigger input interface.



The camera trigger input cable connector types are shown below.

Camera trigger input cable connector

Type: KX0-M657L-00

Dedicated tool

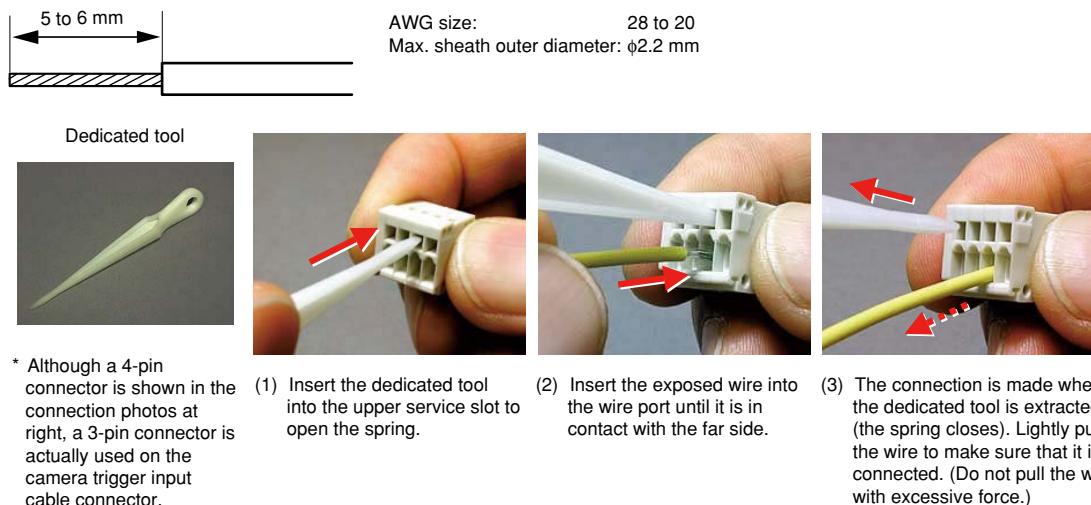
Type: KX0-M657M-00

} Set type: KX0-M657K-00

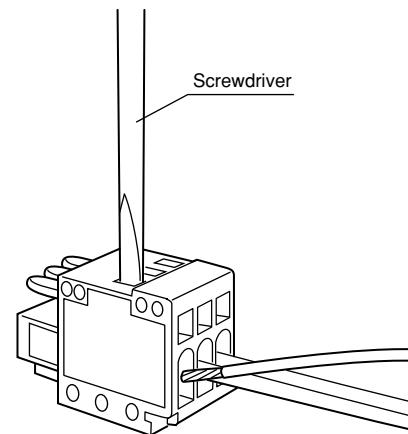
As the photoelectric and proximity sensor used as the trigger, we recommend a non-contact type sensor. If chattering occurs due to a wired type sensor or a relay, the lighting board's strobe might not match the camera's exposure timing, making it impossible to acquire the image accurately. The strobe and exposure start timing may be delayed approximately 5 ms from the trigger input.

■ Wiring connection method

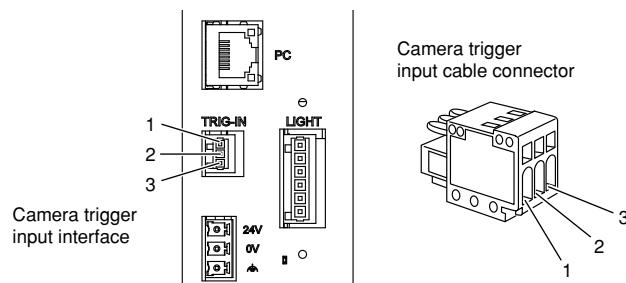
Strip the wire sheath to expose 5 to 6 mm of bare lead.



The exposed wire can also be inserted into the wire port while pressing the spring down with a screwdriver inserted into the upper service slot.

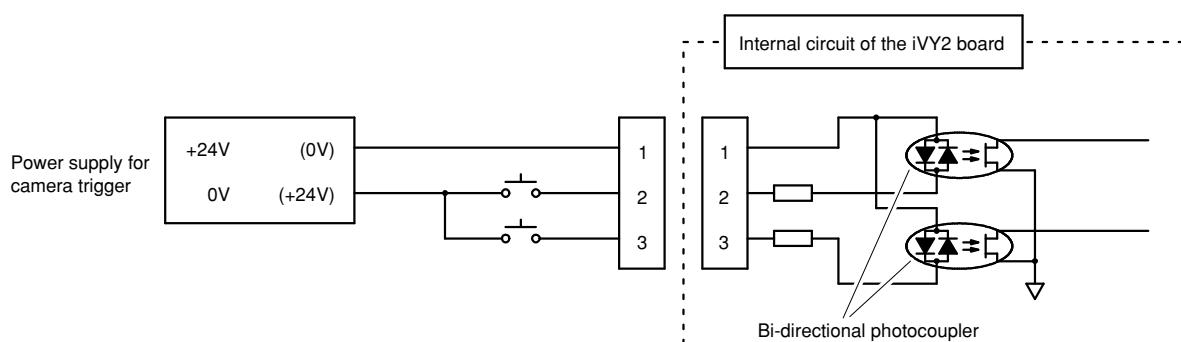


■ Camera trigger input interface signal table



Terminal No.	Signal Name	Signal Description
1	COMMON	External power supply input (0 V / +24 V)
2	C.TRG1	Camera port 1 external trigger input (+24 V / 0 V)
3	C.TRG2	Camera port 2 external trigger input (+24 V / 0 V)

The camera trigger circuit has the following structure.



3.2.1.4 Wiring to the personal computer connector

A 1000BASE-T type personal computer connector is used. The RCXiVY2+ unit is connected directly to the personal computer by a cable.

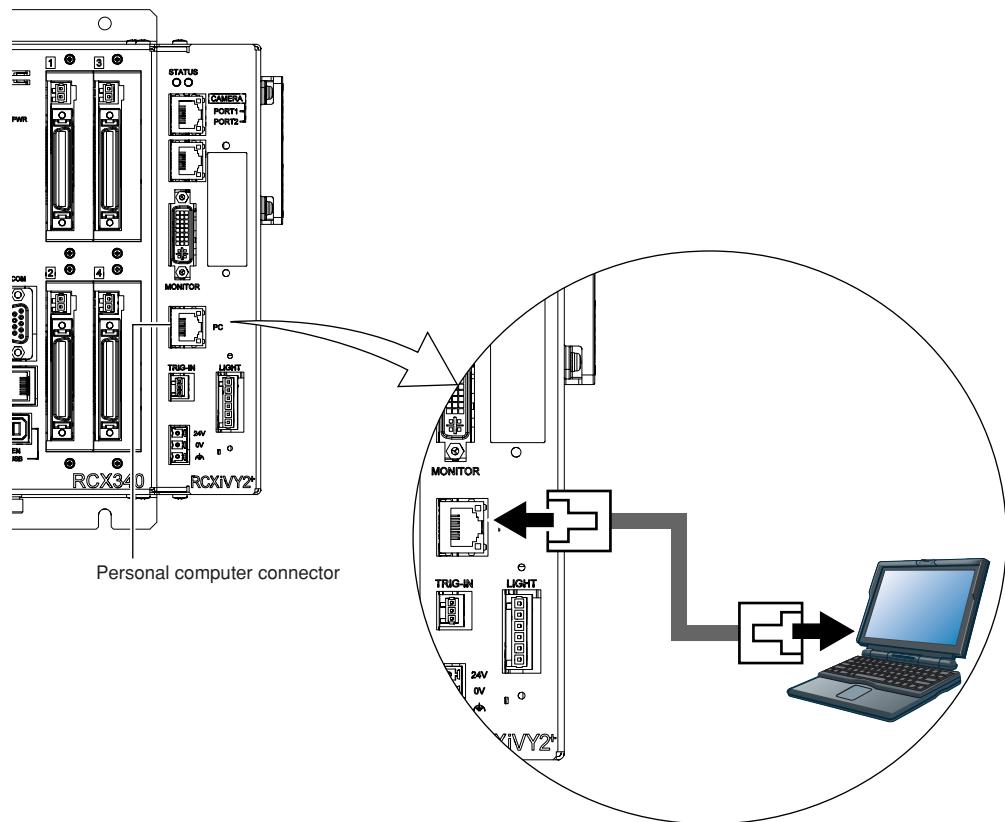
■ Cable to use

Use a cable that supports category 5e or higher

The optional YAMAHA Ethernet cable type is shown below.

Ethernet crossover cable (shielded) Type: 5 m KX0-M55G0-00

Insert the cable's modular jack into the personal computer connector until it clicks into place.



NOTE

YAMAHA recommends using a personal computer which has a wired LAN connector, allowing the cable's modular jack to be plugged directly into the personal computer. Anti-noise performance could be reduced by using a personal computer equipped with LAN conversion type format such as PCMCIA card.

Moreover, because the anti-noise performance is also affected by the personal computer being used, YAMAHA cannot guarantee the anti-noise performance of its recommended optional cable.

3.2.2 Wiring to the lighting control board

3.2.2.1 Wiring to the lighting power interface

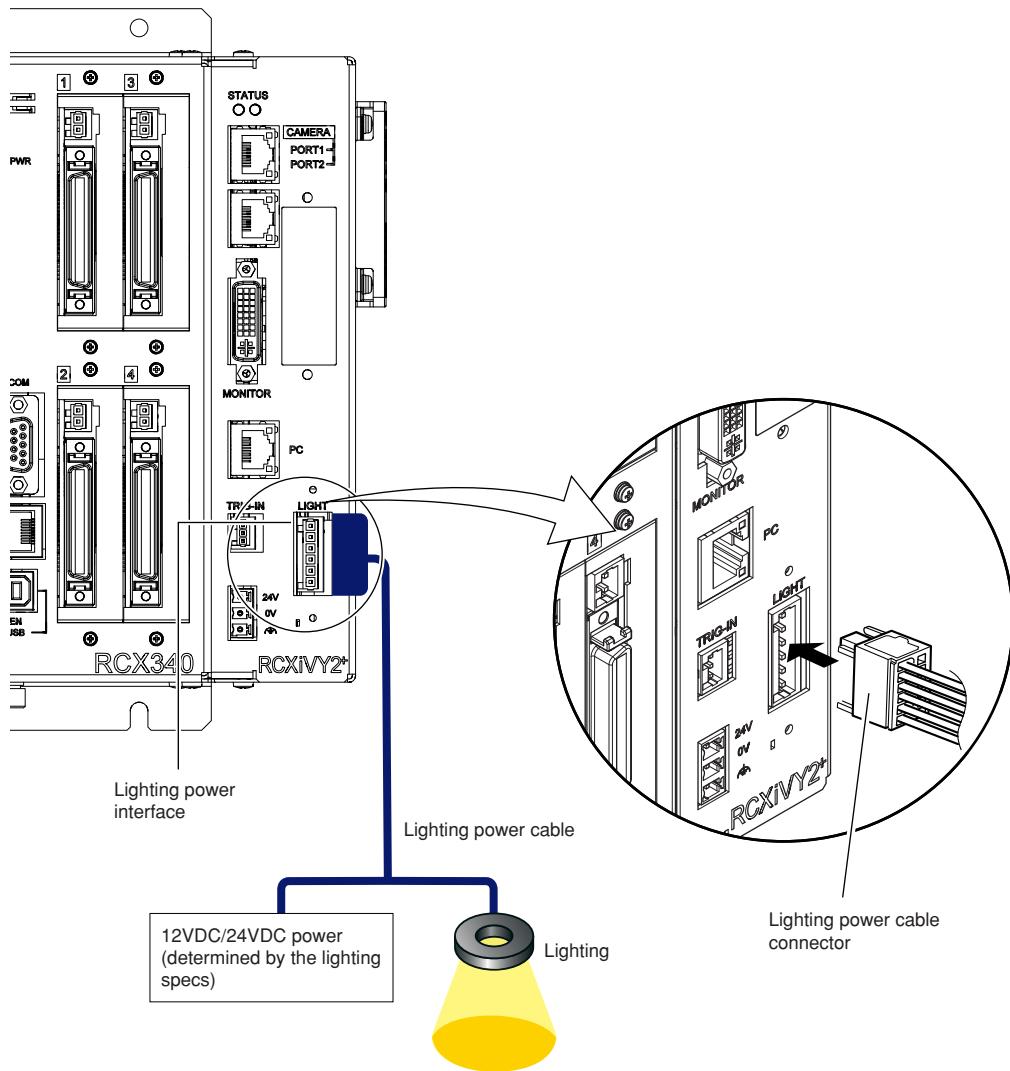
Connect the lighting power cable connector to the lighting power interface.

* Only if the lighting control board option is selected.


DANGER

Be sure that all system power is off when making lighting control board wirings. Failing to do so could result in electrical shocks.

After performing the necessary wire preparation work at the lighting control board's accessory lighting power cable connector (see the figure below), connect the cable to the lighting power interface.



The lighting power interface types are shown below.

Lighting power interface

Type: KX0-M657L-10

Wiring lever

Type: KX0-M657M-10

} Set type: KX0-M657K-10


CAUTION

You cannot use Lighting 1 and Lighting 2 to mix 12V and 24V.

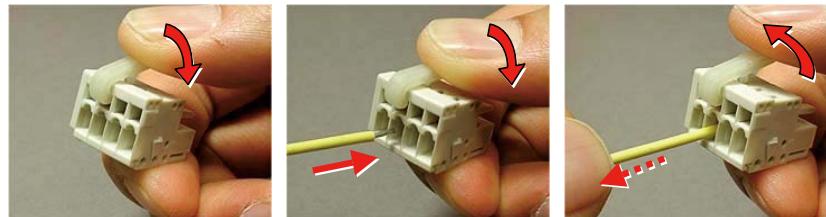
■ Wiring connection method

Strip the wire sheath to expose 7 mm of bare lead.



AWG size : 28 to 14
Max. sheath outer diameter : ϕ 3.4 mm

* A wiring size of AWG24 or larger is recommended.
(For a 2ch lighting current total of 3A)



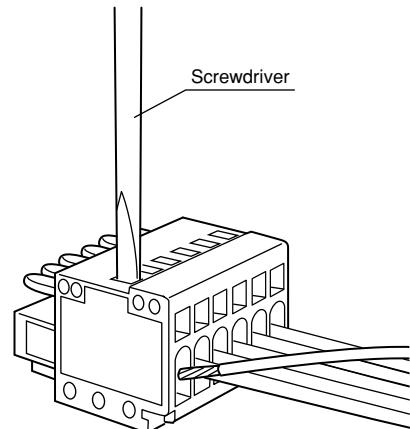
* Although a 4-pin connector is shown in the connection photos at right, a 6-pin connector is actually used on the lighting power cable connector.

(1) Insert the wiring lever into the upper service slot and press the lever down with your finger to open the spring.

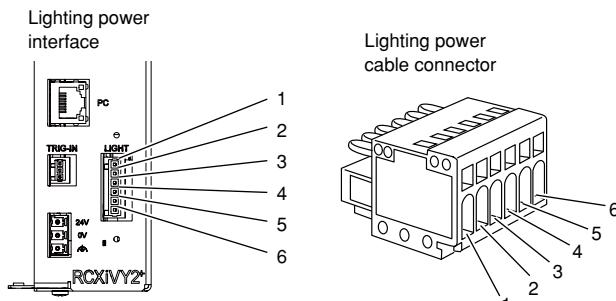
(2) With the wiring lever pressed down, insert the wire into the wire port until it is in contact with the far side.

(3) Release the lever to make the connection. Lightly pull the electric wire to make sure that it is connected.
(Do not pull the wire with excessive force.)

The exposed wire can also be inserted into the wire port while pressing the spring down with a screwdriver inserted into the upper service slot.



■ Lighting power interface signal table



Terminal No.	Signal Name	Signal Description
1	12/24VDC	Lighting external power input (12 V/ 24 V)
2	GND	Lighting external power input (0 V)
3	LOUT1+	Lighting 1 control output + (12 V /24 V)
4	LOUT1-	Lighting 1 control output -
5	LOUT2+	Lighting 2 control output + (12 V / 24 V)
6	LOUT2-	Lighting 2 control output -



CAUTION

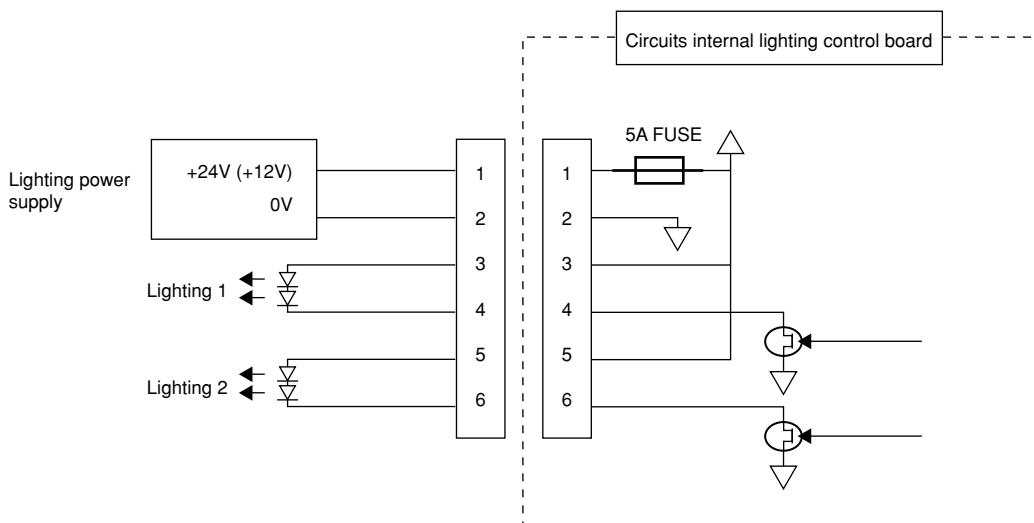
You cannot use Lighting 1 and Lighting 2 to mix 12 V and 24 V.



CAUTION

Incorrect wiring of the lighting power cable could cause device damage. Be sure to verify the interface pin numbers and the wiring before connecting.

The lighting control circuit configuration is shown below.



CAUTION

Rush current conditions of approximately 60A for 1 ms occur at the lighting power supply. Therefore, take care to prevent adverse effects of power voltage drops and over-current protection functions, etc., under rush current conditions, when sharing the lighting power supply with other applications (loads).



CAUTION

Select the lighting power supply which is appropriate for the lighting voltage being used, and is able to meet the current consumption. (Using a 24V-power supply for 12 V lighting might trip the fuse inside the lighting control board or damage the lighting.)



CAUTION

In the unforeseen event that the lighting control function of the lighting control board stops working, the lighting might be in a state of 100% lit. In preparation for such an event, make sure to use lighting that remains within its rated limits even when the power supply keeps it 100% lit, or that has a protective function such as a thermal fuse.

3.3 Turning the power on/ off

3.3.1 Power-on procedure

step 1 Connect the programing box to the controller.

Connect the PB connector to the PB connector jack (PB) located on the front panel of the controller.

step 2 Supply power from the 24 VDC power connector.

step 3 From the power supply jack on the front panel of the controller, supply main power (motor drive power) and control power.

On the front panel of the controller, the "PWR" LED is lit, and the 7-segment LED indicates the following. (Servo off, return-to-origin incomplete, emergency stop cancelled)



It takes approximately one minute from when the "PWR" LED lights until the RCXiVY2+ system starts up normally.

3.3.2 Power-off procedure

Step 1 Turn off the controller's main power (motor drive power) and control power.

Step 2 Turn off the 24 VDC power.



CAUTION

While the RXCiVY2+ unit's status LED is blinking green, the CFast card is being accessed. Do not turn off the power. If you turn off the power while the status LED is blinking green, the data in the CFast card may be damaged.

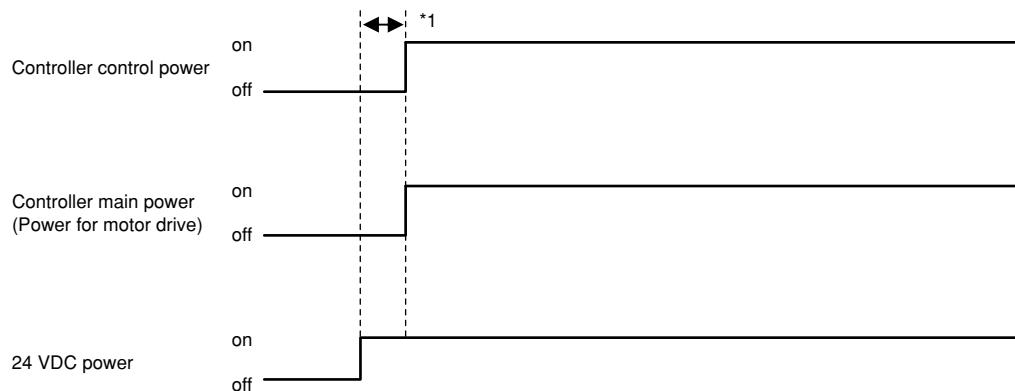


NOTE

Do not turn off the power while the program is executing.

Before turning the power off, make sure to end or stop the program.

3.3.3 Power-on timing chart



*1 Be sure to turn on the 24 VDC power at the same time or before turning on the controller control power and main power. It is recommended to turn on the controller control power and main power 100 ms or longer after the 24 VDC power has been turned on.

3.4 Checking the robot controller settings

You can check from RCX-Studio whether the RCXiVY2+ unit and lighting control board are installed in the robot controller.

The procedure for checking the robot controller settings is described below.

For details on RCX-Studio, refer to the YAMAHA Support Software RCX-Studio User's Manual.

Step 1 Connect the computer and robot controller.

Using a dedicated cable or Ethernet cable (category 5e or higher), connect the computer and robot controller. For details on how to make the connection, refer to the robot controller manual.

Step 2 Start RCX-Studio.

The *RCX-Studio* window appears.

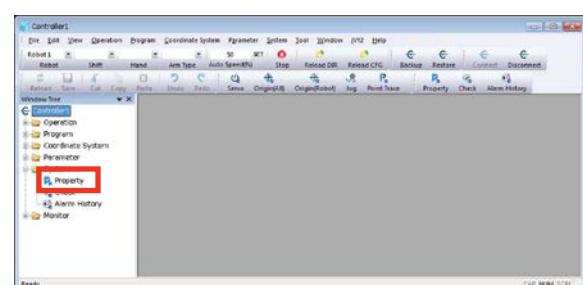
Step 3 Connect with the controller.

Connect with the controller. For the procedure, refer to the YAMAHA Support Software RCX-Studio User's Manual.

Step 4 Select "Property".

In the window tree of the target window, in (System), double-click (Property).

► Step 4 Target window

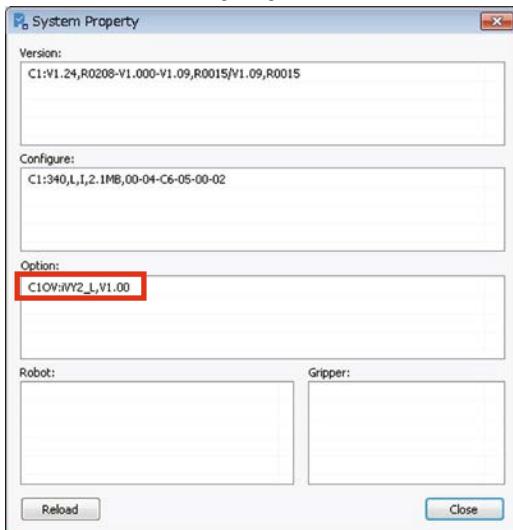


Step 5 System Property appears.

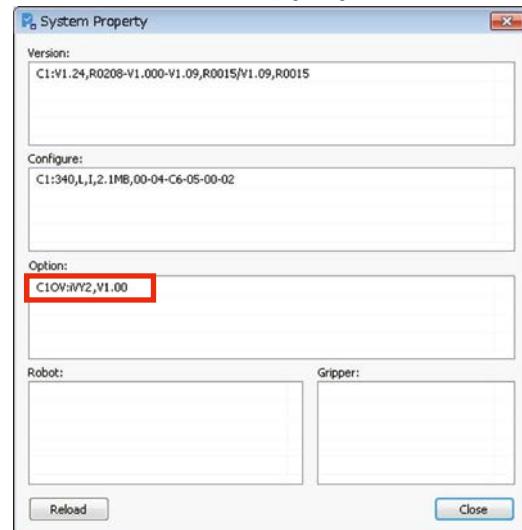
If (IVY2_L) is shown in (Option), this means that the RCXiVY2+ unit and lighting control board are installed.

If (IVY2) is shown, this means that only the RCXiVY2+ unit is installed, and that the lighting control board is not installed.

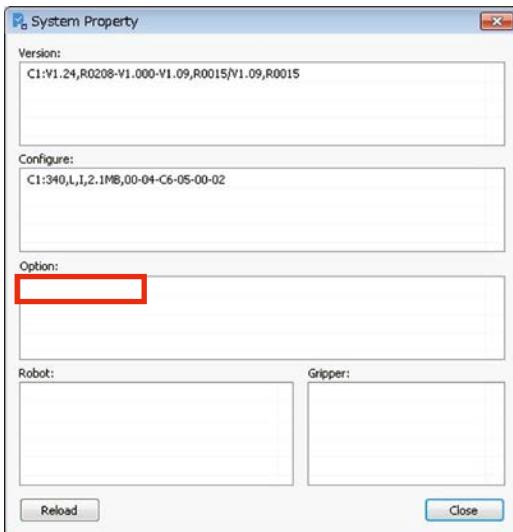
■ RCXiVY2+ unit and lighting control board are installed



■ RCXiVY2+ unit is installed (lighting control board is not installed)



■ RCXiVY2+ unit is not installed



4. Preparations

4.1 Checking the RCXiVY2+ unit status

In order to use the robot vision function and lighting control function, the RCXiVY2+ unit must be in a usable state.

You can check from RCX-Studio whether the RCXiVY2+ unit is in a usable state. Use the following procedure to check the status of the RCXiVY2+ unit.

For details on RCX-Studio, refer to the YAMAHA Support Software RCX-Studio User's Manual.

Step 1 Connect the computer and robot controller.

Connect the computer and robot controller using a dedicated cable or Ethernet cable (category 5e or higher). For details on how to make the connection, refer to the robot controller manual.

Step 2 Start RCX-Studio.

The RCX-Studio window appears.

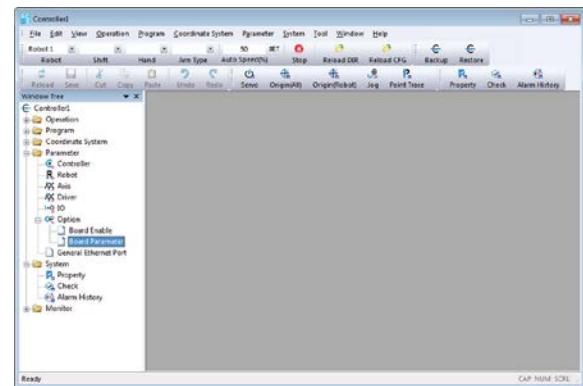
Step 3 Connect the controller.

Connect the controller. For the procedure, refer to the YAMAHA Support Software RCX-Studio User's Manual.

Step 4 Select "Board Parameter".

In the window tree of the target window, under (Parameter), under (Option), double-click (Board Parameter).

▶ Step 4 Target window



Step 5 The RCXiVY2+ unit parameters are displayed.

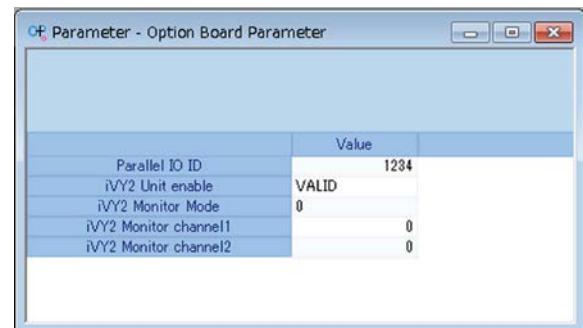
If (IVY2 Unit enable) is (VALID), this means that the RCXiVY2+ unit and the lighting control board (only if the lighting control board is installed) are in a usable state.

If (IVY2 Unit enable) is (INVALID), this means that the RCXiVY2+ unit and lighting control board (only if the lighting control board is installed) are in an unusable state.

To put them in a usable state, change the (IVY2 Unit enable) setting to (VALID), and then on the main menu, in (Edit), click (Save) to save the settings.

For details, refer to the YAMAHA Support Software RCX-Studio User's Manual.

▶ Step 5 Option Board Parameters

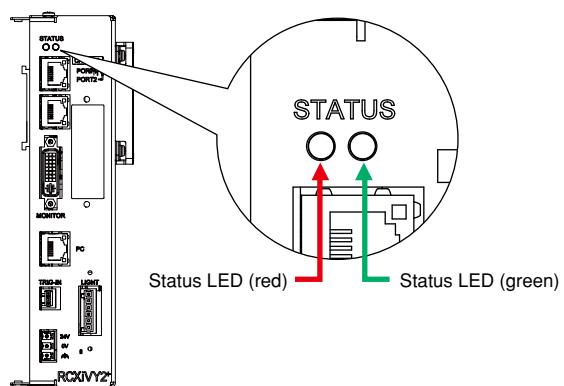


4.2 Checking RCXiVY2+ unit LED statuses

4.2.1 RCXiVY2+ unit status LEDs

The status LEDs at the RCXiVY2+ unit indicate the RCXiVY2+ unit statuses. Descriptions of the LED indications are given below.

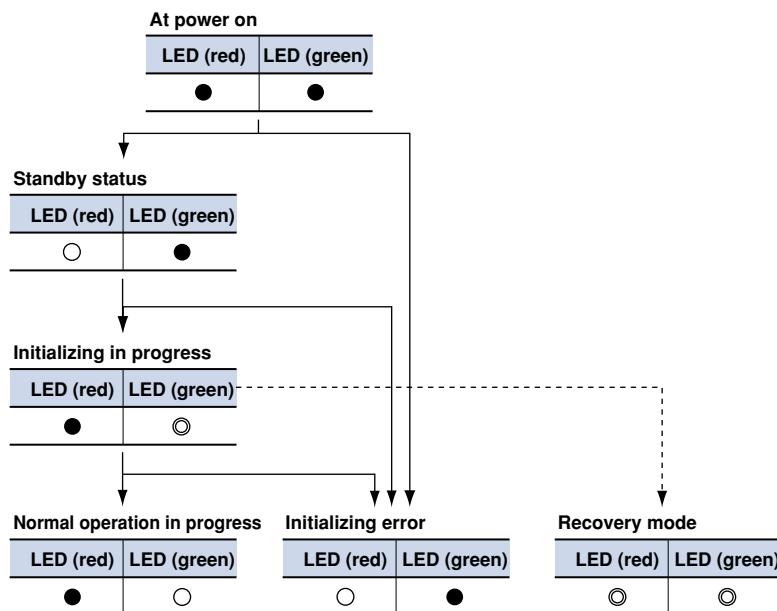
Status LEDs



■ Status LED descriptions and status changes

○ : On (not blinking), ◎ : Blinking, ● : Off

LED (red) status	LED (green) status	Description
●	○	Initializing in progress
●	◎	Normal operation in progress
○	●	Standby status / Initialization error
●	●	Power off
◎	◎	Recovery mode (Red and green LEDs are blinking alternately.)
○	○	Started without CFast card
-	○	Accessing CFast card (irregular blinking)



CAUTION

While the green LED is blinking, the CFast card is being accessed. Do not turn off the power.

If you turn off the power while the green LED is blinking, the data in the CFast card might be damaged.



NOTE

If a fault is detected in the CFast card data during initialization, the system automatically transitions to Recovery mode. Connect to RCXiVY2+ Studio and perform the recovery operation.

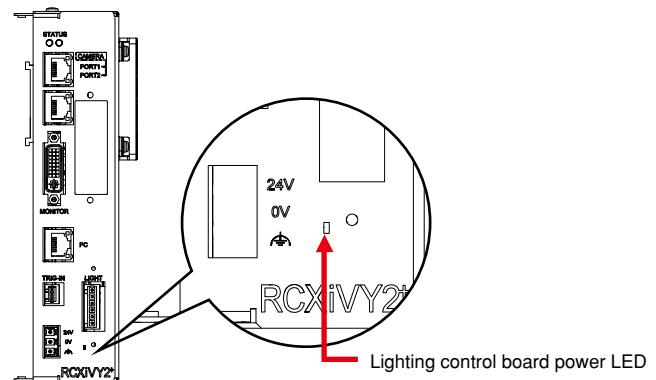
For details, refer to C TROUBLESHOOTING AND SPECIFICATIONS SECTION, "1.3 Recovery mode".

4.2.2 Lighting control board power LED

The lighting control board power LED indicates the input status of the lighting power supply. The LED indication has the following significance.

* Only if the lighting control board option is selected.

Power LED



Power LED descriptions

○: ON, ●: Off

LED status	Description
○	Lighting control board power is being input.
●	Lighting control board power is not being input.

4.3 Personal computer and RCXiVY2+ unit connection settings

To connect the RCXiVY2+ unit to the RCXiVY2+ Studio, the communication settings such as IP address and subnet mask must be specified in advance for each of the RCXiVY2+ unit and the personal computer in which the RCXiVY2+ Studio is installed. Specify the RCXiVY2+ unit's communication settings based on the personal computer settings.

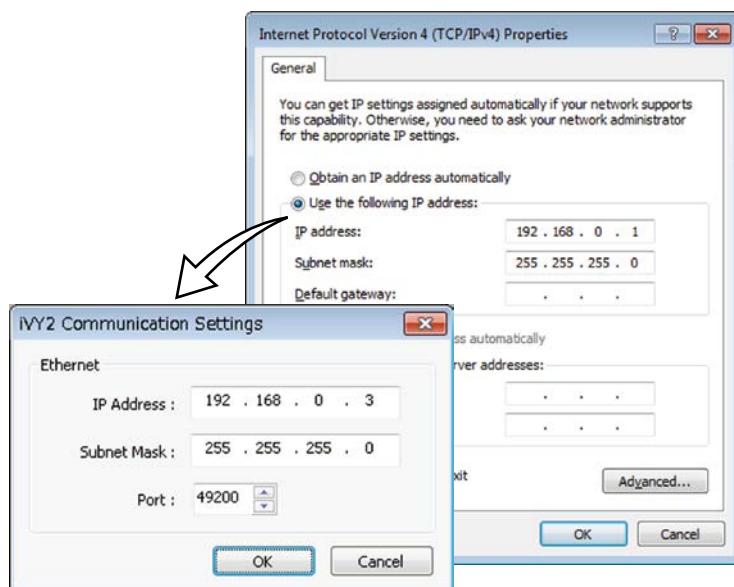
For the setting procedure, refer to B RCXiVY2+ Studio OPERATION SECTION, "3. RCXiVY2+ unit connection settings".



NOTE

Specify the communication settings such as IP address and subnet mask for each of the personal computer and the RCXiVY2+ unit according to the user's network environment. For the setting values, please ask the network administrator.

Personal computer and RCXiVY2+ unit connection settings

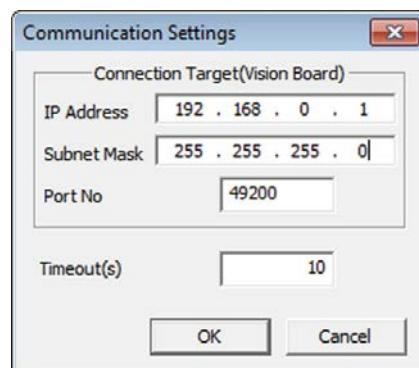


4.4 RCXiVY2+ Studio communication settings

The RCXiVY2+ Studio communication settings consist of information (IP address, subnet mask, port number, timeout) about the RCXiVY2+ unit, to which RCXiVY2+ Studio is connected.

The connection destination RCXiVY2+ unit's IP address, subnet mask, and port number settings are those which were specified in B RCXiVY2+ Studio OPERATION SECTION "3.2 Setting the RCXiVY2+ unit's communication". In the "Timeout" field shown right, input the number of seconds until the RCXiVY2+ Studio connection is disconnected forcibly if no response is returned from the vision board.

For the setting procedure, refer to B RCXiVY2+ Studio OPERATION SECTION "5.1 Communication settings".

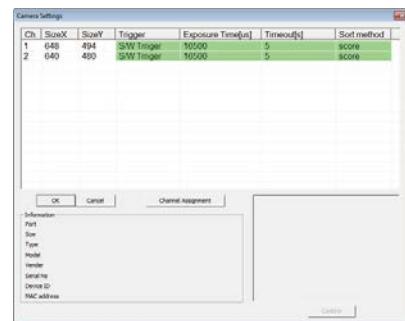


4.5 RCXiVY2+ Studio camera settings

The camera settings must be specified before using RCXiVY2+ Studio.

The trigger mode, exposure time, timeout, and sort method as camera data are specified.

For the setting procedure, refer to RCXiVY2+ Studio OPERATION SECTION, "5.2 Camera settings".



NOTE

If connecting RCXiVY2+ Studio to RCXiVY2+ unit without setting camera, a message which demands to specify the camera setting will appear. "Camera settings" window will be shown after clicking (OK).

4.5.1 Parameter details

	Input range	Default setting	Units
Trigger mode	SOFTWARE TRG HARDWARE TRG	SOFTWARE TRG	—

Function

This parameter specifies the timing to capture an image.

Explanation

The trigger mode can be specified individually for each camera channel.

Settings

HARDWARE TRG: The exposure START is set at the timing when the trigger input to the external trigger terminal occurs.

SOFTWARE TRG: The exposure START is set at the timing when the software outputs the image capture command to the camera.



NOTE

This setting is the same as that specified at the RCXiVY2+ unit's "Trigger mode" parameter. Therefore, if the RCXiVY2+ unit's "Trigger mode" parameter is changed, this parameter setting value is also changed.

	Input range	Default setting	Units
Exposure time	10 to 50000	16500	μs

Function

This parameter specifies the camera's exposure time (units: μs).

Explanation

A shorter exposure time produces a darker image, and a longer exposure time produces a brighter image. Moreover, a shorter exposure time can be used to obtain blur-free images of fast-moving objects.

The exposure time can be specified individually for each camera channel.



NOTE

This setting is the same as that specified at the RCXiVY2+ unit's "exposure time" parameter. Therefore, if the RCXiVY2+ unit's "exposure time" parameter is changed, this parameter setting value is also changed.

	Input range	Default setting	Units
Timeout	0 to 36000	5	s

Function

This parameter specifies the image capture timeout period (units: s).

Explanation

This parameter applies to image capture when the trigger mode is "HARDWARE_TRG". If the trigger mode is "SOFTWARE TRG", the timeout period cannot be set.

A setting of "0" is processed as no timeout setting.

**NOTE**

This parameter is the same as that specified at the RCXiVY2+ unit's "HW trigger timeout". Therefore, if the RCXiVY2+ unit's the "HW trigger timeout" parameter, the value of this parameter is also changed.

Sort method	Input range	Default setting	Units
	Score X ascending X descending Y ascending Y descending	Score	—

Function

This parameter specifies the sort order for the search results array. The search results are output using the sort method specified here.

Explanation

The search results array is sorted as follows.

ScoreThe search results are sorted for output in order of score.

X ascending.....The search results are sorted for output in ascending order of X-axis.

X descending.....The search results are sorted for output in descending order of X-axis.

Y ascending.....The search results are sorted for output in ascending order of Y-axis.

Y descending.....The search results are sorted for output in descending order of Y-axis.

**NOTE**

- The search results array is an array containing the search results when search is performed.
- Sorting is done using robot coordinates. However, if no calibration number is specified, sorting is done using pixel coordinates.

For details on sorting methods, refer to "7.2.3.5 VSORTMTD".

5. Parameter settings

5.1 Parameter list

The parameters are divided into 5 main groups:

- RCXiVY2+ unit parameters
- Camera parameters
- Lighting control board parameters
- Edge setting and search setting parameters in Model mode
- Edge setting and search setting parameters in Mark mode

Parameters for the RCXiVY2+ unit are set using RCX-Studio.

Parameters for the camera and the lighting control board are set using RCXiVY2+ Studio or RCX-Studio.

Edge setting and search setting parameters for Model mode and Mark mode are made using RCXiVY2+ Studio.

5.1.1 RCXiVY2+ unit parameter list

The RCXiVY2+ unit's parameter items are listed in the following table.

Name	Identifier	Setting range	Default setting	Units
iVY2 Unit enable ^{*1}	IVYENBL	VALID / INVALID	VALID	—
iVY2 Monitor mode	DISPMODE	0: single latest image / 1: specify 2 channels 2: latest + previous / 3: latest + latest NG	0: single latest image	—
iVY2 Monitor channel 1 ^{*2}	DISPCH1	0: no monitor display 1 to 16: specify the camera channel	0: no monitor display	—
iVY2 Monitor channel 2 ^{*2}	DISPCH2	0: no monitor display 1 to 16: specify the camera channel	0: no monitor display	—

*1 This parameter cannot be changed while the servo is turned on. When changing it, turn the servo off. It is required to turn the power off and on again when changing this parameter.

*2 If you specify a numerical value of 1 to 16 for monitor display CH1 or monitor display CH2, the camera image of the corresponding camera channel is shown on the monitor.

5.1.2 Camera parameter list

The camera's parameter items are listed in the following table.

Name	Identifier	Setting range	Default setting	Units
iVY Camera OUI (company code)	CAMOUI	Read-only	—	—
iVY Camera ID (model code)	CAMID	Read-only	—	—
iVY Camera exposure time	EXPOTIM	10 to 50000	16500	μs
iVY Camera trigger mode	TRGMODE	HARDWARE TRG / SOFTWARE TRG	SOFTWARE TRG	—
iVY Camera HW trigger timeout	HWTOUT	0 to 36000	5	s
iVY Camera sort method	SORTMTD	0: Score 1: X-axis ascending/ 2: X-axis descending 3: Y-axis ascending/ 4: Y-axis descending	0: Score	—
CLBLINK* (Calibration link number)	CLBLINK	-1 to 31	-1	—

5.1.3 Lighting control board parameter list

The lighting control board's parameter items are listed in the following table.

Name	Identifier	Setting range	Default setting	Units
iVY Light enable	LENABLE	VALID / INVALID	INVALID	—
iVY Light Hz	LIGHTHZ	62.5K / 125K	62.5K	—
iVY Light mode	LCTRLMOD	CONTINUE / STROBE	CONTINUE	—
iVY Light volume	LVOLUME	0 to 100	0	%
iVY Light strobe time	LSTRBTIM	0 to 200000	33000	μs
iVY Light sync camera ch*	LSYNCCH	0 to 65535	0	—

* For this parameter, all 16 channels are indicated as 16 bits, with a bit being 1 if synchronization is enabled. This 16-bit value is converted into a decimal value and handled as the parameter.

5.1.4 Model mode parameter list

The edge setting and search setting parameter items are listed in the following tables in Model mode.

■ Edge settings

Name	Description	Setting range	Default setting	Units
Filter type	This sets the filter processing method used to obtain the edge of the workpiece.	Sobel Correlate	Sobel	—
Contrast threshold	This sets the contrast threshold value for workpiece edge distinction.	0 to 255	30	—
Edge strength threshold	This sets the threshold value of the edge strength (a value that indicates similarity to an edge) when "Correlate" is set at the "Filter type".	0 to 255	160	—
Filter size	This sets the size of the filter used to extract the edge of the workpiece when "Correlate" is set at the "Filter type".	Odd number from 3 to 21	13	—



NOTE

The "edge strength threshold" and "filter size" parameters are displayed only when "Correlate" is specified as the filter parameter setting value.

■ Search settings

Name	Description	Input range	Default setting	Units
START angle	This setting specifies the start angle of the permissible rotation angle, from the edge data of the registered model workpiece.	-180 to 179	-180	degree (°)
END angle	This setting specifies the end angle of the permissible rotation angle, from the edge data of the registered model workpiece.	-180 to 179	179	degree (°)
Compression Level	This setting specifies the compression level of the workpiece edge data.	0 to 5	3	—
Error range	This setting specifies the permissible deformation range based on the workpiece edge data of the registered model.	0 to 5	1	—
Score threshold 1	The score threshold can be set to narrow the number of search candidates before performing a search for a registered model workpiece.	0 to 100	50	—
Score threshold 2	The threshold value can be set for registered model workpiece search result output.	0 to 100	60	—
Priority area threshold	This setting specifies the threshold value for priority area check of the registered model workpiece. This is valid only for a workpiece whose priority area has been specified in the contour setting.	0 to 100	60	—
Precision*	This setting specifies the search precision.	Normal / High	Normal	—
Reduction weight*	Set the amount which the score is reduced for an edge detected within the reduction area.	0 to 1000	2	%
Edge Polarity*	This setting specifies the contrast polarity.	Normal Reverse / Both	Normal	—
Max number of matches*	This setting specifies the maximum number of detected workpieces.	1 to 100	1	Piece
Timeout*	This setting specifies the timeout period.	1 to 300	300	100ms

* These parameters include the condition "when searching for the registered model workpiece".

5.1.5 Mark mode parameter list

The edge setting and search setting parameter items are listed in the following tables in Mark mode.

■ Edge settings

Name	Description	Setting range	Default setting	Units
Filter type	This sets the filter processing method used to obtain the edge of the workpiece.	Sobel Correlate	Sobel	—
Contrast threshold	This sets the contrast threshold value for workpiece edge distinction.	0 to 255	30	—
Edge strength threshold	This specifies the threshold value of the edge strength (a value that indicates similarity to an edge) when "Correlate" is specified at the "Filter type".	0 to 255	160	—
Filter size	This specifies the size of the filter used to extract the edge of the workpiece when "Correlate" is specified at the "Filter type".	Odd number from 3 to 21	13	—



NOTE

The "edge strength threshold" and "filter size" parameters are displayed only when "Correlate" is specified as the filter parameter setting value.

■ Search settings

Name	Description	Setting range	Default setting	Units
START angle	This setting specifies the start angle of the permissible rotation angle, from the edge data of the registered model workpiece.	-180 to 179	-180	degree (°)
END angle	This setting specifies the end angle of the permissible rotation angle, from the edge data of the registered model workpiece.	-180 to 179	179	degree (°)
Compression Level	This setting specifies the compression level of the workpiece edge data.	0 to 5	3	—
Error range	This setting specifies the permissible deformation range based on the workpiece edge data of the registered model.	0 to 5	1	—
Score threshold 1	The score threshold can be set to narrow the number of search candidates before performing a search for a registered model workpiece.	0 to 100	50	—
Score threshold 2	The threshold value can be set for registered model workpiece search result output.	0 to 100	60	—
Priority area threshold	This setting specifies the threshold value for priority area check of the registered model workpiece. This is valid only for a workpiece whose priority area has been specified in the contour setting.	0 to 100	60	—
Precision	This setting specifies the search precision.	Normal / High	Normal	—
Reduction weight	Set the amount which the score is reduced for an edge detected within the reduction area.	0 to 1000	2	%
Edge Polarity	This setting specifies the contrast polarity.	Normal Reverse / Both	Normal	—

5.1.6 Measure mode parameter list

The measure mode parameter items are listed in the following tables.

■ Line detection

Name	Description	Setting range	Default setting	Units
Search margin	The detection frame width is set.	1 to 100	5	pixel
Vote theta	The tolerance angle between edge points on the line is set.	0 to 179	10	degree
Color of line	The line color to detect is set.	BLACK / WHITE BLACK_WHITE	BLACK_WHITE	—

■ Circle detection

Name	Description	Setting range	Default setting	Units
Search margin	The detection frame width is set.	1 to 100	5	pixel
Vote theta	The tolerance angle between edge points on the circle is set.	0 to 90	10	degree
Percentage threshold of circumference	The threshold of circularity for the detected circle is set.	0 to 99	35	%
Color of circle	The circle color to detect is set.	BLACK / WHITE BLACK_WHITE	BLACK_WHITE	—
Refine	Setting "TRUE" improves the detection accuracy.	TRUE / FALSE	TRUE	—

5.1.7 Blob mode parameter list

■ Automatic adjustment

Name	Description	Setting range	Default setting	Units
Target color	This setting specifies the detection target color.	Black/White	Black	
Hole filling ratio	This setting specifies the ratio of the hole to the blob when the hole in the workpiece is filled.	0 to 100	0	%

■ Blob settings

Name	Description	Setting range	Default setting	Units
Binarization lower limit	This setting specifies the brightness lower limit of the pixel targeted for the blob.	0 to 255	0	
Binarization upper limit	This setting specifies the brightness upper limit of the pixel targeted for the blob.	0 to 255	255	
Hole filing ratio	This setting specifies the ratio of the blob to the hole when the hole in the workpiece is filled.	0 to 100	0	%
Boundary blob removal	This setting specifies whether the blobs on the boundary of the search area are removed.	Valid/Invalid	Invalid	
Filter 1	This setting specifies the filter process (1st stage) for the binarization.	Shrinkage Expansion Opening Closing	Shrinkage	
Filter 1 count	This setting specifies the filter 1 execution count for the binarization.	0 to 9	0	Count
Filter 2	This setting specifies the filter process (2nd stage) for the binarization.	Shrinkage Expansion Opening Closing	Expansion	
Filter 2 count	This setting specifies the filter 2 execution count for the binarization.	0 to 9	0	Count

■ Search settings

Name	Description	Setting range	Default setting	Units
Detection quantity	This setting specifies the maximum number of detection workpieces during searching.	1 to 100	1	Piece
Area lower limit	This setting specifies the area lower limit of the blob that is detected during searching.	0 to 9999999	0	pixel
Area upper limit	This setting specifies the area upper limit of the blob that is detected during searching.	0 to 9999999	9999999	pixel
Start angle of main axis angle	This setting specifies the allowable rotation start angle of the main axis angle of the blob that is detected during searching.	-180 to 179	-180	degree
End angle of main axis angle	This setting specifies the allowable rotation end angle of the main axis angle of the blob that is detected during searching.	-180 to 179	180	degree
Main axis length lower limit	This setting specifies the main axis length lower limit of the blob that is detected during searching.	0 to 9999999	0	pixel
Main axis length upper limit	This setting specifies the main axis length upper limit of the blob that is detected during searching.	0 to 9999999	999999	pixel
Roundness lower limit	This setting specifies the roundness lower limit of the blob that is detected during searching.	0 to 100	0	%
Roundness upper limit	This setting specifies the roundness upper limit of the blob that is detected during searching.	0 to 100	100	%

5.2 RCXiVY2+ unit parameter settings

The various parameters of the RCXiVY2+ unit are set using RCX-Studio. The setting procedure is described below. For details on RCX-Studio, refer to the YAMAHA Support Software RCX-Studio User's Manual.

Step 1 Connect the computer and robot controller.

Using a dedicated cable or an Ethernet cable (category 5e or higher), connect the computer and the robot controller. For details on the connection, refer to the robot controller manual.

Step 2 Start RCX-Studio.

The RCX-Studio window appears.

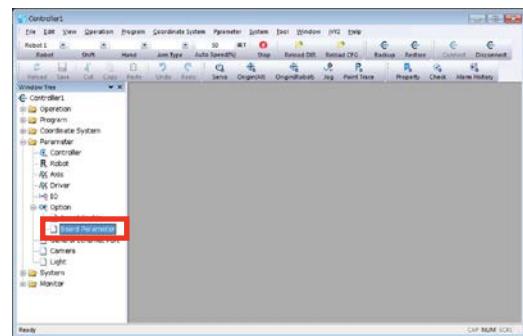
Step 3 Connect the controller.

Connect the controller. For details on connection to the controller, refer to the YAMAHA Support Software RCX-Studio User's Manual.

Step 4 Select Board Parameter.

In the window tree of the target window, under (Parameter), under (Option), double-click (Board Parameter).

Step 4 Target window



Step 5 The RCXiVY2+ unit's parameters are displayed.

For details on how to set each parameter, refer to "5.2.1 RCXiVY2+ unit parameter details".

Step 5 Option board parameter

Parameter - Option Board Parameter	
	Value
Parallel IO ID	1234
iVY2 Unit enable	VALID
iVY2 Monitor Mode	0
iVY2 Monitor channel1	0
iVY2 Monitor channel2	0

Step 6 Edit the parameter settings.

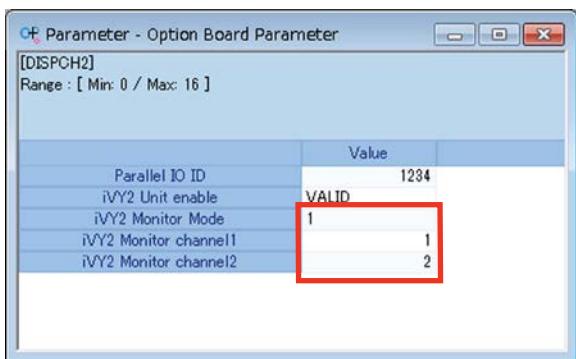
When a parameter has been edited, the cell turns red.

Step 6 Option board parameter editing

Parameter - Option Board Parameter	
[DISPCH2]	
Range : [Min: 0 / Max: 16]	
Parallel IO ID	1234
iVY2 Unit enable	VALID
iVY2 Monitor Mode	1
iVY2 Monitor channel1	1
iVY2 Monitor channel2	2

Step 7 Save the edited settings.

Save the edited settings. For details on how to save the edited settings, refer to the YAMAHA Support Software RCX-Studio User's Manual. When a parameter has been saved, the cell turns white.

Step 7 Option board parameter saving**5.2.1 RCXiVY2+ unit parameter details**

This section explains each of the RCXiVY2+ unit's parameters.

■ iVY2 unit enable <IVYENBL>

This parameter enables/disables the RCXiVY2+ unit. If this parameter is initialized, it is set to VALID by default.

Setting	Content
INVALID	Disables the RCXiVY2+ unit.
VALID	Enables the RCXiVY2+ unit.



NOTE

- When changing this parameter, you must turn the power on again.
- If you disable the RCXiVY2+ unit, option board parameters other than "iVY2 unit enable" are not shown, and their setting cannot be changed. Also, the "camera" and "light" parameters in the window tree are also not shown, and their setting cannot be changed.

■ Monitor Mode <DISPMODE>

This parameter specifies the screen layout when outputting to a monitor from the RCXiVY2+ unit's DVI output jack. If this parameter is initialized, it is set to 0 by default.

Setting	Description
0: single latest image	The most recent image taken by the camera is output to the monitor.
1: specify 2 channels	The camera channels to be output to the monitor are specified; the latest images taken by the selected cameras are output to the monitor.
2: latest + previous	The most recent image taken by the camera and the previous image are output to the monitor.
3: latest + latest failure	The most recent image taken by the camera and the most recent image determined as failure are output to the monitor.



NOTE

If not even one workpiece is found when search is executed, the result is failure.

■ Monitor channel 1 <DISPCH1>

This parameter specifies the camera channel of the camera image that is shown on channel 1 of the monitor output screen when the monitor display mode (DISPMODE) is set to "1: specify 2 channels".
If this parameter is initialized, it is set to 0 by default.

Setting	Description
0: no monitor display	No camera image is output to monitor CH1.
1: specify camera channel 1	The camera image of camera channel 1 is output to monitor CH1.
2 : specify camera channel 2	The camera image of camera channel 2 is output to monitor CH1.
3 : specify camera channel 3	The camera image of camera channel 3 is output to monitor CH1.
4 : specify camera channel 4	The camera image of camera channel 4 is output to monitor CH1.
5 : specify camera channel 5	The camera image of camera channel 5 is output to monitor CH1.
6 : specify camera channel 6	The camera image of camera channel 6 is output to monitor CH1.
7 : specify camera channel 7	The camera image of camera channel 7 is output to monitor CH1.
8 : specify camera channel 8	The camera image of camera channel 8 is output to monitor CH1.
9 : specify camera channel 9	The camera image of camera channel 9 is output to monitor CH1.
10 : specify camera channel 10	The camera image of camera channel 10 is output to monitor CH1.
11 : specify camera channel 11	The camera image of camera channel 11 is output to monitor CH1.
12 : specify camera channel 12	The camera image of camera channel 12 is output to monitor CH1.
13 : specify camera channel 13	The camera image of camera channel 13 is output to monitor CH1.
14 : specify camera channel 14	The camera image of camera channel 14 is output to monitor CH1.
15 : specify camera channel 15	The camera image of camera channel 15 is output to monitor CH1.
16 : specify camera channel 16	The camera image of camera channel 16 is output to monitor CH1.

■ Monitor channel 2 <DISPCH2>

This parameter specifies the camera channel of the camera image that is shown on channel 2 of the monitor output screen when the monitor display mode (DISPMODE) is set to "1: specify 2 channels".
If this parameter is initialized, it is set to 0 by default.

Setting	Description
0: no monitor display	No camera image is output to monitor CH2
1: specify camera channel 1	The camera image of camera channel 1 is output to monitor CH2.
2 : specify camera channel 2	The camera image of camera channel 2 is output to monitor CH2.
3 : specify camera channel 3	The camera image of camera channel 3 is output to monitor CH2.
4 : specify camera channel 4	The camera image of camera channel 4 is output to monitor CH2.
5 : specify camera channel 5	The camera image of camera channel 5 is output to monitor CH2.
6 : specify camera channel 6	The camera image of camera channel 6 is output to monitor CH2.
7 : specify camera channel 7	The camera image of camera channel 7 is output to monitor CH2.
8 : specify camera channel 8	The camera image of camera channel 8 is output to monitor CH2.
9 : specify camera channel 9	The camera image of camera channel 9 is output to monitor CH2.
10 : specify camera channel 10	The camera image of camera channel 10 is output to monitor CH2.
11 : specify camera channel 11	The camera image of camera channel 11 is output to monitor CH2.
12 : specify camera channel 12	The camera image of camera channel 12 is output to monitor CH2.
13 : specify camera channel 13	The camera image of camera channel 13 is output to monitor CH2.
14 : specify camera channel 14	The camera image of camera channel 14 is output to monitor CH2.
15 : specify camera channel 15	The camera image of camera channel 15 is output to monitor CH2.
16 : specify camera channel 16	The camera image of camera channel 16 is output to monitor CH2.

5.3 Camera parameter settings

The camera parameters are set using RCX-Studio or RCXiVY2+ Studio.

Details of the setting procedure using RCX-Studio are given below.

For details on the setting procedure using RCXiVY2+ Studio, refer to "RCXiVY2+ Studio OPERATION SECTION", "5.2 Camera settings".

Step 1 Connect the computer and robot controller.

Using a dedicated cable or Ethernet cable (category 5e or higher), connect the computer and robot controller. For details on how to make the connection, refer to the robot controller manual.

Step 2 Start RCX-Studio.

The RCX-Studio window appears.

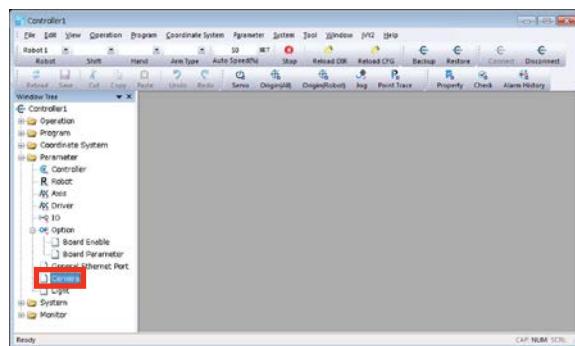
Step 3 Connect the controller.

Connect the controller. For the procedure, refer to the YAMAHA Support Software RCX-Studio User's Manual.

Step 4 Select Camera.

In the window tree of the target window, under (Parameter), double-click (Camera).

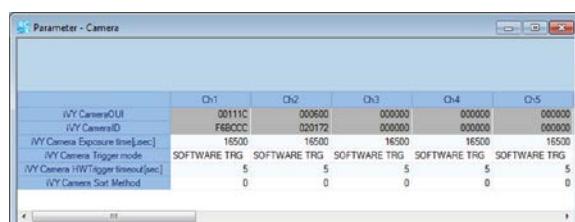
Step 4 Target window



Step 5 The camera parameters are displayed.

For details on how to set each parameter, refer to "5.3.1 Camera parameter details".

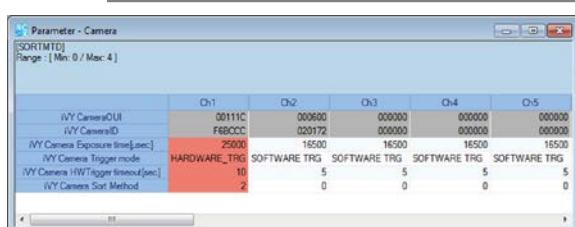
Step 5 Camera parameters



Step 6 Edit the parameter settings.

When a parameter has been edited, the cell turns red.

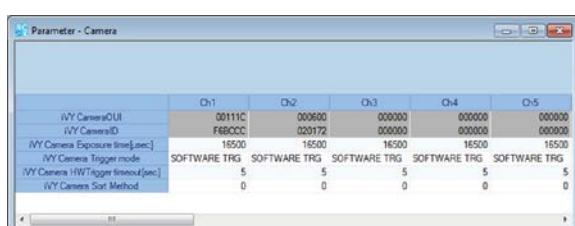
Step 6 Camera parameter editing



Step 7 Save the edited settings.

Save the edited settings. For details on how to save the edited settings, refer to the YAMAHA Support Software RCX-Studio User's Manual. When a parameter has been saved, the cell turns white.

Step 7 Camera parameter saving



CAUTION

If the camera for which settings were made is not connected when the controller is restarted, the camera channel settings are cleared.

**NOTE**

In order to set the camera parameters, first assign a camera channel. For details, refer to B RCXIVY2+ Studio OPERATION SECTION, "5.2 Camera settings".

5.3.1 Camera parameter details

This section explains each of the camera parameters.

■ Camera OUI (company code) <CAMOUI>

This parameter obtains the camera's MAC address (company code). This parameter is read-only, and cannot be set.

■ Camera ID (model code) <CAMID>

This parameter obtains the camera's MAC address (model code). This parameter is read-only, and cannot be set.

■ Camera Exposure time <ESPOTIM>

This parameter specifies the camera's exposure time in microsecond (μs) units with the setting range 10 to 50000.

Shortening the exposure time darkens the acquired image, and lengthening it brightens the acquired image. Shortening the exposure time also allows a rapidly moving object to be acquired without blurring.

If this parameter is initialized, it is set to 16500 by default.

■ Camera Trigger mode <TRGMODE>

This parameter specifies the capture timing.

If this parameter is initialized, it is set to SOFTWARE TRG by default.

Setting	Content
HARDWARE TRG	Exposure start timing is specified as the timing of the trigger input to the external trigger jack.
SOFTWARE TRG	Exposure start timing is specified as the timing at which the software sends a capture command to the camera.

■ Camera HW Trigger timeout <HWTTOUT>

This parameter specifies the timeout period in second units when capturing the image with the setting range 0 to 36000.

This parameter applies to capturing when the trigger mode is "HARDWARE TRG".

A setting of 0 seconds is considered as no timeout. If this parameter is initialized, it is set to 5 by default.

■ Camera Sort Method <SORTMTD>

This parameter specifies the sort method for the search result array. The search result is output with the sort method specified here. If this parameter is initialized, it is set to 0 by default.

Setting	Content
0: score	The search results are sorted for output in order of score.
1: X-axis ascending	The search results are sorted for output in ascending order of X-axis.
2: X-axis descending	The search results are sorted for output in descending order of X-axis.
3: Y-axis ascending	The search results are sorted for output in ascending order of Y-axis.
4: Y-axis descending	The search results are sorted for output in descending order of Y-axis.

■ CLBLINK (Calibration link number) <CLBLINK>

This parameter specifies the camera calibration data to be used when capturing images with camera.

The setting range is -1 to 31. When "-1" is specified, the camera calibration data is not used for capturing images.

This parameter is connected with "VSEARCH", "VCAPTURE", "VMEASURE" and "VCALIBNO" commands and when these commands are executed, the camera calibration number specified by the command will be specified to this parameter.

**NOTE**

This parameter is available with RCX340 / RCX320 software version 1.40 or later.

5.4 Lighting control board parameter settings

The parameters for the lighting control board are set using RCX-Studio or RCXiVY2+ Studio.

Details of the setting procedure using RCX-Studio are given below.

For details on the setting procedure using RCXiVY2+ Studio, refer to B RCXiVY2+ Studio OPERATION SECTION, "5.4 Light settings".

Step 1 Connect the computer and robot controller.

Using a dedicated cable or Ethernet cable (category 5e or higher), connect the computer and robot controller. For details on how to make the connection, refer to the robot controller manual.

Step 2 Start RCX-Studio.

The RCX-Studio window appears.

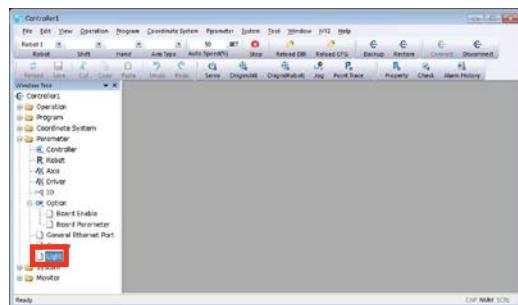
Step 3 Connect the controller.

Connect the controller. For the procedure, refer to the YAMAHA Support Software RCX-Studio User's Manual.

Step 4 Select Light.

In the window tree of the target window, under (Parameter), double-click (Light).

Step 4 Target window



Step 5 The light parameters are displayed.

For details on how to set each parameter, refer to "5.4.1 Lighting control board parameter details".

Step 5 Light parameters

	Ch1	Ch2
iVY Light enable	VALID	VALID
iVY Light Hz	62.5K	62.5K
iVY Light mode	CONTINUE	CONTINUE
iVY Light volume[%]	0	0
iVY Light strobe time[usec]	33000	33000
iVY Light sync camerach	1	3

Step 6 Edit the parameter settings.

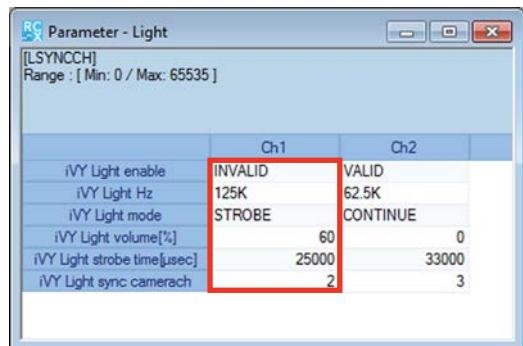
When a parameter has been edited, the cell turns red.

Step 6 Light parameter editing

	Ch1	Ch2
iVY Light enable	INVALID	VALID
iVY Light Hz	125K	62.5K
iVY Light mode	STROBE	CONTINUE
iVY Light volume[%]	60	0
iVY Light strobe time[usec]	25000	33000
iVY Light sync camerach	2	3

Step 7 Save the edited settings.

Save the edited settings. For details on how to save the edited settings, refer to the YAMAHA Support Software RCX-Studio User's Manual. When a parameter has been saved, the cell turns white.

Step 7 Light parameter saving

5.4.1 Lighting control board parameter details

This section explains each of the light parameters.

■ Light enable <LENABLE>

This parameter enables/disables the lighting control function of light 1 and light 2.

If this parameter is initialized, it is set to INVALID by default.

Setting	Content
INVALID	The lighting control function is disabled.
VALID	The lighting control function is enabled.

■ Light Hz <LIGHTHZ>

This parameter specifies the PWM modulation function of light 1 and light 2.

If this parameter is initialized, it is set to 62.5 kHz by default.

Setting	Content
62.5 kHz	The light PWM modulated light frequency is set to 62.5 kHz.
125 kHz	The light PWM modulated light frequency is set to 125 kHz.

■ Light mode <LCTRLMOD>

This parameter specifies the light control mode for light 1 and light 2.

If this parameter is initialized, it is set to CONTINUE by default.

Setting	Content
CONTINUE	The light control mode is set to continuous light.
STROBE	The light control mode is set to strobe light.

■ Light volume <LVOLUME>

This parameter specifies the lighting volume in % units for light 1 and light 2.

The lighting volume setting range is 0 to 100. If this parameter is initialized, it is set to 0 by default.

**NOTE**

This setting is applied to both light control modes; CONTINUE and STROBE.

■ Light strobe time <LSTRBTIM>**NOTE**

- This setting is applied if the camera's trigger mode parameter is set to "camera direct trigger".
- Camera direct trigger will be supported at a later date.

This parameter specifies the light emission time in microseconds (μs) units when light 1 and light 2 are respectively used in strobe mode with the setting range 0 to 200000.

If this parameter is initialized, it is set to 33000 by default.

■ Light sync camera ch <LSYNCCH>

When light 1 and light 2 are respectively used in strobe mode, this parameter specifies the cameras that will synchronize. The setting range is 0 to 65535.

The synchronization status of all 16 camera channels are expressed using 16 bits, where a bit set to 1 indicates that synchronization is enabled for the corresponding camera. This number is converted to decimal and handled as the parameter value.

For example when synchronizing camera channel 1 and camera channel 5, specify "17".

If not specifying camera channels for synchronization, specify 0. If this parameter is initialized, it is set to 0 by default.

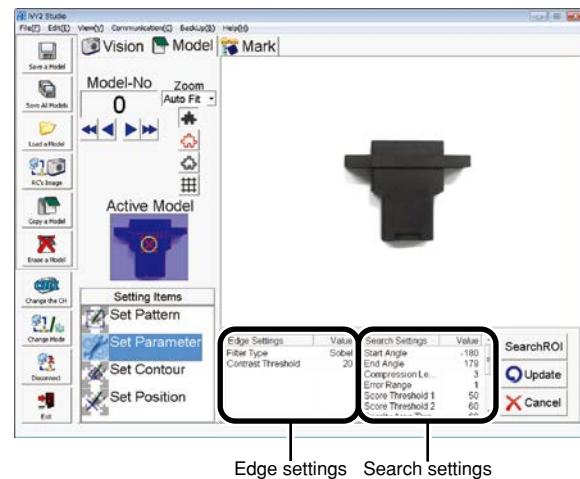
Camera channel	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Synchronized	x	x	x	x	x	x	x	x	x	x	x	O	x	x	x	O

Binary : 0000 0000 0001 0001

Decimal : 17

5.5 Model mode parameter settings

This section explains the various parameter settings required in order to register models in Model mode.



5.5.1 Edge settings

This section explains the parameters related to edge extractions which occur in Model mode.

For details on how to set each parameter, refer to B RCXiVY2+ Studio OPERATION SECTION", "7.3.3 Parameter settings".

5.5.1.1 Parameter details

■ Filter type

This parameter specifies the processing method for the filter which acquires the workpiece edge image. The default filter value is *Sobel*.

Setting	Content	
Sobel	Specifies the Sobel filter.	
Correlate	Specifies the correlated edge filter.	

The various characteristics of the "Sobel filter" and "correlated edge filter" methods are given below. Select the filter type which is suitable for the application.

● Filter characteristics

Filter name	Characteristics	
Sobel filter	Merits	Offers high-speed edge extraction.
	Demerits	Easily affected by noise and light changes.
Correlated edge filter	Merits	Relatively unaffected by noise and light changes.
	Demerits	Offers low-speed edge extraction.

■ Contrast threshold

This parameter specifies the threshold contrast (brightness difference) for workpiece edge discrimination.

Edges with contrast which is less than this setting is not processed as edges.

The setting range is 0 to 255, and the default value is 30.

■ Edge strength threshold

This parameter specifies the threshold for the edge value (edge strength) when using the "correlated edge filter" processing method. Normally, the default setting should be used.

The setting range is 0 to 255, and the default value is 160.



NOTE

The "Edge strength threshold" parameter is displayed only when the filter parameter is specified as "Correlate".

■ Filter size

This parameter specifies the size of the filter used to extract the workpiece edge when using the "correlated edge filter" processing method.

Normally, the default setting should be used. However, when acquiring an edge image along fine lines such as characters, etc., the filter size should be adjusted in accordance with the line thickness. The narrower the line, the smaller this setting value should be.

The setting range is the odd numbers 3 to 21, and the default value is 13.



NOTE

The "Filter size" parameter is displayed only when the filter parameter is specified as "Correlate".

5.5.2 Search settings

This section explains the various search related parameters which apply in Model mode.

For details on how to set each parameter, refer to B RCXiVY2+ Studio OPERATION SECTION, "7.3.3 Parameter settings".

5.5.2.1 Parameter details

■ START angle

This parameter specifies in degree ($^{\circ}$) units the start angle of the permissible rotation angle, from the edge data of the registered model workpiece.

When an actual search is performed, the search focuses on candidates within the setting range specified by the START and END angle parameters.

The narrower the search range, the faster the search. When searching for edge data to which circular rotation does not apply, both the START and END angles can be specified as " 0° " (permissible rotation angle range: 0° to 0°) to enable a high-speed search.

The setting range is -180 to 179, and the default value is -180.

■ END angle

This parameter specifies in degree ($^{\circ}$) units the end angle of the permissible rotation angle, from the edge data of the registered model workpiece.

When an actual search is performed, the search focuses on candidates within the setting range specified by the START and END angle parameters.

The narrower the search range, the faster the search. When searching for edge data to which circular rotation does not apply, both the START and END angles can be specified as " 0° " (permissible rotation angle range: 0° to 0°) to enable a high-speed search.

The setting range is -180 to 179, and the default value is 179.

■ Compression Level

This parameter specifies the compression level of the workpiece edge data.

Although a higher setting value will shorten the search time, the detection probability also decreases.

The setting range is 0 to 5, and the default value is 3.

■ Error range

This parameter specifies the permissible deformation range based on the edge data of the registered model.

Although a higher setting increases the detection probability, the erroneous detection probability also increases.

The setting range is 0 to 5, and the default value is 1.

■ Score threshold 1

This parameter specifies the score threshold to narrow the number of search object candidates before performing a search for a registered model.

A search occurs only for objects with scores equal to or higher than this setting value. Be sure that the "Score threshold 1" setting value is lower than the "Score threshold 2" setting value.

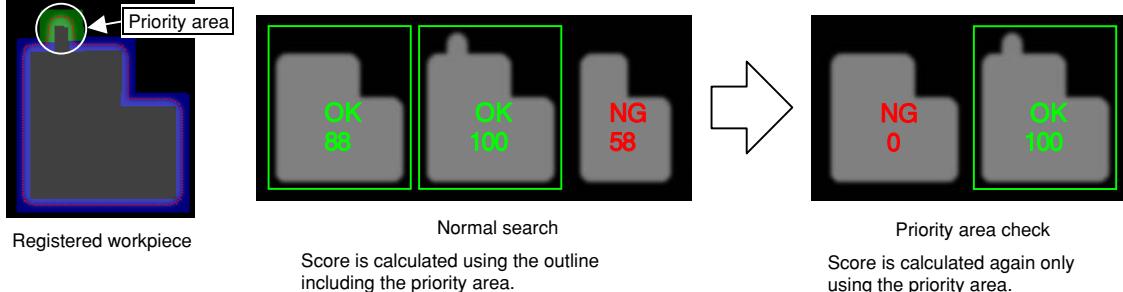
The setting range is 0 to 100, and the default value is 50.

■ Score threshold 2

This parameter specifies the threshold value for registered model search result outputs. Only search results with scores equal to or higher than this threshold value are reported. Be sure that the "Score threshold 1" setting value is lower than the "Score threshold 2" setting value. The setting range is 0 to 100, and the default value is 60.

■ Priority area threshold

This parameter specifies the threshold value for the priority area check of the workpiece, whose model is registered. This setting is valid only for the workpiece, whose priority area is set in the contour setting. The priority area check is performed for the workpiece that is detected during the normal search. The score is calculated again only using the locations set in the priority area to output the results of the workpiece, whose score exceeds the priority area threshold value. This parameter is effective to exactly distinguish the model when there are multiple models with similar shapes. The setting range is 0 to 100, and the default value is 60.



■ Precision

This parameter specifies the search precision when searching for registered models. The precision default value is *Normal*.

Setting	Content
Normal	Specifies a "normal precision" search.
High	Specifies a "high precision" search.

The settings and their characteristics are given below. Select a setting which is suitable for the application.

● Search precision settings and their characteristics

Setting	Characteristics
Normal	Gives priority to the search speed, resulting in reduced precision.
High	Gives priority to the search precision, resulting in slower searches.

■ Reduction weight

This parameter specifies in % units the amount by which the score is reduced if an edge is detected inside the reduction area of the registered model workpiece when searching.

The score is reduced if an edge is detected in the reduction area. Changing this parameter setting adjusts the score reduction.

If an edge is detected in the reduction area, then the score is calculated as follows:

$$\text{Score} = \frac{(\text{Number of matched edge points} - \text{Number of edge points in reduction area} \times \text{Reduction weight})}{\text{Number of edge points of registered model workpiece}} \times 100$$

The reduction weight setting range is 0 to 1000, and the default value is 2.

■ Edge Polarity

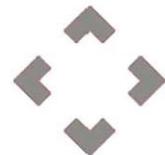
This parameter specifies the contrast polarity of the image to be detected when searching for the registered model workpieces.

The default value for edge polarity is *Normal*.

Setting	Content
Normal	Detects the image contrast that is the same as the registered model workpiece.
Reverse	Detects the image contrast that is the reverse of the registered model workpiece.
Both	Detects the image contrast that is the same as the registered model workpiece and also detects the image contrast that is the reverse of the registered model workpiece.

If the background of a model registration workpiece varies greatly, changing this parameter setting makes an improvement. For example if the setting is "Normal", and a gray colored workpiece was registered on a white background (upper figure), the gray colored workpiece on a black background (lower figure) is not found. In this case, setting this parameter to "Reverse" or "Both" allows the gray colored workpiece to be found on the black background (lower right figure). If the background color is not uniform, use "Both". The workpiece will be found stably.

(When set to "Reverse", the gray colored workpiece cannot be found on the white background (upper figure)).



Gray colored workpiece
on white background



Gray colored workpiece
on black background

■ Max Number of Matches

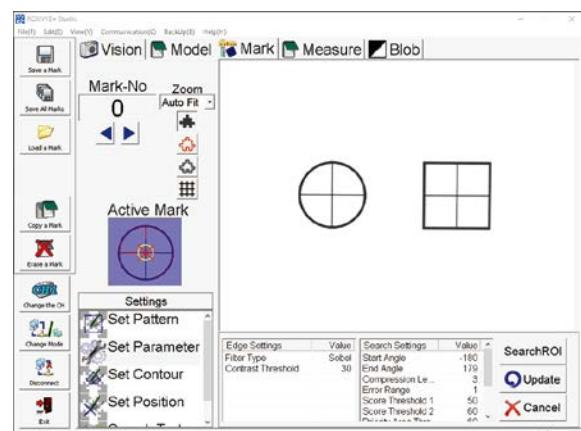
This parameter specifies the max. number of detected workpieces when searching for registered models. The setting range is 1 to 100, and the default value is 1.

■ Timeout

This parameter specifies the timeout period in 100-millisecond (ms) units when searching for the registered model workpiece. The setting range is 1 to 300, and the default value is 300.

5.6 Mark mode parameter settings

This section explains the various parameter settings required in order to register fiducial marks in Mark mode.



5.6.1 Edge settings

This section explains the parameters related to edge extractions which occur in Mark mode.

For details on how to set each parameter, refer to B RCXiVY2+ Studio OPERATION SECTION", "7.3.3 Parameter settings".

5.6.1.1 Parameter details

■ Filter type

Specifies the processing method for the filter which acquires the fiducial mark edge image.
The default value for Filter is *Sobel*.

Setting	Content
Sobel	Specifies the Sobel filter.
Correlate	Specifies the correlated edge filter.

The various characteristics of the "Sobel filter" and "correlated edge filter" methods are given below. Select the filter type which is suitable for the application.

● Filter characteristics

Setting	Characteristics	
Sobel	Merits	Offers high-speed edge extraction.
	Demerits	Easily affected by noise and light changes.
Correlate	Merits	Relatively unaffected by noise and light changes.
	Demerits	Offers low-speed edge extraction.

■ Contrast threshold

This parameter specifies the threshold contrast (brightness difference) for fiducial mark edge discrimination.
Edges with contrast which is less than this setting is not processed as edges.
The setting range is 0 to 255, and the default value is 30.

■ Edge strength threshold

This parameter specifies the threshold for the edge value (edge strength) when using the "correlated edge filter" processing method. Normally, the default setting should be used.
The setting range is 0 to 255, and the default value is 160.



NOTE

The "Edge strength threshold" parameter is displayed only when the filter parameter is specified as "Correlate".

■ Filter size

This parameter specifies the size of the filter used to extract the workpiece edge when using the "correlated edge filter" processing method.
Normally, the default setting should be used. However, when acquiring an edge image along fine lines such as characters, etc., the filter size should be adjusted in accordance with the line thickness. The narrower the line, the smaller this setting value should be.
The setting range is the odd number from 3 to 21, and the default value is 13.



NOTE

The "Filter size" parameter is displayed only when the filter parameter is specified as "correlated edge".

5.6.2 Search settings

This section explains the various search related parameters which apply in Mark mode. For details on how to set each parameter, refer to B RCXiVY2+ Studio OPERATION SECTION, "7.3.3 Parameter settings".

5.6.2.1 Parameter details

■ START angle

This parameter specifies in degree ($^{\circ}$) units the start angle of the permissible rotation angle, from the edge data of the fiducial mark. When an actual search is performed, the search focuses on candidates within the setting range specified by the START and END angle parameters.

The narrower the search range, the faster the search. When searching for edge data to which circular rotation does not apply, both the START and END angles can be specified as " 0° " (permissible rotation angle range: 0° to 0°) to enable a high-speed search. The setting range is -180 to 179, and the default value is -180.

■ END angle

This parameter specifies in degree ($^{\circ}$) units the end angle of the permissible rotation angle, from the edge data of the fiducial mark. When an actual search is performed, the search focuses on candidates within the setting range specified by the START and END angle parameters.

The narrower the search range, the faster the search. When searching for edge data to which circular rotation does not apply, both the START and END angles can be specified as " 0° " (permissible rotation angle range: 0° to 0°) to enable a high-speed search.

The setting range is -180 to 179, and the default value is 179.

■ Compression Level

This parameter specifies the compression level of the fiducial mark edge data.

Although a higher setting will shorten the search time, the detection probability also decreases.

The setting range is 0 to 5, and the default value is 3.

■ Error range

This parameter specifies the permissible deformation range based on the edge data of the fiducial mark.

Although a higher setting increases the detection probability, the erroneous detection probability also increases.

The setting range is 0 to 5, and the default value is 1.

■ Score threshold 1

This parameter specifies the score threshold to narrow the number of search object candidates before performing a search for a fiducial mark.

A search occurs only for objects with scores equal to or higher than this setting value. Be sure that the "Score threshold 1" setting value is less than the "Score threshold 2" setting value.

The setting range is 0 to 100, and the default value is 50.

■ Score threshold 2

This parameter specifies the threshold value for fiducial mark search result outputs.

Only search results with scores equal to or higher than this threshold value are reported.

Be sure that the "Score threshold 1" setting value is less than the "Score threshold 2" setting value.

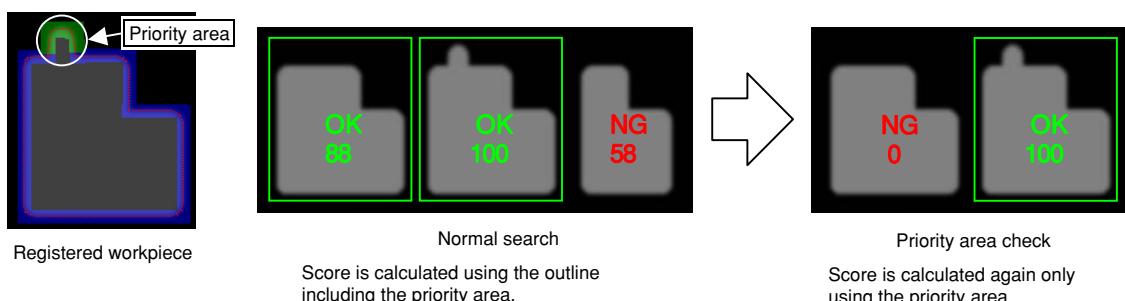
The setting range is 0 to 100, and the default value is 60.

■ Priority area threshold

This parameter specifies the threshold value for checking the priority area of the fiducial mark. This setting is valid only for the workpiece, whose priority area is set in the contour setting.

Priority area check is performed on a workpiece that is detected by a fiducial mark search. The score is calculated again only using the locations set in the priority area to output the results of the workpiece, whose score exceeds the priority area threshold value. This parameter is effective to exactly distinguish the model when there are multiple models with similar shapes.

The setting range is 0 to 100, and the default value is 60.



Precision

This parameter specifies the search precision when searching for fiducial marks. The precision default value is *Normal*. The settings and their characteristics are given below. Select a setting which is suitable for the application in question.

Setting	Content	Characteristics
Normal	Specifies a "normal precision" search.	Gives priority to the search speed, resulting in reduced precision.
High	Specifies a "high precision" search.	Gives priority to the search precision, resulting in slower searches.

Reduction weight

This parameter specifies in % units the amount by which the score is reduced if an edge is detected inside the reduction area of the fiducial mark when searching.

The score is reduced if an edge is detected in the reduction area. Changing this parameter setting adjusts the score reduction. The setting range is 0 to 1000, and the default value is 2.

If an edge is detected in the reduction area, then the score is calculated as follows:

$$\text{Score} = \frac{(\text{Number of matched edge points} - \text{Number of edge points in reduction area} \times \text{Reduction weight})}{\text{Number of edge points of registered model workpiece}} \times 100$$

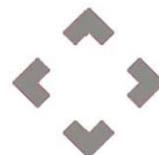
Edge Polarity

This parameter specifies the contrast polarity of the image to be detected when searching for the registered model workpieces. The default value for edge polarity is *Normal*.

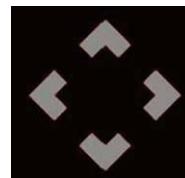
Setting	Content
Normal	Detects the image contrast that is the same as the registered model workpiece.
Reverse	Detects the image contrast that is the reverse of the registered model workpiece.
Both	Detects the image contrast that is the same as the registered model workpiece and also detects the image contrast that is the reverse of the registered model workpiece.

If the background of a model registration workpiece varies greatly, changing this parameter setting makes an improvement. For example if the setting is "Normal", and a gray colored workpiece was registered on a white background (upper figure), the gray colored workpiece on a black background (lower figure) is not found. In this case, setting this parameter to "Reverse" or "Both" allows the gray colored workpiece to be found on the black background (lower right figure). If the background color is not uniform, use "Both". The workpiece will be found stably.

(When "Reverse" is set, the gray colored workpiece cannot be found on the white background (upper figure)).



Gray colored workpiece
on white background



Gray colored workpiece
on black background

Max number of matches

This parameter specifies the max. number of detected workpieces when searching for registered models. The setting range is 1 to 100, and the default value is 1.

Timeout

This parameter specifies units the timeout period in 100-millisecond (ms) when searching for the registered model workpiece. The setting range is 1 to 300, and the default value is 300.

5.7 Measure mode parameter settings

This section explains the various parameter settings required in order to use measure function. Refer to B RCXiVY2+ Studio OPERATION SECTION, "7.6.4 Setting measure tool parameters" for details on setting.

5.7.1 Line detection parameter details

■ Search margin

This parameter specifies the width for the detection frame. Be sure that the straight line is within the frame.

■ Vote theta

This parameter specifies the tolerance angle between edge points on the line.

Setting smaller value shortens the processing time. Setting larger value improves noise immunity.

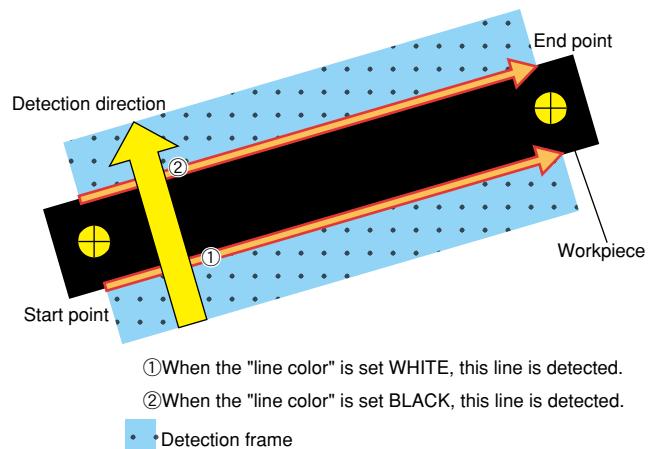
When the edge point on the line cannot be obtained clearly, set this value larger.

■ Color of line

This parameter specifies the line color of the workpiece to detect. When setting WHITE, the line is detected where the color changes from white to black in the detection direction and vice versa when setting BLACK. When setting BLACK_WHITE, the line can be detected in both cases and the line with higher score is adopted.

The line is detected from the 90-degree counterclockwise direction against one line connecting the start and end points as the right figure shows.

Specifying the line color enables detection of outside or inside the line part.



5.7.2 Circle detection parameter details

■ Search margin

This parameter specifies the width for the detection frame. Be sure that the circle is within the frame.

■ Vote theta

This parameter specifies the tolerance angle between edge points on the circle.

Setting smaller value shortens the processing time. Setting larger value improves noise immunity.

When the edge point on the circle cannot be obtained clearly, set this value larger.

■ Percentage threshold of circumference

This parameter specifies the threshold which decides the number of edge points on the circle contour to consider the shape is a circle by percentage.

Set smaller value when the circle to be detected is distorted or the edge point on the circle cannot be obtained clearly.

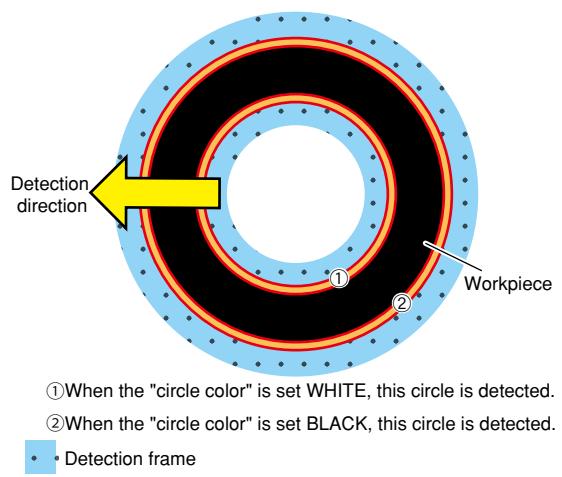
■ Color of circle

This parameter specifies the circle color of the workpiece to detect. When setting WHITE, the circle is detected where the color changes from white to black in the detection direction and vice versa when setting BLACK. When setting BLACK_WHITE, the circle can be detected in both cases and the circle with higher score is adopted.

The circle is detected from inside to outside as the right figure shows. Specifying the circle color enables detection of outside or inside the circle.

■ Refine

Setting "Use" improves the detection accuracy. The detection time will be longer on the other hand.



① When the "circle color" is set WHITE, this circle is detected.

② When the "circle color" is set BLACK, this circle is detected.

• Detection frame

5.8 Blob mode parameter settings

Each parameter related to the search in the Blob mode is described. For details about how to set each parameter, refer to B RCXiVY2+Studio OPERATION SECTION "7.7.5 Blob tool parameter settings".

5.8.1 Automatic adjustment parameter details

■ Target color

Set the detection target color to black or white for the automatic adjustment. When the background is white and the workpiece is black, set black. On the contrary, when the background is black and workpiece is white, set white.

■ Hole filling ratio

For details, refer to the hole filling ratio stated in "5.8.2 Blob setting parameter details".

5.8.2 Blob setting parameter details

■ Binarization upper limit/lower limit

Set the brightness upper limit or lower limit of the pixel targeted for the blob.

When the brightness of the pixel is in the range set by the upper limit and lower limit, this is recognized as a blob target. For the brightness of the pixel, the black pixel is 0 and the white pixel 255.

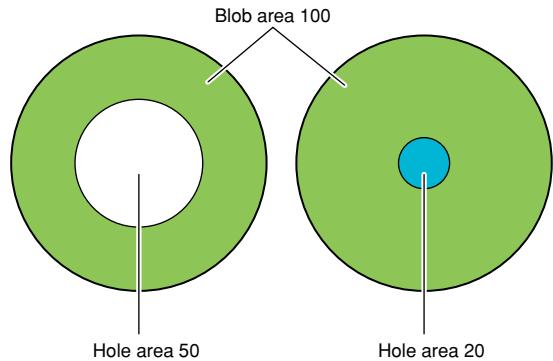
■ Hole filing ratio

Set the ratio of the blob to the hole when the hole in the workpiece is filled.

For the area of the blob (including the hole) to be targeted,

- When the area of the hole is smaller than the set value, the hole is filled.
- The larger the set value, a larger hole is also filled.
- When the set value is 0, the hole is not filled.

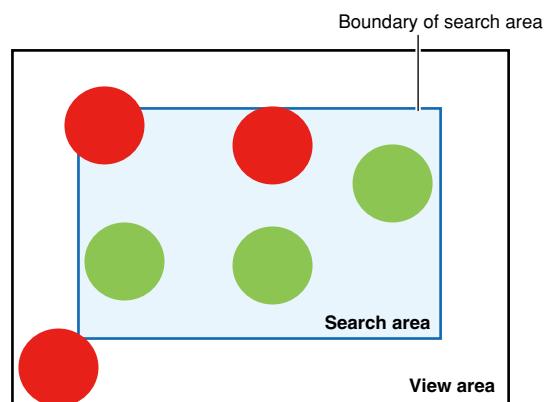
In the figure shown on the right, there is a workpiece with a blob area (including the hole) of 100 pixels, and hole areas of 50 pixels and 20 pixels in the view field. When the hole filling ratio is 30%, the hole with an area of 20 pixels is filled and the blob with an area of 100 pixels is output, the hole with an area of 50 pixels is not filled, and then the workpiece is output as a blob with an area of 50 pixels.



■ Boundary blob removal

Set whether the blobs on the boundary of the search area are removed. When the setting is valid, the blobs on the boundary of the search area are removed from the search target.

	Blobs that are removed from the search target.
	Blobs that are targeted for the search.



■ Filter

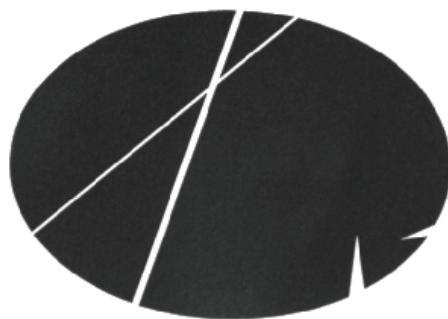
Set the filter process that is performed for the image after binarization.

The filter process is performed to remove small noises and reduce chips and cracks of blobs. The setting can be made individually for filter 1 and filter 2.

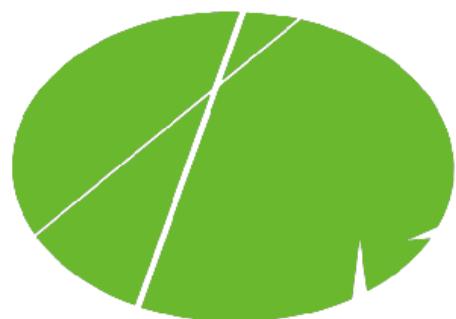
Filter name	Effect
Expansion	Expands the blob to reduce the chipping or cracking.
Shrinkage	Shrinks the blob to remove small noises.
Opening	Performs the shrinkage and expansion in order to reduce the chipping or cracking.
Closing	Performs the expansion and shrinkage in order to remove noises.

■ Utilization example of expansion and closing filters

<Original image>



<Binarization>



<Expansion is applied 9 times.>



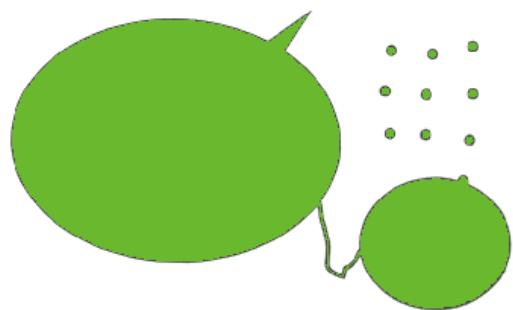
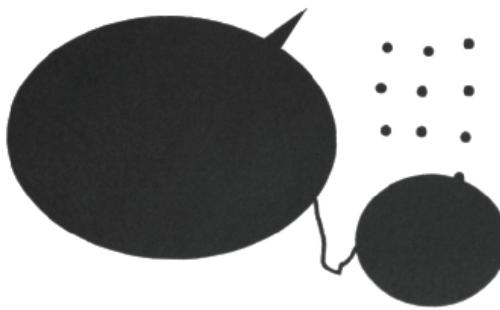
<Closing is applied 9 times.>



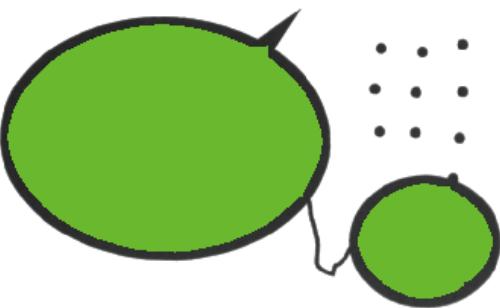
If the blob is cracked or chipped as shown in the figure above, the expansion and closing filters are effective. As the expansion filter is applied, stripes or chipping of the workpiece can be reduced. Since the closing filter performs the shrinkage the same times after expansion, the size can be returned to the original level while the effects of the expansion filter are obtained.

■ Utilization example of shrinkage and opening filters

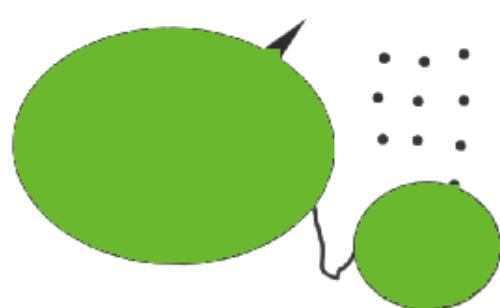
<Original image>



<Shrinkage>



<Opening>



If the blobs are connected or small blobs are detected as shown in the figure above, the shrinkage and opening filters are effective. As the shrinkage filter is applied, small noises or protrusion parts are removed or reduced. The opening filter performs the expansion the same times after shrinkage. The size can be returned to the original level while the effects of the shrinkage filter are obtained.

■ Filter count

Set the number of execution times in the corresponding filter setting. When the number of times is high, the effects of the filter process become large, but the process time increases.

5.8.3 Search setting parameter details

■ Detection quantity

Set the maximum number of detection workpieces during searching. The setting range of the detection quantity is 1 to 100 and the default value is 1.

■ Area upper limit and lower limit

Set the allowable area of the blob to be detected during searching. Blobs in the set range of the area are detected.

■ Start angle and end angle of main axis angle

Set the allowable rotation angle of the main axis angle of the blob to be detected during searching. The oval fitting is performed for the blob and the angle on the main axis camera coordinate of this oval is determined to the main axis angle. Blobs in the set range between the start angle and end angle are targeted for the detection.

■ Main axis length

Set the allowable range of the main axis length of the blob to be detected during searching. The oval fitting is performed for the blob and the main axis length of this oval is determined to the main axis length. Blobs in the set range of the main axis length are detected.

■ Roundness

Set the allowable roundness range of the blob to be detected during searching. The oval fitting is performed for the blob and the circularity of this oval is determined to the roundness. Blobs in the set range of the roundness are detected.

A 6. Camera calibration

"Camera calibration" refers to the process in which the coordinates (camera coordinates) of the image acquired by the camera are aligned with the robot coordinates, which must be performed when using the RCXiVY2+ system for the first time, and when the relative position of the camera and robot has changed (e.g., when the camera has moved).

There are two setting methods of interactive camera calibration;

Simple camera calibration: For simple camera calibration

Advance camera calibration: For lens distortion correction and camera tilt correction

■ Simple camera calibration

This calibration type is simple, and two setting methods are available; Automatic camera calibration and manual camera calibration.

In the following cases, camera calibration can be executed in both ways.

Robot type	Camera installation method
SCARA	Upward and fixed
Cartesian	Upward and fixed camera/ Downward and 2nd arm camera

For robot types and installation methods other than those shown above, manual camera calibration is available.

■ Advance camera calibration

This method is for higher accuracy.

If accuracy is required, the lens distortion is large, or the camera is installed aslant, this method is effective.

Auto camera calibration is executed using calibration jigs.

6.1 Simple camera calibration

6.1.1 Interactive simple camera calibration setting method

The setting method for interactive simple camera calibration is given below.

Step 1 Register the fiducial mark at RCXiVY2+ Studio.

For details concerning how to register fiducial marks at RCXiVY2+ Studio, refer to B RCXiVY2+Studio OPERATION SECTION "7.5 Registering fiducial marks".



- When executing the manual simple camera calibration, be sure to register 2 fiducial marks of differing shapes at mark numbers 0 and 1.
- When executing the auto simple camera calibration, register one fiducial mark at mark number 0. For the upward fixed camera, attach the fiducial mark at the Z-axis or the tip of R-axis of the robot.

Step 2 Start RCX-Studio

Simple camera calibration is executed using RCX-Studio. Start RCX-Studio. Refer to the YAMAHA Support Software RCX-Studio User's Manual for details.

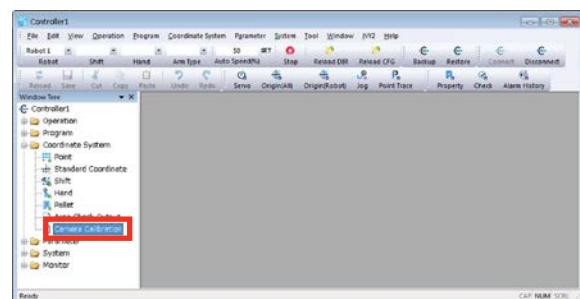
Step 3 Connect to the controller with RCX-Studio.

Connect to the controller with RCX-Studio. Refer to the YAMAHA Support Software RCX-Studio User's Manual for details.

Step 4 Select "Camera Calibration".

In the window tree of the target window, under "Coordinate System", double-click "Camera Calibration".

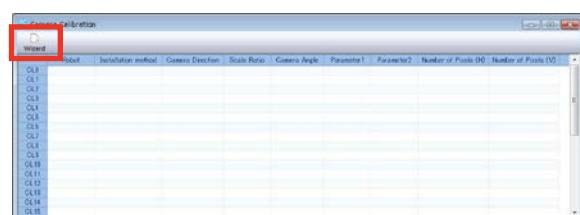
Step 4 Target window



Step 5 Click "Wizard".

The camera calibration window is shown. Click "Wizard" on the toolbar of the camera calibration window.

Step 5 Camera Calibration



Step 6 The "Camera Calibration - Step 1" window appears.

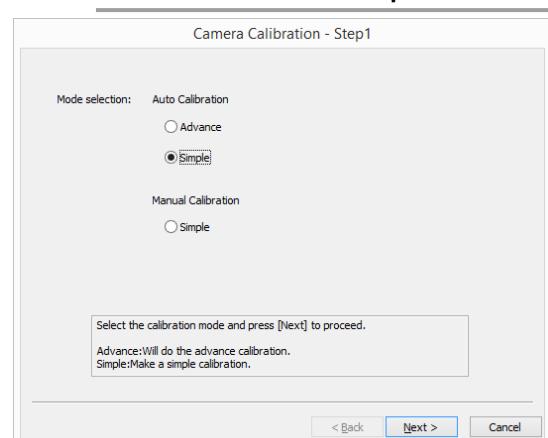
Select the mode for simple camera calibration, and click (Next).

Step 6 Camera Calibration - Step 1

Robot type	Camera installation method
SCARA	Upward and fixed
Cartesian	Upward and fixed / Downward and 2nd arm

For the robot type and installation method settings shown above, Auto calibration mode is selectable.

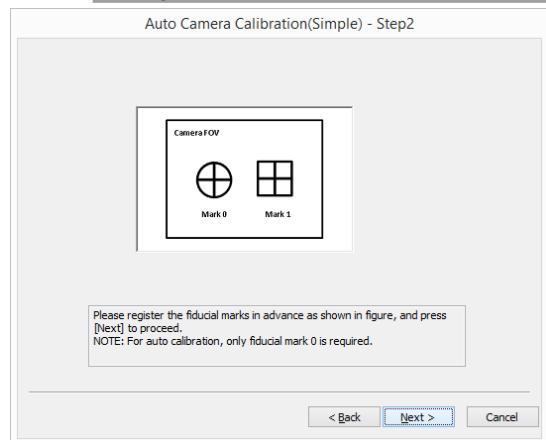
For robot type and installation method other than those shown above, the mode should be manual calibration (simple).



Step 7 The "Camera Calibration (Simple) - Step 2" window appears.

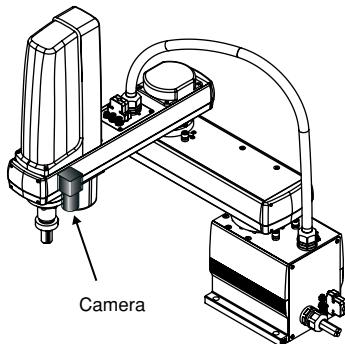
Register the fiducial mark as a model and click (Next).

► **Step 7 Auto Camera Calibration (Simple) - Step 2**

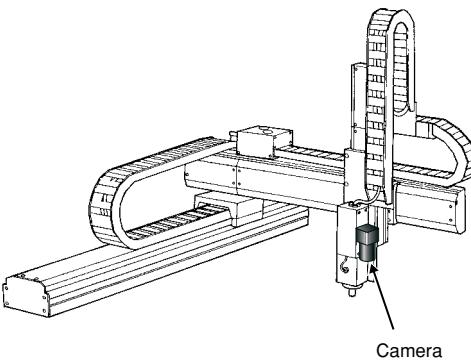
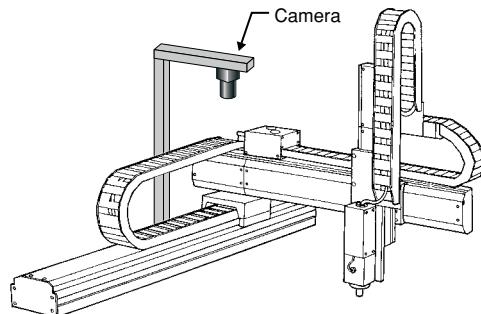


■ Examples of camera installation

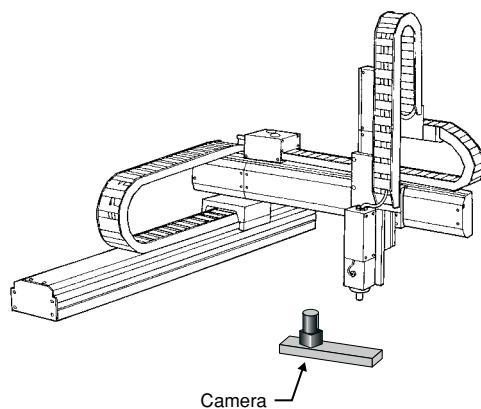
If installing the camera on the Y-axis or Z-axis of the robot, set [Camera Axis] to [2nd Arm], and set [Camera Direction] to [Down].



If the camera is fixed on a non-moving part and the fixed camera is facing downward, set [Camera Axis] to [Fixed], and set [Camera Direction] to [Down].



If the camera is fixed on a non-moving part and the fixed camera is facing upward, set [Camera Axis] to [Fixed], and set [Camera Direction] to [Up].



6.1.2 Executing auto camera calibration

This section explains how to execute auto camera calibration.

Step 1 Set each item in "Calibration Settings", and click [Next].

When setting the "Camera Calibration - Step 1" mode selection to "Auto" and click [Next], the "Auto Camera Calibration - Step 2" window appears.

Set each item in "Calibration Setting", and click [Next].



NOTE

Click (Back) to return to the "Camera Calibration - Step 1" window.

Step 1

Auto Camera Calibration - Step 2 (Calibration Settings)

■ Calibration No.

Specify the calibration number that will register the camera calibration settings. The setting range is 0 to 31.

■ Camera Channel

Specify the camera channel number that will acquire the image. The setting range is 1 to 16.

■ Installation method

Select the camera setting.

Setting	Content
Fixed	Select this if using a fixed camera, and Camera Direction is automatically set to "Up Direction".
2nd Arm	Select this if using a 2nd arm camera, and Camera Direction is automatically set to "Down Direction".

■ Camera Direction

Select the camera's direction.

Setting	Content
Down Direction	Select this if the camera faces downward.
Up Direction	Select this if the camera faces upward.

Step 2 In "Auto Calibration Setting", input "FOV Width" and then click [Next].

"Auto Calibration Setting" will now accept inputting.

Input the "Auto Calibration Setting" values and select items, and then click [Next].



NOTE

When clicking (Back), "Auto Calibration Setting" becomes invalid, and "Calibration Settings" can be specified.

Step 2

Auto Camera Calibration - Step 2 (Auto Calibration Setting)

■ FOV Width (mm)

Specify the field width [mm] of the camera that executes camera calibration. The setting range is 10 to 9999999.



NOTE

When executing auto camera calibration, the robot operates within the specified field width.

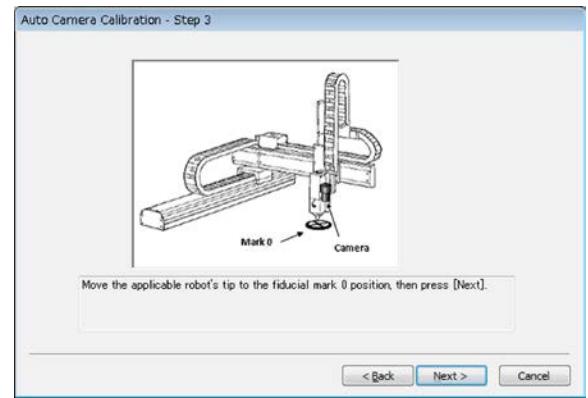
Step 3 Align the robot tip with the fiducial mark, and click [Next]. ► **Step 3 Auto Camera Calibration - Step 3**

If the "Installation Method" is set to "2nd Arm", the "Auto Camera Calibration - Step 3" window appears. Align the robot tip with the fiducial mark, and click (Next).



NOTE

- If "Installation Method" is set to "Fixed", the "Auto Camera Calibration - Step 4" window appears instead of "Auto Camera Calibration - Step 3".
- Click (Back) to return to the "Auto Camera Calibration - Step 2" window.



Step 4 Move the fiducial mark so that it comes to the center of the camera's field of view (FOV), and when the fiducial mark is detected, click [Next].

The "Auto Camera Calibration - Step 4" window appears.

Move the robot so that the fiducial mark is seen in the middle of the FOV.

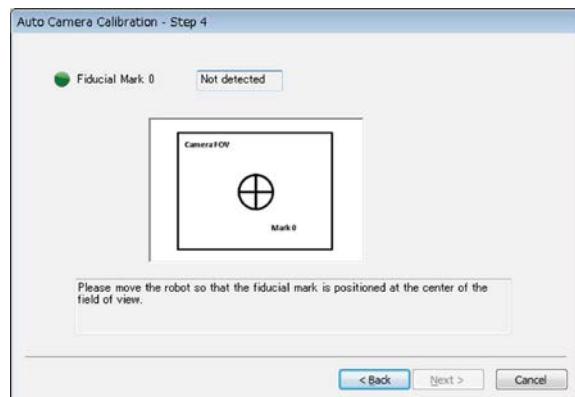
To move the tip of the applicable robot, use the jog keys to move it, or move the robot by hand while in the emergency stop status.

When the mark enters the FOV, search for the fiducial mark begins.

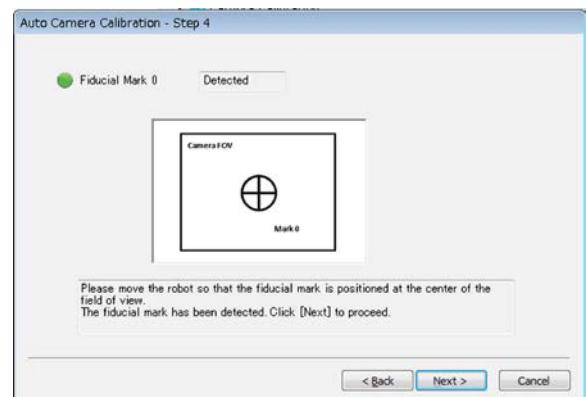
When the fiducial mark is detected, the LED is lit, and the fiducial mark 0 "Not detected" changes to "Detected".

When the fiducial mark is detected, (Next) is enabled, so click it.

■ Fiducial mark is not detected.



■ Fiducial mark is detected.



WARNING

- When using the jog keys to move the robot, do not enter the robot's working envelope to avoid danger.
- When moving the robot manually, make sure that it is in the emergency stop status where the hardware prevents the servo from turning on.



NOTE

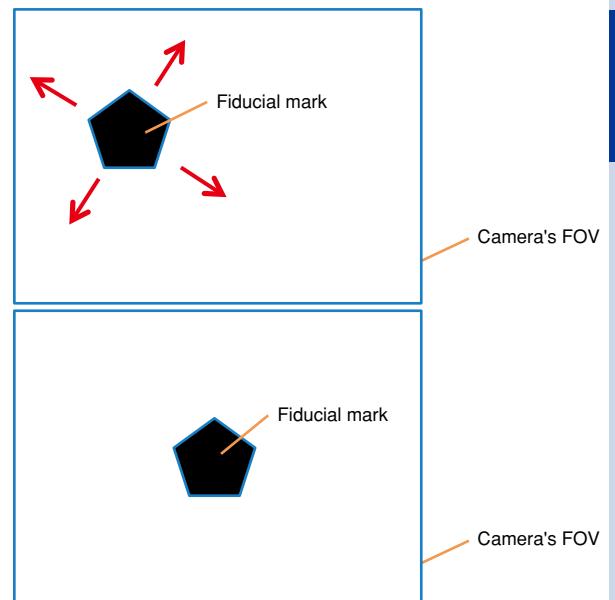
- By using the monitor function of RCXiVY2+ Studio, the fiducial mark search status can be verified while making camera calibration settings.
- If a fiducial mark is not detected, reconsider the parameter settings (edge setting, search setting, search range) of Mark mode in RCXiVY2+ Studio. For details on these values and how to set them, refer to "5.6 Mark mode parameter settings", and B RCXiVY2+Studio OPERATION SECTION "7.5.2 Parameter settings".
- When using the jog keys to move the robot, use the programming box or RCX-Studio to change the manual movement speed. For details on changing the manual movement speed, refer to the RCX3 series Operator's Manual or the YAMAHA Support Software RCX-Studio User's Manual.
- When executing auto camera calibration, the robot operates at the specified automatic operation speed.
- Click (Back) to return to the "Auto Camera Calibration - Step 2" window (if "Installation Method" is set to "Fixed") or the "Auto Camera Calibration - Step 3" window (if "Installation Method" is set to "2nd Arm").
- If RCXiVY2+ Studio is connected in Edit mode, an error occurs. Terminate the RCXiVY2+ connection, or switch to Monitor mode.

Step 5 Turn the servo on, confirm the safety around the working envelope, and click [Start] under "Preliminary Calibration".

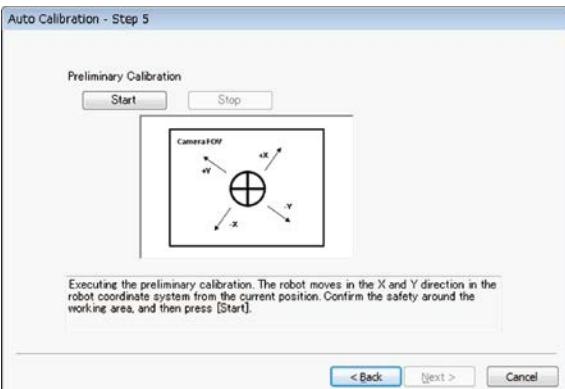
When clicking (Start), the robot tip, starting from its current location, moves in the +X direction, +Y direction, -X direction, and -Y direction of the robot coordinates, by approximately 1/4 of the FOV Width (mm) specified in "Auto Camera Calibration - Step 2".

When clicking (Stop), the preliminary calibration is halted. After the robot tip has moved, the fiducial mark is detected.

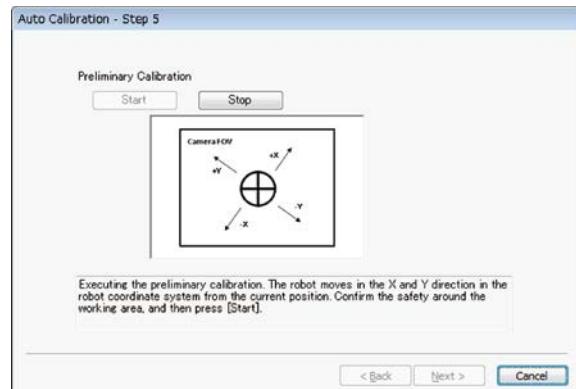
When the robot tip moves in each direction and the fiducial mark is detected, the robot moves so that the fiducial mark is arranged close to the center of the camera's FOV.



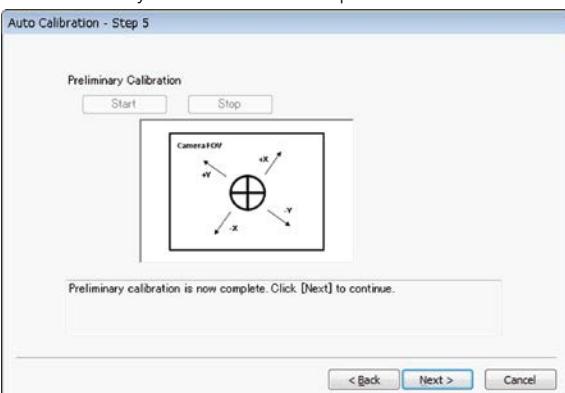
■ Before starting preliminary calibration



■ During executing preliminary calibration



■ Preliminary calibration is complete.



WARNING

- When executing preliminary calibration, the robot moves at the automatic operation speed . To avoid danger, do not enter the robot's operation area.
- When executing preliminary calibration, be prepared to stop the robot immediately if necessary (e.g., using the programming box's emergency stop button).



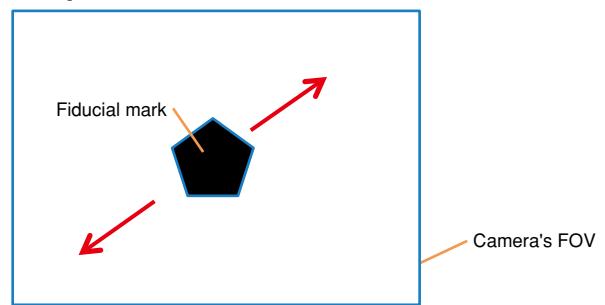
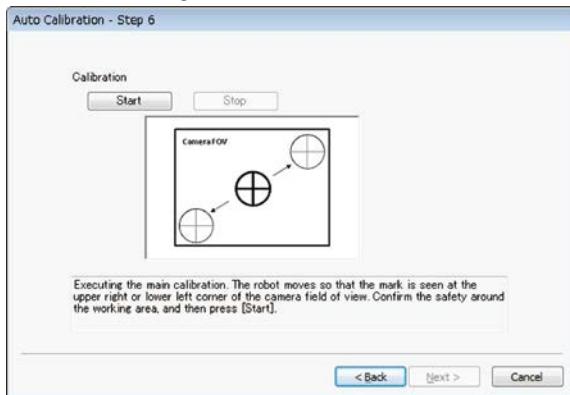
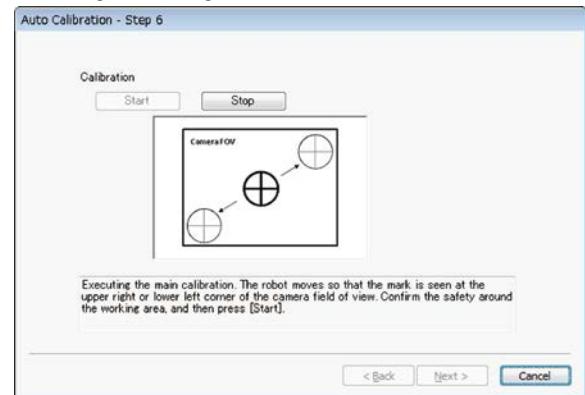
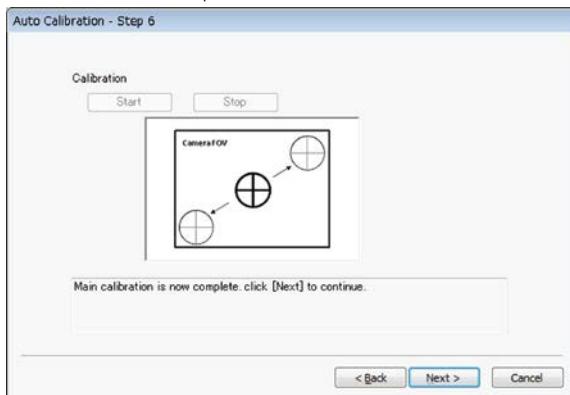
NOTE

- Make adjustments in advance so that the robot can move within the camera's field of vision. If soft limit over occurs, the robot moves to the next point without moving to that point.
- If the fiducial mark could not be detected, an error occurs.
- Click (Back) to before executing preliminary calibration to return to the "Auto Camera Calibration - Step 4" window.
- Click (Back) before completing preliminary calibration to return to the state prior to executing preliminary calibration.

Step 6 Confirm the safety around the working envelope, and then click Calibration [Start].

The robot moves so that the fiducial marks are located in the upper right and lower left of the camera's field, and the fiducial marks are detected. The robot moves to 4 separate points each in the upper right and lower left of the camera's field. (4 points in the upper right, 4 points in the lower left; a total of 8 points.)

Click (Stop) to stop camera calibration.

**■ Before starting calibration****■ During executing calibration****■ Calibration completed****WARNING**

- When executing camera calibration, the robot moves at the automatic operation speed . To avoid danger, do not enter the robot working envelope.
- When executing camera calibration, be prepared to stop the robot immediately if necessary (e.g., using the programming box's emergency stop button).

**NOTE**

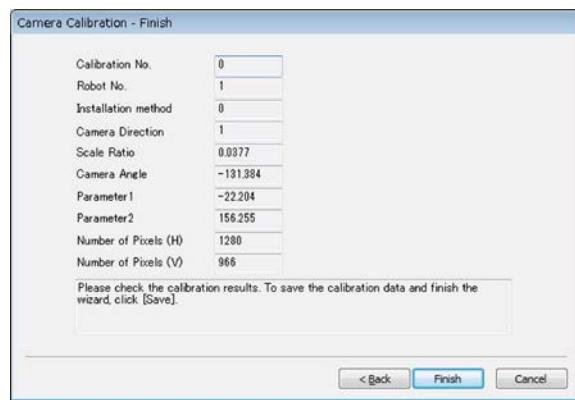
- Make adjustments in advance so that the robot can move within the camera's FOV. If soft limit over occurs, the robot moves to the next point without moving to that point.
- If the fiducial mark could not be detected, an error occurs.
- Click (Back) before executing calibration to return to the "Auto Camera Calibration - Step 5" (Preliminary calibration is completed) window.

Step 7 Check the camera calibration result.

When auto camera calibration was executed correctly, the result is displayed, then check it.

For details on camera calibration data, refer to "6.3.2 Camera Calibration data details".

▶ Step 7 Auto Camera Calibration - Finish



Click (Finish), and then a message asks whether to save the settings.

Click (Yes) to save the camera calibration settings in the specified calibration number. Click (No) to dismiss the save confirmation message.

▶ Step 7 Auto Camera Calibration - Save confirmation message



NOTE

- The saved camera calibration settings can be viewed and edited in the target window's "Camera Calibration". For details, refer to "6.3 Camera calibration data editing".
- To discontinue without saving the camera calibration settings, click (Cancel) in the "Camera Calibration - Finish" window.
- Click (Back) to return to the "Auto Camera Calibration - Step 6" (calibration completed) window.

6.1.3 Executing manual camera calibration

This section explains how to execute manual camera calibration.

Step 1 Set each item in "Calibration Settings", and click [Next].

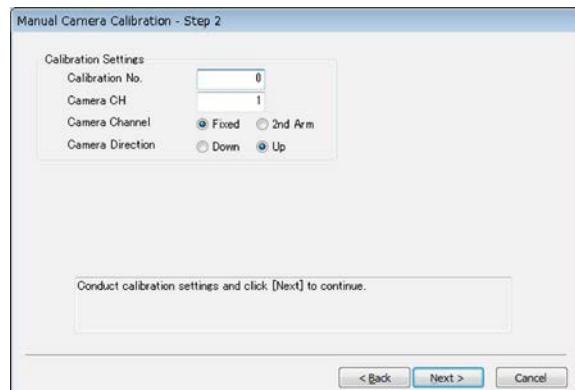
When selecting "Manual" for the mode selection of "Camera Calibration - Step 1" and click (Next), the "Manual Camera Calibration - Step 2" window appears. Set each item in "Calibration Settings", and click (Next).



NOTE

Click (Back) to return to the "Camera Calibration - Step 1" window.

▶ Step 1 Manual Camera Calibration - Step 2



■ Calibration number

Specify the calibration number that will save the camera calibration settings. The setting range is 0 to 31.

■ Camera Channel

Specify the camera channel number that acquires the image. The setting range is 1 to 16.

■ Installation method

Specify how the camera is installed.

Setting	Content
Fixed	Select this if using a fixed camera.
2nd Arm	Select this if using a 2nd arm camera.

■ Camera Direction

Specify the camera's direction.

Setting	Content
Down	Select this if the camera faces downward.
Up	Select this if the camera faces upward.

Step 2 Place the 2 fiducial marks so that they are within the camera's FOV but as far apart from each other as possible, and when the fiducial marks are detected, click [Next].

Place the 2 fiducial marks (fiducial mark 0 and 1) so that they are within the camera's FOV but as far apart from each other as possible. Do not place the fiducial marks at the 4 corners of the camera's FOV.

When each mark enters the camera's FOV, searching for the fiducial marks begins.

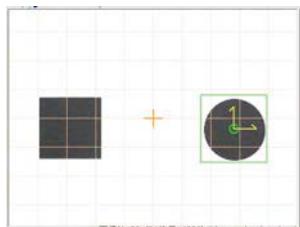
When fiducial mark 0 is detected, the fiducial mark 0 LED is lit, and "Not detected" changes to "Detected".

When fiducial mark 1 is detected, the fiducial mark 1 LED is lit, and "Not detected" changes to "Detected".

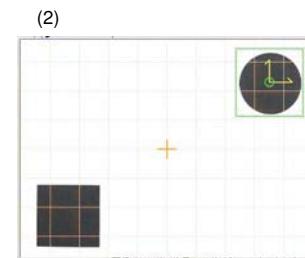
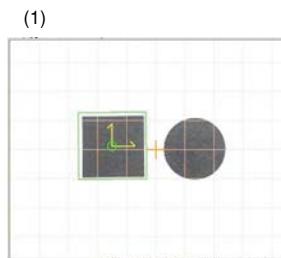
When both the fiducial marks 0 and 1 are detected and (Next) becomes available, then click (Next).

● Mark arrangement examples

Good example



Bad examples



(1) The fiducial marks are close to each other.

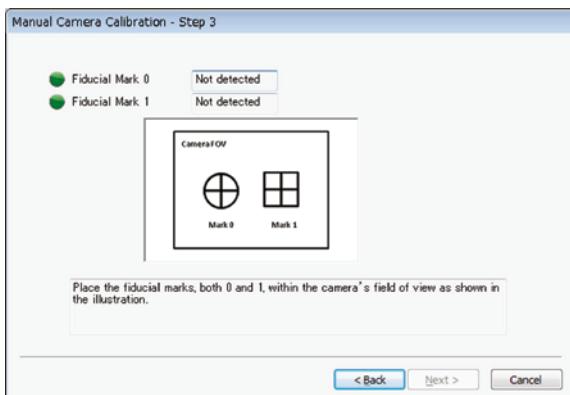
If the fiducial marks are close to each other, the precision of the coordinate conversion lowers. Place the fiducial marks so that they are as apart from each other as possible.

(2) The fiducial marks are put at 4 corners of the camera's FOV.

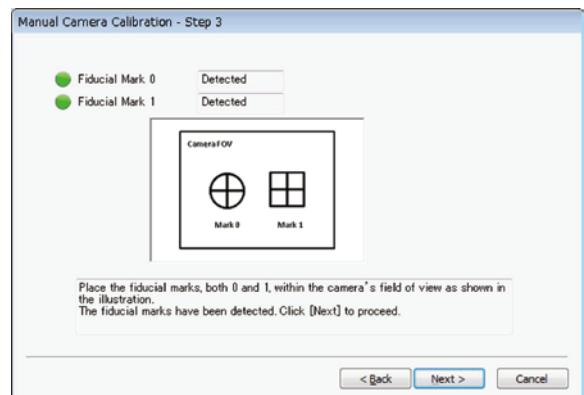
If the fiducial marks are put at 4 corners of the camera's FOV, the fiducial mark image may become distorted depending on the type of lens to be used. Do not place the fiducial marks at 4 corners of the camera's FOV.

● Manual Camera Calibration - Step3

■ Fiducial mark 0 and fiducial mark are not detected



■ Fiducial mark 0 and fiducial mark 1 are detected



NOTE

- By using the monitor function of RCXiVY2+ Studio, you can verify the fiducial mark search status while making camera calibration settings.
- If a fiducial mark is not detected, reconsider the parameter settings (edge setting, search setting, search range) of Mark mode in RCXiVY2+ Studio. For details on these values and how to set them, refer to "5.6 Mark mode parameter settings", and B RCXiVY2+Studio OPERATION SECTION "7.5.2 Parameter settings".
- Click (Back) to return to the "Manual Camera Calibration - Step 2" window.
- If RCXiVY2+ Studio is connected in Edit mode, an error occurs. Terminate the RCXiVY2+ connection, or switch to Monitor mode.

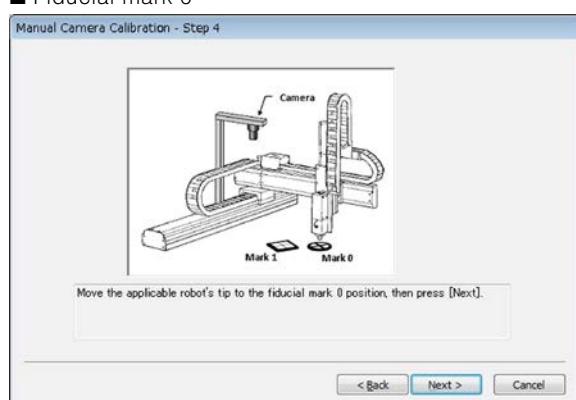
step3 Move the robot to the position of the fiducial mark, and click [Next].

Move the tip of the applicable robot to the position of the fiducial mark 0, and click (Next). Next, move the tip of the applicable robot to the position of the fiducial mark 1, and click (Next).

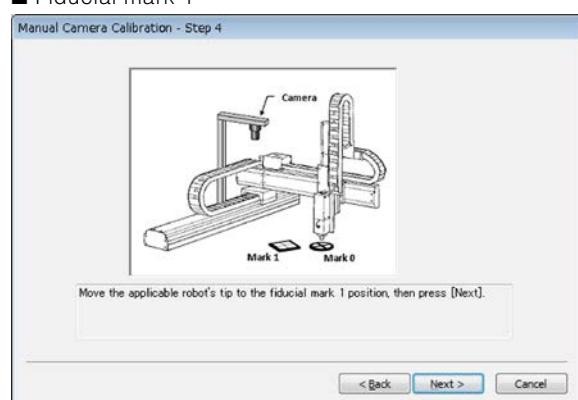
To move the tip of the applicable robot, you can either use the jog keys to move it, or move the robot manually in the emergency stop status.

● Manual Camera Calibration - Step4

■ Fiducial mark 0



■ Fiducial mark 1



WARNING

- When using the jog keys to move the robot, do not enter the robot's working envelope to avoid danger.
- When moving the robot manually, make sure that it is in the emergency stop state where the hardware prevents the servos from turning on.



NOTE

- When using the jog keys to move the robot, use the programming box or RCX-Studio to change the manual movement speed.

For details on changing the manual movement speed, refer to the RCX3 series Operator's Manual or the YAMAHA Support Software RCX-Studio User's Manual.

- Click (Back) to return to the "Manual Camera Calibration - Step 3" window.

step4 Check the camera calibration result.

When the manual camera calibration result is displayed, check it.

For details on the camera calibration data, refer to "6.3.2 Camera calibration data details".

Click (Finish). A message asks whether to save the camera calibration.

Click (Yes) to save the camera calibration settings in the specified calibration number.

Click (No) to dismiss the save confirmation message.

▶ Step 4

Manual Camera Calibration - Save confirmation message



NOTE

- The saved calibration settings can be viewed and edited in the target window's "Camera Calibration". For details, refer to "6.3.1 Camera calibration data editing".
- To discontinue without saving the calibration settings, click (Cancel) in the "Camera calibration - Finish" window.
- Click (Back) to return to the "Manual Camera Calibration - Step 4" (calibration is complete) window.

6.2 Advance camera calibration

6.2.1 Interactive advance camera calibration setting method

The setting method for interactive advance camera calibration is given below.

Step 1 Start RCX-Studio.

Advance camera calibration is executed using RCX-Studio. Start RCX-Studio. For details on RCX-Studio, refer to the YAMAHA Support Software RCX-Studio User's Manual.

Step 2 Connect to the controller with RCX-Studio.

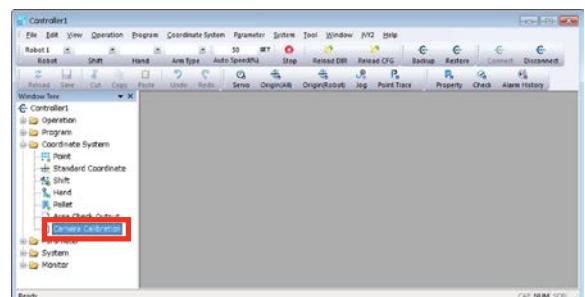
Connect to the controller with RCX-Studio.

For details on how to connect to the controller, refer to the YAMAHA Support Software RCX-Studio User's Manual.

Step 3 Select "Camera Calibration".

In the window tree of the target window, under "Coordinate System", double-click "Camera Calibration".

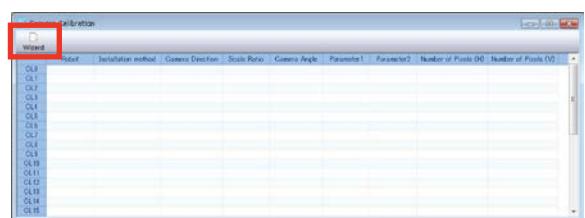
Step 3 Target window



Step 4 Click "Wizard".

A camera calibration window is shown. Click "Wizard" on the toolbar of the camera calibration window.

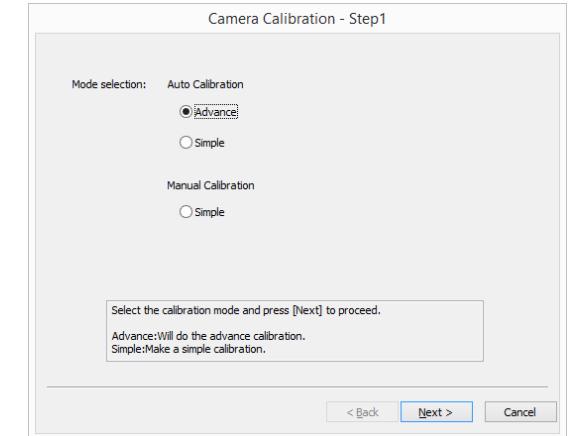
Step 4 Camera Calibration



Step 5 The "Camera Calibration - Step 1" window appears.

Select "Advance" camera calibration.

Step 5 Camera Calibration - Step 1



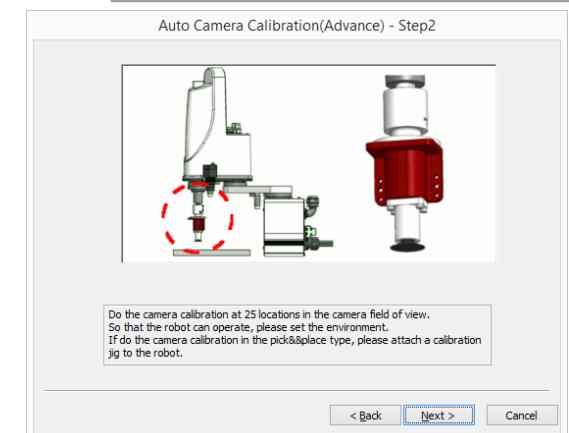
Step 6 Attach the calibration jig to the robot.

Prepare the calibration jig or calibration mark.

For pick and place method, attach the calibration jig to the robot.

For mark grip method, let the robot grip the mark.

Step 6 Auto Camera Calibration (Advance) - Step 2



■ Pick & Place

Camera calibration is executed while the robot is picking and placing the calibration jig.

This method is suitable in using downward fixed / 2nd arm camera. The work place for calibration must be plane.

■ Mark Grip

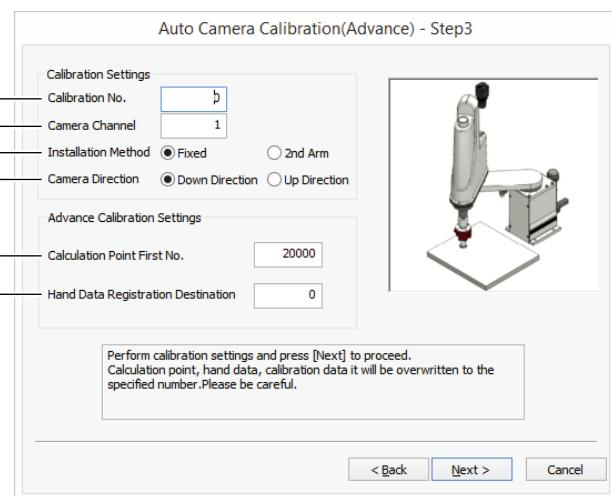
Camera calibration is executed while the robot is moving with gripping the calibration mark.

This method is suitable in using upward fixed camera.

6.2.2 Executing advance camera calibration

This section explains how to execute advance camera calibration.

Step 1 Set each item in "Auto Camera Calibration (Advance)", and click [Next].



[Calibration Settings]

1. Calibration No.

The calibration number in which the camera calibration settings are registered can be specified using numbers 0 to 31.

2. Camera Channel

The camera channel number that acquires the image can be specified using numbers 1 to 16.

3. Installation Method

Select the camera setting.

Setting	Content
Fixed	Select this if using a fixed camera.
2nd Arm	Select this if using a 2nd arm camera.

4. Camera Direction

Select the camera's direction.

Setting	Content
Down Direction	Select this if the camera faces downward.
Up Direction	Select this if the camera faces upward.

[Advance Calibration Settings]

5. Calculation Point First No.

The first point number of point area for calibration data calculation is set. Approximately 330 points from this number are used for calculation.

* Note that the point data with this number is overwritten and deleted when advance calibration is executed.

6. Hand Data Registration Destination

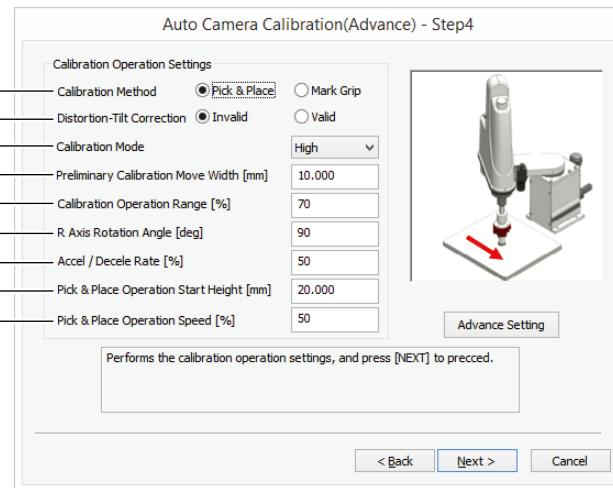
The hand data with number for calibration data calculation is set.

* Note that the hand data with this number is overwritten by that for calculation.

Step2 Set each item in "Calibration Operation Settings" and "Advance Settings" as necessary, and then click [Next].

Clicking (Next) executes writing robot program for calibration (MULTI_CALIB_PGM) to the robot controller.
Note that if a program named (MULTI_CALIB_PGM) already exists, it will be overwritten.

[Calibration Operation Settings]



7. Calibration Method

Pick & Place	The calibration jig is attached on the robot and calibration is executed during pick and place operation.
Mark Grip	The robot grips the mark for calibration and then calibration is executed while the robot is moving the mark.

8. Distortion - Tilt Correction

Whether or not to create the calibration data for distortion or tilt correction can be set. When this is valid, even though the acquiring time while operation becomes longer, distortion of the lens and tilt of the camera can be corrected.

9. Calibration Mode

The calibration method is set; High > Normal > Simple is the accuracy order (high to low). Oppositely calibration time will be longer.

High Calibration is executed with rotating the R-axis for 4 different angles at each search point.

Normal Calibration is executed with rotating the R-axis for 2 different angles at each search point.

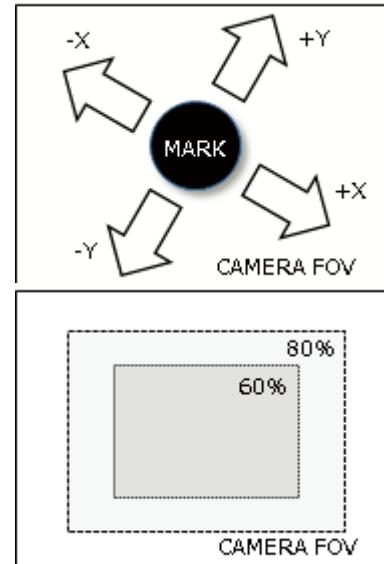
Simple Calibration is executed with the R-axis 1 angle at each search point.

10. Preliminary Calibration Move Width [mm]

The movement width of preliminary calibration is set.

The robot will move by the setting value in $\pm X$ /

Y -direction from the position which is set at [Step3](#).



11. Calibration Operation Range [%]

The calibration movement range from the center of camera's FOV is set.

Distortion - Tilt Correction is VALID:

setting range is 60 to 100[%].

Distortion - Tilt Correction is INVALID:

setting range is 1 to 100[%].

12. R Axis Rotation Angle

Rotation amount of R-axis for calibration is specified. 90-degree is recommended.

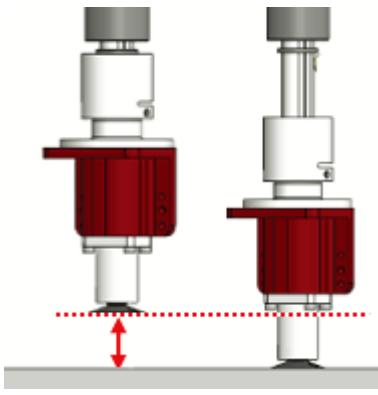
*Under the condition of R-axis rotation angle = 90, START angle = 0, R-axis moves to -90, 0, 90 and 180-degree positions.

13. Accel/ Decelerate Rate [%]

The acceleration/ deceleration of robot operation at calibration is specified. If the attached tool is vibrated at operation, set this value lower.

14. Pick & Place Operation Start Height [%]

The start height where pick and place operation starts is specified. Set this value from the pick and place height set at **Step 3**. The robot starts moving at this height.



15. Pick & Place Operation Speed [%]

The pick and place operation speed is specified.

This is the product of [auto operation speed], [pick and place operation speed], and [option speed]*.

* Only when the option speed is used.

[Advance setting]

Advance Setting	
16	Search before delay [ms] 500
17	Pick & Place Threshold [mm] 0.300
18	Preliminary Calibration Accuracy Threshold [mm] 0.100
19	Calibration Accuracy Threshold [mm] 0.100
20	Mirror option <input checked="" type="radio"/> None <input type="radio"/> Exist Set the amount of time to wait before the camera imaging after robot operation. If the tool is swaying in the operation, please set to increase.
<input type="button" value="OK"/> <input type="button" value="Cancel"/>	

16. Search before delay [ms]

Waiting time before camera capturing after robot operation is specified. When the attached tool is vibrated at operation, set this time longer.

17. Pick & Place Threshold [mm]

Accuracy threshold of position deviation at pick and place operation is specified. When the deviation is large and not improved, set this value larger.

18. Preliminary Calibration Accuracy Threshold [mm]

Preliminary calibration accuracy threshold is specified. Preliminary calibration data is created by 4-direction movement and R-axis rotation. When an accuracy error occurs and it is not resolved, set this value larger.

19. Calibration Accuracy Threshold [mm]

Calibration accuracy threshold is specified. The related warning will occur when the maximum X/Y direction error is larger than the specified threshold.

20. Mirror option

Select "Exist" when mirror is installed on the camera.

Step3 Set calibration operation point (1).

Obtain the robot current position by clicking (Teach). Editing by hand input is also available.

Decide the position and click (Next).

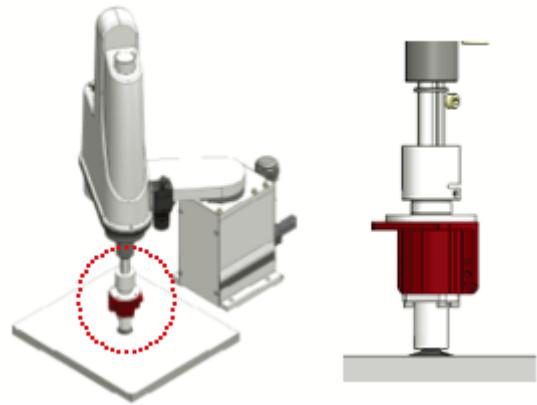
Pick & Place

With the calibration jig attaching on the robot, decide the position for calibration mark around the center of camera's FOV.

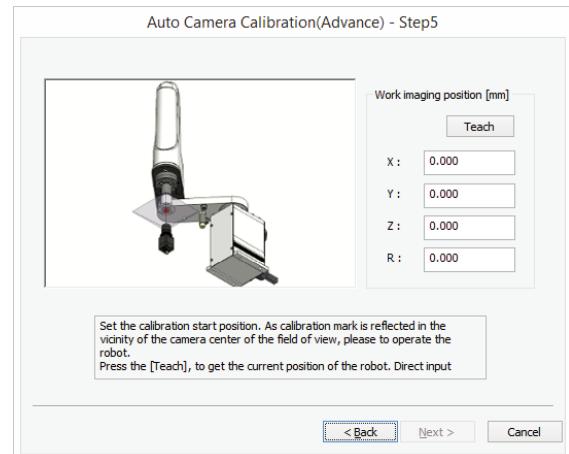


NOTE

Z-axis guide height: +2mm down from the position where the calibration mark touches the work plane. Refer to the right figure.

**Mark Grip**

Set the position around the center of the camera's FOV with the robot gripping the calibration mark.

**Step4 Set calibration operation point (2).**

Click (Teach) to obtain the robot current position. The position can be edited by manual inputting.

Decide the position and click (Next).

Pick & Place

Set the robot position for capturing the calibration mark placed on the work plane.

Mark Grip

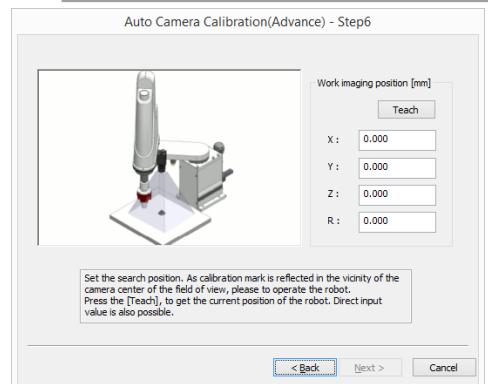
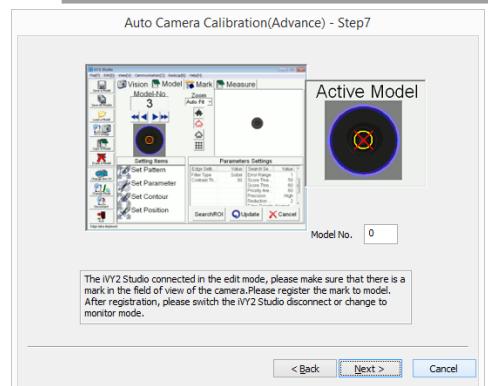
This Step is skipped.

Step5 Register the calibration mark as a model.

Register the calibration mark as a model with the RCXiVY2+ Studio. For details, refer to B RCXiVY2+Studio OPERATION SECTION "7.3 Registering models".

Set the mark so that the detection position does not move even if the mark rotates. For example, in the case of circular mark, it is required to set the center of the circle as the detection position, which is, although, not necessary if the workpiece angle can be detected.

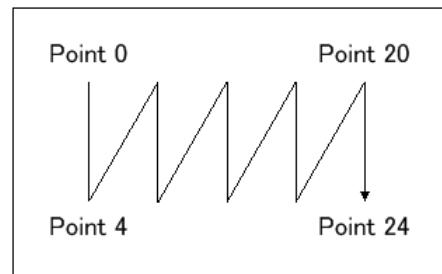
Specify the model number in which the calibration mark is registered.

Step 4 Auto Camera Calibration (Advance) - Step 6**Step 5 Auto Camera Calibration (Advance) - Step7**

step 6 Verify the safety of the surroundings and start calibration.

Set the calibration speed. Turn the servo on and verify the surrounding safety to click (Start).

As the right figure shows, the robot moves within the camera's FOV so that the mark can be calibrated at 25 points (Point 0 to 24). The operation range is specified by "Calibration Operation Range" described in 11 of [Step 2](#).



WARNING

- When executing preliminary calibration, the robot moves at the automatic operation speed. To avoid danger, do not enter the robot's movement envelope.
- When executing preliminary calibration, be prepared to stop the robot immediately if necessary (e.g., using the programming box's emergency stop button).



NOTE

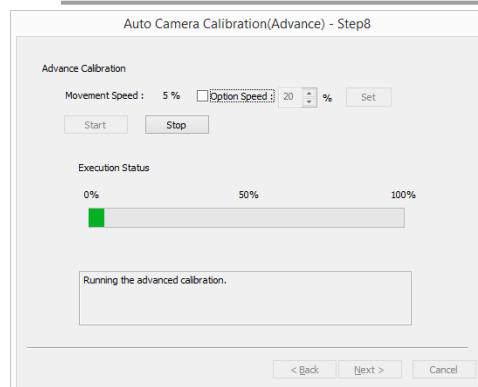
Arrange the surroundings beforehand so that the robot can move in the camera's FOV.

step 7 Calibration progress state is displayed.

Click (NEXT) when the calibration operation finishes.

▶ Step 7

Auto Camera Calibration (Advance) - Step 8



step 8 Check the camera calibration result.

The result will be displayed when camera calibration is finished correctly.

Camera Calibration - Finish	
Calibration No.	0
Robot No.	1
Installation method	Fixed
Camera Direction	Down Direction
Scale Ratio [mm/pix]	0.1248
Camera Angle [deg]	179.796
Parameter 1 [mm]	21.790
Parameter 2 [mm]	277.225
Number of Pixels(H) [pix]	1624
Number of Pixels(V) [pix]	1236
Detection result detail	
Please check the calibration results. To save the calibration data and finish the wizard, click [Finish].	
< Back Finish Cancel	

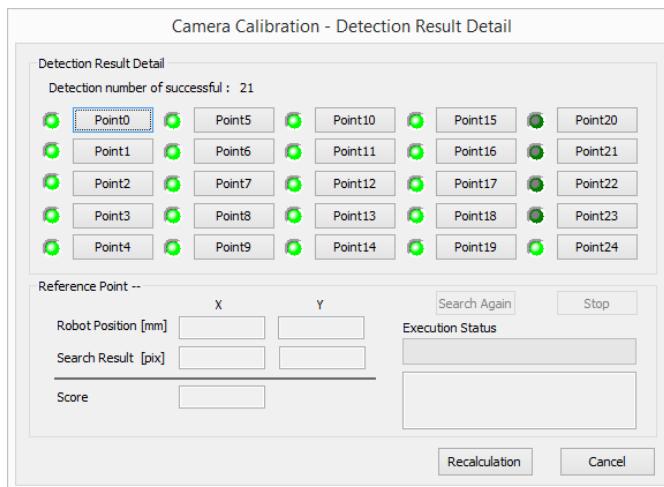
1. Maximum X / Y direction error [mm]

The maximum deviation [mm] between the results of 25 searches from advance calibration and the robot coordinate value is shown. The closer to 0 the value is, the more accurate the calibration is.

2. Camera inclination X/ Y

The camera tilt in X/Y direction comparing to the camera coordinate is shown. The closer to 0 the value is, the more vertically the camera is installed.

Click [Detection result detail] to show the window below. The detection results at each position can be checked and search can be executed again.



Point n The robot coordinates, detection position and score at detection are displayed.

Search Again Calibration will be executed again at the point.

Recalculation The calibration data will be calculated again and the window will return to previous one.

Cancel The previous window will be shown.

Step 9 Save the calibration data.

Save the calibration data and finish calibration by clicking (Finish).

6.3 Camera calibration data editing

6.3.1 Camera calibration data editing

This section explains how to edit the camera calibration data.

Step 1 Start RCX-Studio.

Camera calibration is executed in RCX-Studio. Start RCX-Studio. For details on RCX-Studio, refer to the YAMAHA Software Support RCX-Studio User's Manual.

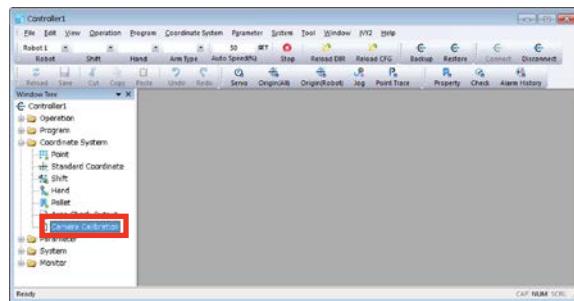
Step 2 Connect to the controller in RCX-Studio.

Connect to the controller in RCX-Studio. For details on how to connect, refer to the YAMAHA Support Software RCX-Studio User's Manual.

Step 3 Select "Camera Calibration".

In the window tree of the target window, under "Coordinate System", double-click "Camera Calibration".

Step 3 Target window



Step 4 The "Camera Calibration" window appears.

For details on each item, refer to "6.3.2 Camera Calibration data details".

Robot	Installation method	Camera Direction	Scale Ratio	Camera Angle	Parameter1	Parameter2	Number of Pixels (H)	Number of Pixels (V)	Correction PRM
CL0	Robot 1	2nd Arm	Down Direction	0.1131	-06.028	4	84.921	1624	1236
CL1	Robot 1	2nd Arm	Down Direction	0.1180	-06.840	4	84.924	1624	1236
CL2	Robot 1	Fixed	Up Direction	0.0579	2.296	31.681	352.590	1624	1236
CL3	Robot 1	2nd Arm	Down Direction	0.1117	-06.856	4210	85.140	1624	1236
CL4	Robot 1	Fixed	Down Direction	0.1244	-179.970	21.982	277.840	1624	1236
CL5									
CL6									
CL7									

Step 5 Edit the camera calibration data.

When camera calibration data has been edited, the cell turns red.

Step 5 Editing camera calibration data



NOTE

You can use the "Edit" menu to copy, cut, or paste data.

For details, refer to the YAMAHA Support Software RCX-Studio User's Manual.

Robot	Installation method	Camera Direction	Scale Ratio	Camera Angle	Parameter1	Parameter2	Number of Pixels (H)	Number of Pixels (V)	Correction PRM
CL0	Robot 1	2nd Arm	Down Direction	0.1131	-06.028	4	84.921	1624	1236
CL1	Robot 1	2nd Arm	Down Direction	0.1180	-06.840	4	84.924	1624	1236
CL2	Robot 1	Fixed	Up Direction	0.0579	2.296	31.681	352.590	1624	1236
CL3	Robot 1	2nd Arm	Down Direction	0.1117	-06.856	4210	85.140	1624	1236
CL4	Robot 1	Fixed	Down Direction	0.1244	-179.970	21.982	277.840	1624	1236
CL5									
CL6									
CL7									

Step 6 Save the edited camera calibration data.

Save the edited camera calibration data. For details on how to save the edited data, refer to the YAMAHA Support Software RCX-Studio User's Manual. When the data has been saved, the cell turns white.

Step 6 Saving camera calibration data

Robot	Installation method	Camera Direction	Scale Ratio	Camera Angle	Parameter1	Parameter2	Number of Pixels (H)	Number of Pixels (V)	Correction PRM
CL0	Robot 1	2nd Arm	Down Direction	0.1131	-06.028	4	84.921	1624	1236
CL1	Robot 1	2nd Arm	Down Direction	0.1180	-06.840	4	84.924	1624	1236
CL2	Robot 1	Fixed	Up Direction	0.0579	2.296	31.681	352.590	1624	1236
CL3	Robot 1	2nd Arm	Down Direction	0.1117	-06.856	4210	85.140	1624	1236
CL4	Robot 1	Fixed	Down Direction	0.1244	-179.970	21.982	277.840	1624	1236
CL5									
CL6									
CL7									

6.3.2 Camera calibration data details

This section explains each item of camera calibration data.

■ Robot

Select the robot number from the list. The robot number can be selected from robot 1 to robot 4.

■ Installation method

Select the camera setting from the list.

Setting	Content
Fix	Select this if using a fixed camera.
2nd Arm	Select this if using a 2nd arm camera.

■ Camera Direction

Select the camera direction from the list.

Setting	Content
Down Direction	Select this if the camera is installed downward.
Up Direction	Select this if the camera is installed upward.

■ Scale Ratio

This ratio is a conversion ratio from the camera coordinate to the robot coordinate.

Specify millimeters per pixel. The setting value must be 0.0001 mm/pixel or more.

■ Camera Angle

The meaning of this parameter may vary depending on the camera orientation as described below.

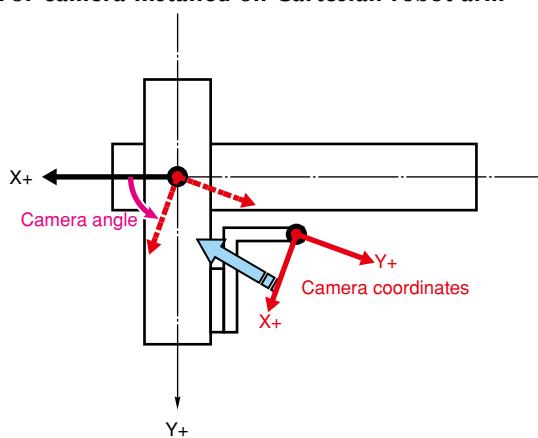
The positive angle is the counterclockwise rotation from the top of robot.

Fixed camera: Camera installation angle to the robot coordinate

Camera installed on the arm of the Cartesian robot: Camera installation angle to the robot coordinate

Camera installed on the arm of the SCARA robot: Camera installation angle to the 2nd arm

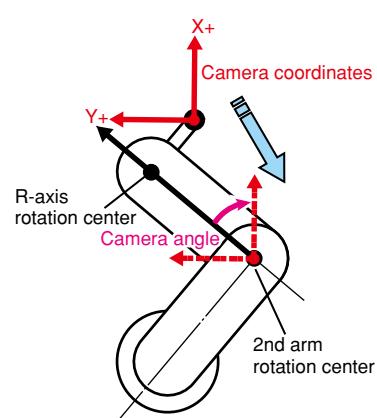
For camera installed on Cartesian robot arm



The angle that is made of the X-axis in robot coordinate and the one in camera coordinates.

To make this angle, slide the origin of camera coordinates to the one of robot coordinates.

For camera installed on SCARA robot arm



The angle that is made of the X-axis in camera coordinates and the line passing through the intersection of two points (the rotation center of second arm and the rotation center of R-axis).

To make this angle, slide the origin of camera coordinates to the rotation center of second arm.

■ Parameter 1/Parameter 2

The meanings of these parameters may vary depending on the camera orientation.

<Fixed camera>

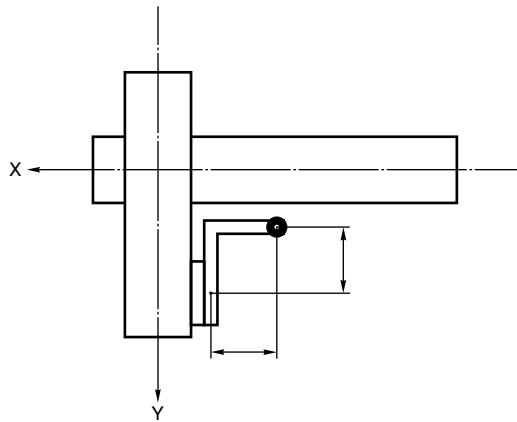
Parameter 1 = Center position of the camera's FOV at the X-coordinate of the robot (Units: mm)

Parameter 2 = Center position of the camera's FOV at the Y-coordinate of the robot (Units: mm)

<Camera installed on the arm of the Cartesian robot>

Parameter 1 = Offset amount from the robot tip to the center of the camera's FOV in the X-direction (Units: mm)

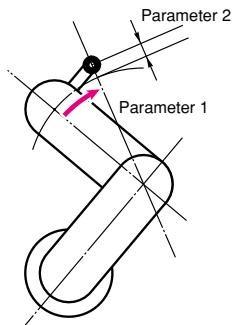
Parameter 2 = Offset amount from the robot tip to the center of the camera's FOV in the Y-direction (Units: mm)



<Camera installed on the arm of the SCARA robot>

Parameter 1 = Number of offset pulses from the line that connects the rotation center and the tip of the 2nd arm to the line that connects the rotation center of the 2nd arm and the center of the camera's FOV. Specify "+" value for the counterclockwise rotation. (Units: pulse)

Parameter 2 = Difference between the length of the 2nd arm and the length of the line that connects the rotation center of the 2nd arm and the center of the camera's FOV. (Units: mm)



■ Number of Pixels (H) / (V)

This is the camera's pixel count. The horizontal pixel count is "H Pixel", and the vertical pixel count is "V Pixel".



NOTE

When specifying a pixel count that differs from that of the camera to acquire an image with the camera, related errors will occur.

■ Correction PRM

When this item is checked, the image is acquired with corrected lens distortion and camera tilt.

6.3.3 Camera calibration detail editing

Step 1 Click "Detail".

Choose the calibration number to confirm the details and click "Detail".

► **Step 1 Clicking "Detail"**

Robot	Installation method	Camera Direction	Scale Ratio	Camera Angle	Parameter 1	Parameter 2
CL0	Robot 1 3rd Arm	Down Direction	0.1181	-86.828	4	84.921
CL1	Robot 1 3rd Arm	Down Direction	0.1180	-86.840	4	84.924
CL2	Robot 1 Fixed	Up Direction	0.0579	2.236	81.081	352.590
CL3	Robot 1 2nd Arm	Down Direction	0.1117	-86.886	4210	85.140
CL4	Robot 1 Fixed	Down Direction	0.1244	-179.970	21962	277.040
CL5						
CL6						
CL7						

Step 2 Edit the detail data.

When the data has been edited, the cell turns red.

The data can be copied, pasted, and cleared using each button.

"Correction Parameter 1 to 3" indicates the correction for lens distortion and camera tilt.

► **Step 2 Camera Calibration Detail**

Basic Data				
Robot	Installation method	Camera Direction	Scale Ratio	Camera Angle
Robot1	2nd Arm	Down Direction	0.1130	-86.840
Parameter1	Parameter2	Number of Pixels (H)	Number of Pixels (V)	
4	84.924	1624	1236	
Correction Parameter1				
Parameter1	Parameter2	Parameter3	Parameter4	Parameter5
0	0	0	0	0
Parameter6	Parameter7	Parameter8	Parameter9	
0	0	0	0	0
Correction Parameter2				
Parameter1	Parameter2	Parameter3	Parameter4	Parameter5
0	0	0	0	0
Parameter6	Parameter7	Parameter8	Parameter9	
0	0	0	0	0
Correction Parameter3				
Parameter1	Parameter2	Parameter3		
0	0	0		
Parameter6	Parameter7	Parameter8	Parameter9	
0	0	0	0	0
<input type="button" value="Copy"/>	<input type="button" value="Paste"/>	<input type="button" value="Clear"/>	<input type="button" value="Reload"/>	<input type="button" value="Save"/>
<input type="button" value="Close"/>				

Step 3 Save the edited details.

To save the edited camera calibration data, click (Save).

7. Robot language commands

This section explains the RCXiVY2+ system's dedicated robot language commands.

Refer to the YAMAHA Robot Controller RCX3 series Programming Manual for robot language information beyond basic items such as the robot language command statement format, variables, and constants. Always refer to the above programming manual when executing programming operations.



NOTE

- The operand in the (shaded section) of the robot language explanation indicates that it can be omitted.
- Italic items* should be written in the specific format.
- Items surrounded by | | are selectable.

7.1 Robot language command list



NOTE

- Within the tables, the online column has the following significance.
- "○" indicates that the command can be used as an online command.
 - "△" indicates that some operands cannot be executed as an online command.
 - "—" indicates that the command cannot be used as an online command.

7.1.1 Image processing related language commands

■ Image recognition processing

Language command	Type	Description	Online
		Format	
VCAPTURE	Command	The memory acquires the image from the camera. VCAPTURE <i>camera channel number, memory number, camera calibration number</i>	○
VSAVEIMG	Command	The memory images are saved in a BMP format. VSAVEIMG <i>memory number, file name</i>	○
VSEARCH	Command	The camera images are searched for a model workpiece. VSEARCH <i>camera channel number, model number, camera calibration number</i>	○
VSEARCHM	Command	The memory images are searched for a model workpiece. VSEARCHM <i>memory number, model number, search method number</i>	○
VSEARCHR	Command	A rough search of camera images is performed for a model workpiece. VSEARCHR <i>camera channel number, model number, camera calibration number</i>	○
VSEARCHS	Command	A single item search of camera images is performed for a model workpiece. VSEARCHS <i>camera channel number, model number, camera calibration number</i>	○

■ Obtaining search results

Language command	Type	Description	Online
		Format	
VCNTEDGE	Function	The edge in the image from the memory image is obtained by setting the model number. VCNTEDGE (<i>memory number, model number</i>)	○
VGETCNT	Function	The number of items detected in the search executed by the task is obtained. VGETCNT [<i>task number</i>]	○
VGETPIX	Function	From the search result array of the search executed by the task, the array element's pixel data is obtained in a point data format. VGETPIX [<i>task number</i>] (<i>array element number</i>)	○
VGETPOS	Function	From the search result array of the search executed by the task, the point data of the array element is obtained. VGETPOS [<i>task number</i>] (<i>array element number</i>)	○
VGETPOSR	Function	From the search result array of the search executed by the task, the workpiece angle of the array element is obtained. VGETPOSR [<i>task number</i>] (<i>array element number</i>)	○
VGETPOSX	Function	From the search result array of the search executed by the task, the X-coordinate value of the point data of the array element is obtained. VGETPOSX [<i>task number</i>] (<i>array element number</i>)	○
VGETPOSY	Function	From the search result array of the search executed by the task, the Y-coordinate value of the point data of the array element is obtained. VGETPOSY [<i>task number</i>] (<i>array element number</i>)	○

Language command	Type	Description	Online
		Format	
VGETSCLE	Function	From the search result array of the search executed by the task, the scale data of the array element is obtained. VGETSCLE [task number] (array element number)	○
		VGETSCR [task number] (array element number)	
VGETSCR	Function	From the search result array of the search executed by the task, the score of the array element is obtained. VGETSCR [task number] (array element number)	○
		VGETTIME [task number]	
VGETTIME	Function	The time (units: ms) required for the search command executed by the task is obtained. VGETTIME [task number]	○
		VPEEKNXT [task number]	
VPEEKNXT	Function	The most recent search results for the presence of the next workpiece is checked. The coordinate value of the next workpiece is added to the array result of the task that searched most recently. VPEEKNXT [task number]	○
		VPEEKNXT [task number]	

* If the task number is not specified, the number of the task executed by the command will be the task number.

■ Condition changes / parameter changes

Language command	Type	Description	Online
		Format	
VCALIBNO	Command	The "CLBLINK" parameter of the camera is changed. VCALIBNO (camera channel number) = camera calibration number	○
		VCALIBNO (camera channel number)	
	Function	The "CLBLINK" parameter of the camera is obtained. VCALIBNO (camera channel number)	
		VCALIBNO (camera channel number)	
VEXPOTIM	Command	The "iVY Camera exposure time" parameter is changed. VEXPOTIM (camera channel number) = setting value	○
		VEXPOTIM (camera channel number)	
	Function	The "iVY Camera exposure time" parameter of the camera is obtained. VEXPOTIM (camera channel number)	
		VEXPOTIM (camera channel number)	
VMONITOR	Command	On/ off of Monitor mode is switched. VMONITOR ON OFF	○
		VMONITOR ON OFF	
VNEXTCHK	Command	The display function for the next workpiece on/off is switched. VNEXTCHK ON OFF	○
		VNEXTCHK ON OFF	
VSORTMTD	Command	The "iVY Camera sort method" parameter for search result array is set. VSORTMTD (camera channel number) = sort method number	○
		VSORTMTD (camera channel number)	
	Function	The "iVY Camera sort method" parameter for search result array is obtained. VSOTRMTD (camera channel number)	
		VSOTRMTD (camera channel number)	
VTRGMOD	Command	The "iVY Camera trigger mode" parameter is changed. VTRGMOD (camera channel number) = trigger mode Trigger mode 1: H/W trigger 2: S/W trigger	○
		VTRGMOD (camera channel number)	
	Function	The "iVY Camera trigger mode" parameter is obtained. VTRGMOD (camera channel number)	
		VTRGMOD (camera channel number)	
VTRGTOUT	Command	The "iVY Camera H/W trigger timeout" parameter is changed. VTRGTOUT (camera channel number) = setting value	○
		VTRGTOUT (camera channel number)	
	Function	The "iVY Camera H/W trigger timeout" parameter is obtained. VTRGTOUT (camera channel number)	
		VTRGTOUT (camera channel number)	

■ Calibration related

Language command	Type	Description	Online
		Format	
VCALCALIB	Command	The camera calibration data is calculated. VCALCALIB [robot number] camera channel number, camera installation method, camera direction, first point number, capture point number	○
		VCALCALIB [robot number] camera channel number, camera installation method, camera direction, number of used data, first robot point number, first camera point number, capture point number	
VCALCALIBA	Command	The camera calibration data including correction for distortion and tilt is calculated. VCALCALIBA [robot number] camera channel number, camera installation method, camera direction, number of used data, first robot point number, first camera point number, capture point number	○
		VCALCALIBA [robot number] camera channel number, camera installation method, camera direction, number of used data, first robot point number, first camera point number, capture point number	
VCHGPIXTOMM	Function	The pixel data is converted to the point data at the camera calibration number. VCHGPIXTOMM (camera calibration number, point expression 1, point expression 2)	○
		VCHGPIXTOMM (camera calibration number, point expression 1, point expression 2)	
VGETCALIB	Function	The camera calibration data that was calculated by the "VCALCALIB" command is obtained. VGETCALIB (data number)	○
		VGETCALIB (data category, data number)	
VGETCALIBA	Function	The camera calibration data that was calculated by the "VCALCALIBA" command is obtained. VGETCALIBA (data category, data number)	○
		VGETCALIBA (data category, data number)	

Language command	Type	Description	Online
		Format	
VSETCALIB	Command	The camera calibration data that was calculated by the "VCALCALIB" command is registered to the camera calibration number.	<input type="radio"/>
		VSETCALIB (<i>camera calibration number</i>)	
VSETCALIBA	Command	The camera calibration data that was calculated by the "VCALCALIBA" command is registered to the camera calibration number.	<input type="radio"/>
		VSETCALIBA (<i>camera calibration number</i>)	

■ Measurement function related

Language command	Type	Description	Online
		Format	
VGETCNTM	Function	The result whether the workpiece was detected or not in the measuring search executed by the task is obtained.	<input type="radio"/>
		VGETCNTM [<i>task number</i>]	
VGETOBJC	Function	The additional information of the result in the measuring search executed by the task on the camera coordinate value is obtained.	<input type="radio"/>
		VGETOBJC [<i>task number</i>]	
VGETOBJR	Function	The additional information of the result in the measuring search executed by the task on the robot coordinate value is obtained.	<input type="radio"/>
		VGETOBJR [<i>task number</i>]	
VGETPIXM	Function	The camera coordinate value of the result in the measuring search executed by the task is obtained in a point data format.	<input type="radio"/>
		VGETPIXM [<i>task number</i>]	
VGETPOSIM	Function	The robot coordinate value of the result in the measuring search executed by the task is obtained in a point data format.	<input type="radio"/>
		VGETPOSIM [<i>task number</i>]	
VMEASURE	Command	The measurement search is performed from the camera images by the measuring tool.	<input type="radio"/>
		VMEASURE <i>camera channel number, measuring tool number, camera calibration number</i>	
VMEASUREM	Command	The measurement search is performed from the memory images by the measuring tool.	<input type="radio"/>
		VMEASUREM <i>memory number, measuring tool number</i>	

■ Blob related

Language command	Type	Description	Online
		Format	
VBLOB	Command	The blob search is performed from the camera images using the specified blob tool number.	<input type="radio"/>
		VBLOB <i>camera CH, blob tool number, calibration number</i>	
VBLOBM	Command	The blob search is performed from the memory images using the specified blob tool number.	<input type="radio"/>
		VBLOBM <i>memory number, blob tool number</i>	
VGETAREAC	Function	The blob area (pix) with the specified array element number is acquired from the result array of the blob search that has been executed by the specified task.	<input type="radio"/>
		A% = VGETAREAC [<i>task number</i>] (<i>array element number</i>)	
VGETAREAR	Function	The blob area (mm ²) with the specified array element number is acquired from the result array of the blob search that has been executed by the specified task.	<input type="radio"/>
		B! = VGETAREAR [<i>task number</i>] (<i>array element number</i>)	
VGETLENC	Function	The main axis length (pix) with the specified array element number is acquired from the result array of the blob search that has been executed by the specified task.	<input type="radio"/>
		A% = VGETLENC [<i>task number</i>] (<i>array element number</i>)	
VGETLENR	Function	The main axis length (mm) with the specified array element number is acquired from the result array of the blob search that has been executed by the specified task.	<input type="radio"/>
		B! = VGETLENR [<i>task number</i>] (<i>array element number</i>)	
VGETROUNDNESS	Function	The roundness with the specified array element number is acquired from the result array of the blob search that has been executed by the specified task.	<input type="radio"/>
		A% VGETROUNDNESS [<i>task number</i>] (<i>array element number</i>)	

7.1.2 Lighting related language commands

Language command	Type	Description Format	Online
LCONTROL	Command	The "iVY Light enable" parameter on/off is changed.	○
		LCONTROL ON (<i>lighting channel number</i>) OFF	
LCTRLMOD	Command	The "iVY Light mode" parameter is changed. LCTRLMOD <i>mode number</i> LCTRLMOD (<i>lighting channel number</i>) = <i>mode number</i> Mode number 0 : Continuous lighting mode 1 : Strobe lighting mode	○
		LCTRLMOD (<i>lighting channel number</i>)	
	Function	The "iVY Light mode" parameter is obtained. LCTRLMOD (<i>lighting channel number</i>)	
LIGHTHZ	Command	The "iVY Light Hz" parameter is changed. LIGHTHZ <i>PWM modulated light frequency</i> LIGHTHZ (<i>lighting channel number</i>) = <i>PWM modulated light frequency</i> PWM modulated light frequency 0 : 62.5 kHz 1 : 125 kHz	○
		LIGHTHZ (<i>lighting channel number</i>)	
	Function	The "iVY Light Hz" parameter is obtained. LIGHTHZ (<i>lighting channel number</i>)	
LSTRBTIM	Command	The "iVY Light strobe time" parameter is changed. LSTRBTIM <i>light emission time</i> LSTRBTIM (<i>lighting channel number</i>) = <i>light emission time</i>	○
		LSTRBTIM (<i>lighting channel number</i>)	
	Function	The "iVY Light strobe time" parameter is obtained. LSTRBTIM (<i>lighting channel number</i>)	
LSYNCCH	Command	The "iVY Light sync camera ch" parameter is changed. LSYNCCH <i>synchronized camera parameter</i> LSYNCCH (<i>lighting channel number</i>) = <i>synchronized camera parameter</i>	○
		LSYNCCH (<i>lighting channel number</i>)	
	Function	The "iVY Light sync camera ch" parameter is obtained. LSYNCCH (<i>lighting channel number</i>)	
LVOLUME	Command	The "iVY Light volume" parameter is changed. LVOLUME <i>lighting volume</i> LVOLUME (<i>lighting channel number</i>) = <i>lighting volume</i>	○
		LVOLUME (<i>lighting channel number</i>)	
	Function	The "iVY Light volume" parameter is obtained. LVOLUME (<i>lighting channel number</i>)	

7.2 Robot language command details

This section explains each of the robot language commands.

7.2.1 Image processing (Image recognition processing)

7.2.1.1 VCAPTURE

● Command

VCAPTURE	VCAPTURE camera channel number, <i>memory number, camera calibration number</i>
	The memory acquires the image from the camera.

Description

This command acquires an image to the memory from the camera. The image is obtained from the camera and is saved to the memory. The camera calibration number information is added to the image when it is saved. The added camera calibration number information is used when executing VSEARCHM command.

Explanation

<Camera channel number>

The camera channel number from which an image is acquired can be specified using one of the numbers 1 to 16 or a variable.

<Memory number>

The memory number to which an image is acquired can be specified using one of the numbers 0 to 15 or a variable. Specifying no memory number means 0 is specified.

Memory numbers are used in common, regardless of the camera channel number.

<Camera calibration number>

The camera calibration number to be used in the search can be specified using one of the numbers 0 to 31 or a variable. This number cannot be specified without specifying the memory number.

When this number is omitted;

1. RCX340 / RCX320 software version 1.40 or later

The camera calibration number specified by the "CLBLINK" parameter. When the parameter is set at "-1", the camera calibration data is not used.

2. RCX340 / RCX320 software version earlier than 1.40

The camera calibration number specified by VCALBNO is used. Unless specified by VCALBNO, the camera calibration data is not used.



CAUTION

Memory number "0" is also used by VSEARCH, VSEARCHR, and VSEARCHS commands. Therefore, if any one of those commands is executed after an image has been saved to memory number "0" by VCAPTURE command, that image will be overwritten.

Statement examples

VCAPTURE 1An image from the channel 1 camera is acquired. (The image is saved to memory 0.)

VCAPTURE 2,1An image from the channel 2 camera is acquired and saved to memory 1.

VCAPTURE 1,2,3An image from the channel 1 camera with camera calibration 3 information added to it is acquired and saved to memory 2.

FOR A%=1 TO 3

 VCAPTURE 1,A% ...An image from the channel 1 camera is acquired and saved to memory A% (1 to 3 in this case) .

NEXT A%

7.2.1.2 VSAVEIMG

● Command

VSAVEIMG	VSAVEIMG <i>memory number, file name</i>
The memory images are saved in a BMP format.	

Description

This command saves acquired images (images acquired and saved to memory by the VCAPTURE command and by search commands such as VSEARCH, etc.) in the BMP format at the iVY2 unit.

Explanation

<Memory number>

The memory number where the image to be saved is located can be specified using one of the numbers 0 to 15 or a variable.

<File name>

The file name under which the image is to be saved can be specified by character strings (characters enclosed in double quotation marks (")), or character string variables.

File names with semicolon (;) breakpoints are processed as continuous file names. File names may contain up to 8 characters (not including the extension).

File name examples

Example) VSAVEIMG 0,"TEST" File name: TEST.bmp

Statement example

```
B%=2
VCAPTURE 1,B%
VSAVEIMG B%,"IMAGE" ..... The memory 2 image is saved under the "IMAGE.bmp" file name.
VSEARCHM B%, 3
IF VGETCNT<1 THEN
C$=STR$(B%)
VSAVEIMG B%,"ERR"+C$... If the search detected no workpieces, the image is saved under the "ERR2.bmp" file name.
ENDIF
```

7.2.1.3 VSEARCH

● Command

VSEARCH	VSEARCH <i>camera channel number, model number, camera calibration number</i>
	The camera images are searched for a model workpiece.

Description

This command searches the camera images for a specified model workpiece number. The images are acquired from the camera channel number, and are searched for the model workpiece number. If a camera calibration number is specified, a coordinate conversion occurs (from camera coordinates to robot coordinates), based on the calibration number's data.

Explanation

<Camera channel number>

The camera channel number from which the image is acquired can be specified using one of the numbers 1 or 16 or a variable.

<Model number>

The model workpiece number to be searched for can be specified using one of the numbers 0 to 253 or a variable.

<Camera calibration number>

The camera calibration number to be used in the search can be specified using one of the numbers 0 to 31 or a variable. When this number is omitted:

1. RCX340 / RCX320 software version 1.40 or later

The camera calibration number specified by the "CLBLINK" parameter. When the parameter is set at "-1", the camera calibration data is not used.

2. RCX340 / RCX320 software version earlier than 1.40

The camera calibration number specified by VCALBNO is used. Unless specified by VCALBNO, the camera calibration data is not used.



CAUTION

- The VSEARCH command saves an image to memory number 0. Therefore, if this command is executed after an image has been saved to memory number 0 by VCAPTURE command, that image will be overwritten.
- The search results are cleared if the controller power is turned off.

Statement examples

VSEARCH 1,2The number 2 model workpiece is searched from the channel 1 camera images.

VSEARCH 2,3,1The number 3 model workpiece is searched from the channel 2 camera images, and corrected at the number 1 camera calibration.

FOR A%=1 TO 3

 VSEARCH 1,A%The number A% (1 to 3 in this case) model workpiece is searched from the channel 1 camera images.

NEXT A%

7.2.1.4 VSEARCHM

● Command

VSEARCHM	VSEARCHM <i>memory number, model number, search method number</i>
	The memory images are searched for a model workpiece.

Description

This command searches the memory images for a model workpiece. The search is performed at the specified memory number, and occurs in accordance with search method.

When camera calibration number information is added to an image at the memory number (by VCAPTURE), a camera-to-robot coordinate conversion is executed, using that camera calibration number data.

Explanation

<Memory number>

The memory number where the image to be searched for is located can be specified using one of the numbers 0 to 15 or a variable.

Memory numbers are used in common, regardless of the camera channel number.

<Model number>

The model workpiece number to be searched for can be specified using one of the numbers 0 to 253 or a variable.

<Search method number>

The search method number can be specified using one of the numbers 0 to 2 or a variable. If no search method number is specified, the "normal search" method is adopted.

0...Normal search

1...Rough search (gives priority to the search speed, resulting in reduced precision.)

2...Single item search (the search ends when one workpiece is detected.)



CAUTION

The search results are cleared when the controller power is turned off.

Statement examples

VSEARCHM 1,2The number 2 model workpiece is searched from the number 1 memory images.

VSEARCHM 2,3,1A rough search for the number 3 model workpiece is performed from the number 2 memory images.

VCAPTURE 1,2,3

VSEARCHM 2,4The number 4 model workpiece is searched from the number 2 memory images and is corrected at the number 3 camera calibration.

7.2.1.5 VSEARCHR

● Command

VSEARCHR	VSEARCHR <i>camera channel number, model number, camera calibration number</i>
	A rough search of camera images is performed for a model workpiece.

Description

This command executes a rough search of the camera images for a specified model workpiece number. This rough search gives priority to the search speed, resulting in reduced precision. An initial rough search occurs for rough positioning, followed by a normal search.

The images are acquired from the specified camera channel number, and are searched for the specified model workpiece number. If a camera calibration number is specified, a coordinate conversion occurs (from camera coordinates to robot coordinates), based on the specified calibration number's data. Except for its "rough search" format, VSEARCHR is identical to VSEARCH.

Explanation

<Camera channel number>

The camera channel number from which the image is acquired can be specified using one of the numbers 1 or 16 or a variable.

<Model number>

The model workpiece number to be searched for can be specified using one of the numbers 0 to 253 or a variable.

<Camera calibration number>

The camera calibration number to be used in the search can be specified using one of the numbers 0 to 31 or a variable. When this number is omitted;

1. RCX340 / RCX320 software version 1.40 or later

The camera calibration number specified by the "CLBLINK" parameter. When the parameter is set at "-1", the camera calibration data is not used.

2. RCX340 / RCX320 software version earlier than 1.40

The camera calibration number specified by VCALBNO is used. Unless specified by VCALBNO, the camera calibration data is not used.



CAUTION

- VSEARCHR command saves an image to memory number 0. Therefore, if this command is executed after an image has been saved to memory number 0 by VCAPTURE command, that image will be overwritten.
- The search results are cleared if the controller power is turned off.

Statement examples

VSEARCHR 1,2 A rough search for the number 2 model workpiece is performed from the number 1 memory images.

VSEARCHR 2,3,1 A rough search for the number 3 model workpiece is performed from the number 2 memory images and is corrected at the number 2 camera calibration.

FOR A%=1 TO 3

 VSEARCHR 1,A%..... A rough search for the number A% (1 to 3 in this case) model workpiece is performed from the channel 1 camera images.

NEXT A%

7.2.1.6 VSEARCHS

● Command

VSEARCHS	VSEARCHS <i>camera channel number, model number, camera calibration number</i>
A single item search of camera images is performed for a model workpiece.	

Description

This command executes a single item search of the camera images for a model workpiece. This single item search gives priority to the search speed, and it ends when one workpiece is detected. The images are acquired from the camera channel, and are searched for the model workpiece.

If a camera calibration number is specified, a coordinate conversion occurs (from camera coordinates to robot coordinates), based on the specified camera calibration number's data. Except for its "single item search" format, VSEARCHS is identical to VSEARCH.

Explanation

<Camera channel number>

The camera channel number from which the image is acquired can be specified using one of the numbers 1 or 16 or a variable.

<Model number>

The model workpiece number to be searched for can be specified using one of the numbers 0 to 253 or a variable.

<Camera calibration number>

The camera calibration number to be used in the search can be specified using one of the numbers 0 to 31 or a variable.

1. RCX340 / RCX320 software version 1.40 or later

The camera calibration number specified by the "CLBLINK" parameter. When the parameter is set at "-1", the camera calibration data is not used.

2. RCX340 / RCX320 software version earlier than 1.40

The camera calibration number specified by VCALBNO is used. Unless specified by VCALBNO, the camera calibration data is not used.



CAUTION

- The VSEARCHS command saves an image to memory number 0. Therefore, if this command is executed after an image has been saved to memory number 0 by VCAPTURE command, that image will be overwritten.
- The search results are cleared if the controller power is turned off.

Statement examples

VSEARCHS 1, 2 A single search for the number 2 model workpiece is performed from the number 1 memory images.

VSEARCHS 2 3, 1 A single search for the number 3 model workpiece is performed from the number 2 memory images and is corrected at the number 2 camera calibration.

FOR A%=1 TO 3

 VSEARCHS 1, A% A single search for the number A% (1 to 3 in this case) model workpiece is performed from the channel 1 camera images.

NEXT A%

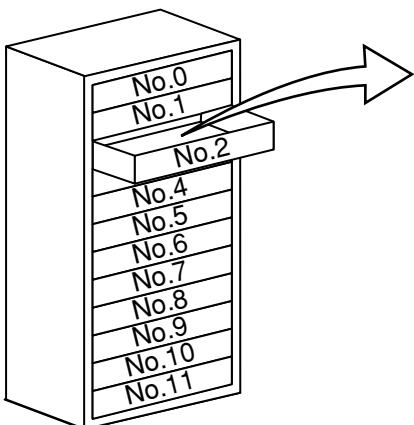
7.2.2 Image processing (Obtaining search results)

■ About result array

When the following search commands are executed, the search result is stored to the search result array.

- Model search VSEARCH VSEARCHM VSEARCHS VSEARCHR
- Blob search VBLOB VBLOBM

Search result array



When the model search is performed, the following information on the detected workpiece is stored.

- X and Y coordinate positions
- Workpiece angle (angle difference between the detected workpiece and specified model workpiece)
- Scale (ratio of the workpiece size to the specified model workpiece size)
- Score (agreement with the specified model workpiece)

When the blob search is performed, the following information on the detected blob is stored.

- X and Y coordinate positions
- Angle of main axis angle (angle on the camera or robot coordinate)
- Area
- Main axis length
- Roundness

The succession of the array is the order specified by VSORTMTD.

These results are acquired using the following commands.

- | | |
|--|---|
| • VGETPIX Pixel data (point data) | • VGETSCLE Scale |
| • VGETPOS Robot coordinate data (point data) | • VGETSCR Score |
| • VGETPOSX Robot coordinate data (X-axis) | • VGETAREAC/R Area (camera coordinate/robot coordinate) |
| • VGETPOSY Robot coordinate data (Y-axis) | • VGETLENCR Main axis length (camera coordinate/robot coordinate) |
| • VGETPOSR Workpiece/blob angle | • VGETROUNDNESS Roundness |

- The acquired point data does not include any hand system flag.
- The search results (detection quantity, detection time, and workpiece information, etc.) are retained by the task that has executed the search.

To acquire the results of the search that has been executed by another task, specify the task number that has executed the search.

TIP

The array is, for example, just like a cabinet. A name (array element number) is put on each drawer that stores data. The same type data is stored into each drawer. In this manual, the drawer name is called "array element number", but it may also be called "subscript".

7.2.2.1 VCNTEDGE

● Function

VCNTEDGE	VCNTEDGE (<i>memory number, model number</i>)
	The edge in the image from the memory image is obtained according to the setting of model number.

Description

This function obtains the number of edge points in the memory image. To detect the edges, use the edge settings for the model number. Edges in the memory image are detected using the edge settings for the model number. The total number of detected edges is obtained as return value.

Explanation

<Memory number>

The memory number to specify the memory image for obtaining edge points can be specified using one of the numbers 1 to 15 or a variable. The memory number is used in common no matter what the camera channel is.

<Model number>

Edges are detected using the edge settings for the specified model number using one of the numbers 0 to 253 or a variable.

Statement examples

VCAPTURE 1, 10 The image from the channel 1 camera is acquired and saved to number 10 memory.

PRINT VCNTEDGE (10, 20) .. The edges are detected from the number 10 memory images by the number 20 model edge setting and the number of edge points is obtained.



NOTE

If the number of detected edge points exceeds 6000, the search speed may become slow. At this time, it is recommended to improve the surrounding environments and review the edge settings for the model.

7.2.2.2 VGETCNT

● Function

VGETCNT	VGETCNT [<i>task number</i>]
	The number of items detected in the search executed by the specified task is obtained.

Description

This function obtains the number of items detected by the search executed by the specified task.



NOTE

The search results (detection quantity, detection time, and workpiece information, etc.) are retained by the task that has executed the search.

To acquire the results of the search that has been executed by another task, specify the task number that has executed the search.

Explanation

<Task number>

The task number in which the search was executed to obtain the number of detected items can be specified using one of the numbers 1 to 16 or a variable.

When this number is not specified, the number of the task in which this command is executed will be the task number.

Statement example

VSEARCH 1, 2

PRINT VGETCNT The number of items detected by the search is output to programming box screen.

C%=VGETCNT-1

FOR A%=0 TO C%

PRINT VGETSCR (A%)..... The processing in accordance with the number of items detected by the search is repeated.

NEXT A%

7.2.2.3 VGETPIX

● Function

VGETPIX	VGETPIX [task number] (array element number)
	From the search result array of the search executed by the specified task, the array element's pixel data is obtained in a point data format.

Description

This function obtains pixel data from the search result array of the search executed by the specified task. The pixel data is obtained in "pixel" units.

Explanation

<Task number>

The task number in which the search was executed to obtain the number of detected items can be specified using one of the numbers 1 to 16 or a variable. When this number is not specified, the number of the task in which this command is executed will be the task number.

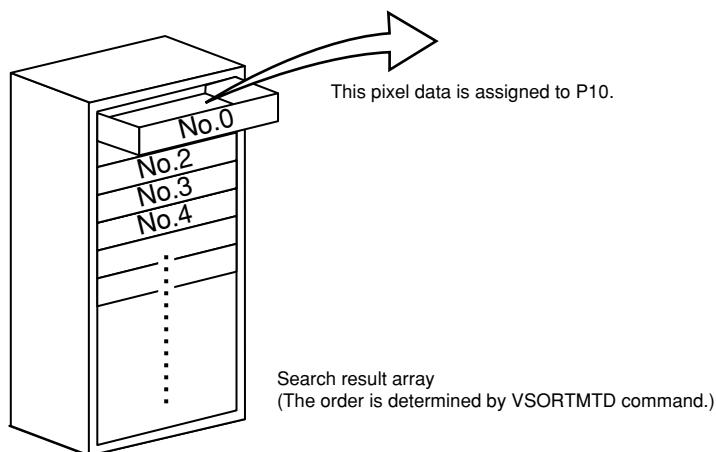
<Array element number>

The "array element number" specifies an array element in the search result array. It specifies the search result array's element number from which pixel data is to be obtained. One of the values 0 to (VGETCNT-1) or a variable can be specified. The search result array count begins from No.0. The array is sorted by the method specified by VSORTMTD command in the order of robot coordinates. (The sorting order is determined by the pixel coordinates if no camera calibration number is specified.)

Statement example

P10=VGETPIX (0) The pixel data from search result number 1 (array element number 0) is assigned to P10.

P10=VGETPIX(0)



NOTE

This function cannot be written in a manner like MOVE P and VGETPIX (0).

7.2.2.4 VGETPOS

● Function

VGETPOS	VGETPOS [task number] (array element number)
	From the search result array of the search executed by the specified task, the point data of the specified array element number is obtained.

Description

This function obtains point data from the search result array of the search executed by the specified task. The robot's Z-axis height at the time of the search is obtained as the Z-axis point data. The point data is obtained (units: mm, Cartesian coordinate).



CAUTION
The robot's Z-axis height at the time of the search is obtained as the Z-axis data of the point data obtained by VGETPOS command. Therefore, the position of the point data obtained by VGETPOS command may vary depending on the robot position at the time of the search. When moving the robot to the position of the point data obtained by VGETPOS command, carefully check the robot movement route so that the Z-axis does not collide with other object.

Explanation

<Task number>

The task number in which the search was executed to obtain the number of detected items can be specified using one of the numbers 1 to 16 or a variable. When this number is not specified, the number of the task in which this command is executed will be the task number.

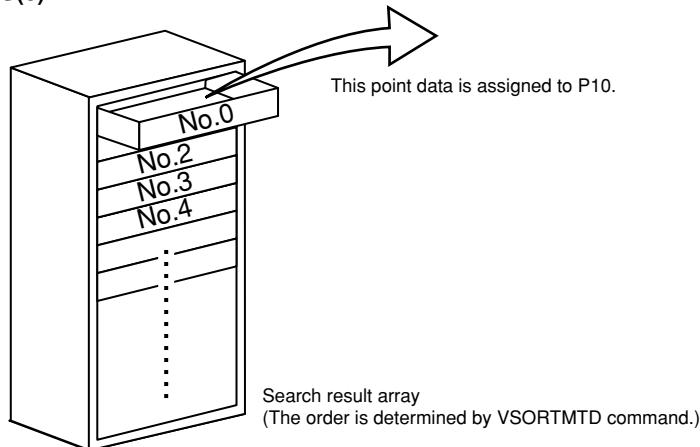
<Array element number>

The "array element number" specifies an array element in the search result array. It specifies the search result array's element number from which point data is to be obtained. One of the values 0 to (VGETCNT-1) or a variable can be specified. The search result array count begins from No.0. The array is sorted by the method specified by VSORTMTD command in the order of robot coordinates. (The sorting order is determined by the pixel coordinates if no camera calibration number is specified.)

Statement example

P10=VGETPOS (0) The point data from search result number 1 (array element number 0) is assigned to P10.

P10=VGETPOS(0)



C%=VGETCNT-1

FOR A%=0 TO C%

MOVE P,VGETPOS (A%) .. Moves sequentially to all the search result point data positions.

NEXT A%

7.2.2.5 VGETPOSX / VGETPOSY / VGETPOSR

● Function

VGETPOSX VGETPOSY VGETPOSR	VGETPOSX [task number] (array element number) VGETPOSY [task number] (array element number) VGETPOSR [task number] (array element number)
	From the result array of the search executed by the specified task, the X or Y-coordinate value or angle of the point data of the array element is obtained.

Description

These functions obtain the workpiece's X or Y-coordinate position or angle from the result array of the search executed by the specified task. The X or Y-coordinate position of the workpiece is obtained from the specified array element in the search result (units: mm, Cartesian coordinate). The angle of the workpiece is obtained (units: degree, Cartesian coordinate).

VGETPOSX The X-coordinate position of the workpiece from the search result array is obtained.

VGETPOSY The Y-coordinate position of the workpiece from the search result array is obtained.

VGETPOSR The angle of the workpiece from the search result array is obtained.

Explanation

<Task number>

The task number in which the search was executed to obtain the number of detected items can be specified using one of the numbers 1 to 16 or a variable. When this number is not specified, the number of the task in which this command is executed will be the task number.

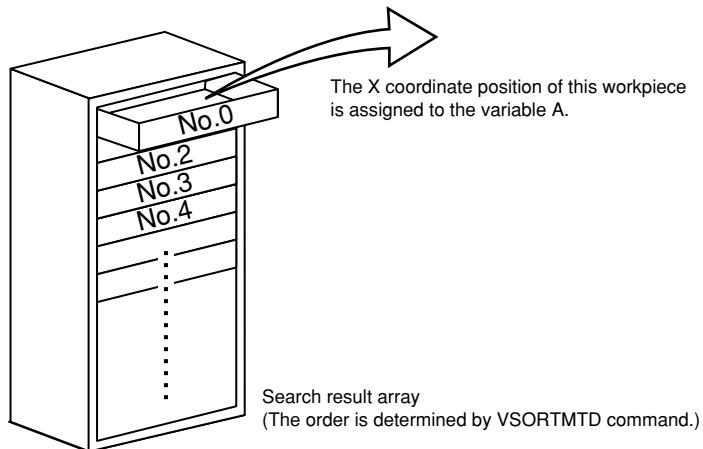
<Array element number>

The "array element number" specifies an array element in the search result array. It specifies the search result array's element number from which data is to be obtained. One of the values 0 to (VGETCNT-1) or a variable can be specified. The search result array count begins from No.0. The array is sorted by the method specified by VSORTMTD command in the order of robot coordinates. (The sorting order is determined by the pixel coordinates if no camera calibration number is specified.)

Statement example

A=VGETPOSX (0)..... The X-coordinate position of the workpiece of research result number 1 (array element number 0) is assigned to A.

A=VGETPOSX(0)



7.2.2.6 VGETSCLE

● Function

VGETSCLE	VGETSCLE [task number] (array element number)
	From the search result array of the search executed by the specified task, the scale data of the array element is obtained.

Description

This function obtains scale data from the search result array of the search executed by the specified task. The scale data is obtained from the specified array-element in the search result array.

Explanation

<Task number>

The specified task number in which the search was executed to obtain the number of detected items can be specified using one of the numbers 1 to 16 or a variable. When this number is not specified, the number of the specified task in which this command is executed will be the specified task number.

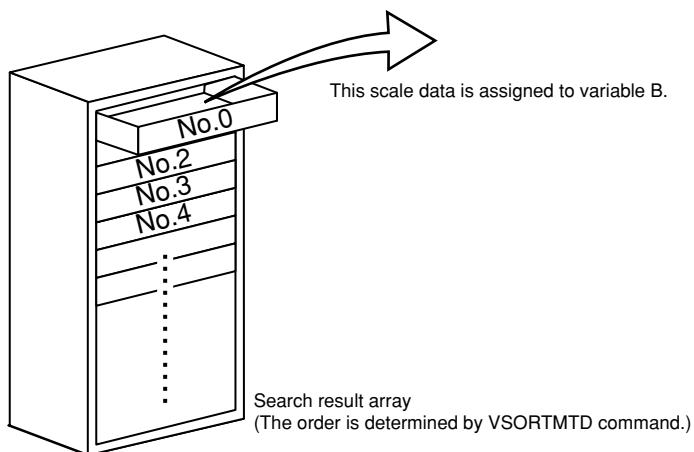
<Array element number>

The "array element number" specifies an array element in the search result array. It specifies the search result array's element number from which scale data is to be obtained. One of the values 0 to (VGETCNT-1) or a variable can be specified. The search result array count begins from No.0. The array is sorted by the method specified by VSORTMTD command in the order of robot coordinates. (The sorting order is determined by the pixel coordinates if no camera calibration number is specified.)

Statement example

B=VGETSCLE (0)..... The scale data from search result number 1 (array element number 0) is assigned to variable B.

B=VGETSCLE(0)



```
C%=VGETCNT-1
FOR A%=0 TO C%
  IF VGETSCLE (A%) > 98 THEN ..... The scale data moves sequentially to the search result point data positions of workpieces with scales larger than 98%.
    MOVE P, VGETPOS (A%)
  ENDIF
NEXT A%
```

7.2.2.7 VGETSCR

● Function

VGETSCR	VGETSCR [task number] (array element number)
	From the search result array of the search executed by the specified task, the score data of the array element is obtained.

Description

This function obtains score data from the search result array of the search executed by the specified task. The score data is obtained from the specified array-element in the search result array.

Explanation

<Task number>

The specified task number in which the search was executed to obtain the number of detected items can be specified using one of the numbers 1 to 16 or a variable. When this number is not specified, the number of the specified task in which this command is executed will be the specified task number.

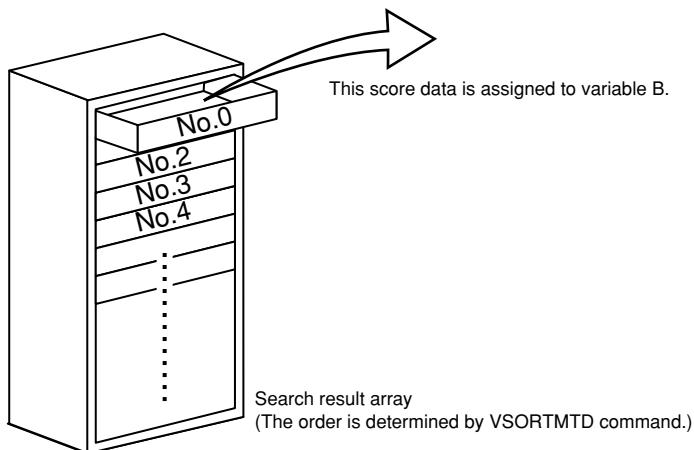
<Array element number>

The "array element number" specifies an array element in the search result array. It specifies the search result array's element number from which score data is to be obtained. One of the values 0 to (VGETCNT-1) or a variable can be specified. The search result array count begins from No.0. The array is sorted by the method specified by VSORTMTD command in the order of robot coordinates. (The sorting order is determined by the pixel coordinates if no camera calibration number is specified.)

Statement example

B=VGETSCR (0)..... The score data from search result number 1 (array element number 0) is assigned to variable B.

| B=VGETSCR(0)



```
C%=VGETCNT-1
FOR A%=0 TO C%
  IF VGETSCR (A%) > 80 THEN ..... The score data moves sequentially to the search result point data positions of
  workpieces with scores higher than 80%.
    MOVE P, VGETPOS (A%)
  ENDIF
NEXT A%
```

7.2.2.8 VGETTIME

● Function

VGETTIME	VGETTIME [task number]
The time (units: ms) required for the search command executed by the task is obtained.	

Description

This function obtains the time (units: ms) required to execute the search command of the search executed by the specified task.

Statement example

```
VSEARCH 1, 1
PRINT "SEARCH TIME:"; VGETTIME .. The search command execution time is displayed at the programming box screen.
```

7.2.2.9 VPEEKNXT

● Function

VPEEKNXT	VPEEKNXT [task number]
The most recent search results for the presence of the next workpiece is checked. The coordinate value of the next workpiece is added to the array result of the task that searched most recently.	

Description

This function checks the presence of the next workpiece for the most recently searched results. When the next workpiece is present, the return value is the array element number (0 to 39) of the search result array containing the next workpiece information. When the next workpiece is not present, the return value of this function becomes -1.

Statement example

```
VSEARCH 1, 1
N% = VPEEKNXT ..... The next workpiece presence check result is assigned to the variable N%.
IF N% > -1 THEN
  PRINT VGETSCR (N%)
ENDIF
```



NOTE

- The next workpiece is present when all conditions shown below are satisfied after searching.
 - The number of detected workpieces is less than the detection workpieces quantity parameter value.
 - There are workpieces rejected by the score threshold valve (priority area threshold value when the priority area is set).
- Even when there are multiple rejected workpieces, the next workpiece to be detected is only one workpiece with the highest score among them.

7.2.3 Image processing (Condition changes / parameter changes)

7.2.3.1 VCALIBNO

● Command

VCALIBNO	VCALIBNO (<i>camera channel number</i>) = <i>camera calibration number</i>
	The "CLBLINK" parameter of the camera is changed.

Description

This command changes the "CLBLINK" parameter of the specified camera. The camera calibration data for coordinate conversion can be specified for each camera channel.

When using the VCAPTURE, VSEARCH, VSEARCHR, VSEARCHS or VMEASURE command without specifying the camera calibration number, the camera calibration data specified by the "CLBLINK" parameter is adopted.

Explanation

<Camera channel number>

The camera channel number to specify the camera calibration can be specified using one of the numbers 1 to 16 or a variable.

<Camera calibration number>

The camera calibration number to be used in the search can be specified the numbers -1 to 31 or a variable.



NOTE

If specifying "-1", the setting will be no camera calibration.



NOTE

VCALIBNO command specifies the camera calibration when performing a search. Even if VCALIBNO is used to change the camera calibration number before using VGETPOS following a search, it will have no effect.

Statement examples

VCALIBNO (1) = 2..... Camera calibration number 2 is specified for the CLB link number of the channel 1 camera.

B=3

VCALIBNO (2) = B..... Camera calibration number 3 is specified for the CLB link number of the channel 2 camera.

● Function

VCALIBNO	VCALIBNO (<i>camera channel number</i>)
	The "CLBLINK" parameter of the camera is obtained.

Description

This function obtains the "CLBLINK" parameter of the camera. The camera calibration data used by the camera for coordinate conversion is obtained.

Explanation

<Camera channel number>

The camera channels number to specify the camera calibration can be specified using one of the numbers 1 to 16 or a variable.

Statement examples

A = VCALIBNO (1)..... The camera calibration data number of the channel 1 camera is assigned to variable A.

B=2

A = VCALIBNO (B)..... The camera calibration data number of the channel 2 camera is assigned to variable A.

7.2.3.2 VEXPOTIM

● Command

VEXPOTIM	VEXPOTIM (<i>camera channel number</i>) = <i>setting value</i>
	The "iVY Camera exposure time" parameter is changed.

Description

This command changes the exposure time (units: μ s) to acquire an image.

When this command is executed, the "iVY Camera exposure time" parameter setting is changed.

Explanation

<Camera channel number>

The camera channel number to specify the exposure time can be specified using one of the numbers 1 to 16 or a variable.

<Setting value>

The setting value is specified the value of the exposure time (units: μ s). This can be specified using one of the numbers 10 to 50000 or a variable.

Statement example

EXPOSURETIME%=16000

VEXPOTIM (1) = EXPOSURETIME% .. Changes the camera 1 exposure time setting to 16 ms.

● Function

VEXPOTIM	VEXPOTIM (<i>camera channel number</i>)
	The "iVY Camera exposure time" parameter of the camera is obtained.

Description

This function obtains the "iVY Camera exposure time" parameter of the camera and the exposure time (units: μ s).

Explanation

<Camera channel number>

The camera channel number to obtain the exposure time can be specified using one of the numbers 1 to 16 or a variable.

Statement example

A = VEXPOTIM (1) The value of the channel 1 camera "iVY Camera exposure time" parameter is assigned to variable A.

B=2

A = VEXPOTIM (B) The value of the channel 2 camera "iVY Camera exposure time" parameter is assigned to variable A.

7.2.3.3 VMONITOR

● Command

VMONITOR	VMONITOR ON OFF
	On/ off of Monitor mode is switched.

Description

This command turns on or off Monitor mode.

Executing this command during connecting to RCXiVY2+ Studio in Edit mode forces to switch to Monitor mode or Controller mode.

Explanation

ON Vision control mode is changed to Monitor mode.

OFF Vision control mode is changed to Controller mode.

Statement example

VMONITOR ON Vision control mode is changed to Monitor mode.

VSEARCH 1,1

VMONITOR OFF Vision control mode is changed to Controller mode.

7.2.3.4 VNEXTCHK

● Command

VNEXTCHK	VNEXTCHK ON OFF
	The display function for the next workpiece on/off is switched.

Description

This command turns on or off the next workpiece display.

Statement example

VNEXTCHK ON..... The next workpiece display function is turned on.

VSEARCH 1, 1

N% = VPEEKNXT

IF N% > -1 THEN

PRINT VGETSCR (N%)

ENDIF



NOTE

When the next workpiece display function turns on, this may affect the search time since the next workpiece information is obtained during search.

7.2.3.5 VSORTMTD

● Command

VSORTMTD	VSORTMTD (<i>camera channel number</i>) = <i>sort method number</i>
The "iVY Camera sort method" parameter for search result array is set.	

Description

This command specifies the sort method parameter for sorting the search result array of the specified camera. The search result is output using the sort method specified here.

Explanation

<Camera channel number>

The camera channel number from which the image is captured can be specified using one of the numbers 1 to 16 or a variable.

<Sorting method number>

The search result array's sorting method number can be specified using one of the numbers 0 to 4 or a variable.

- 0...In score order
- 1...In ascending X-coordinate order
- 2...In descending X-coordinate order
- 3...In ascending Y-coordinate order
- 4...In descending Y-coordinate order



NOTE

- At searches where no sorting method is specified (no VSORTMTD statement), the search result array is output in their score order.
- The search result array is sorted by the robot coordinate. However, if no calibration number is specified, the search result array is sorted by the pixel coordinate.

Statement examples

VSORTMTD (1) = 1..... The search results for channel 1 camera are output in ascending order of X-coordinate.

B=4

VSORTMTD (2) = B..... The search results for channel 2 camera are output in descending order of Y-coordinate.

● Function

VSORTMTD	VSOTRMTD (<i>camera channel number</i>)
The "iVY Camera sort method" parameter for search result array is obtained.	

Description

This function obtains the "iVY Camera sort method" parameter of the search result array for the camera.

If the "iVY Camera sort method" parameter of the search result array for the camera is "score order", this function returns a value of 0. It returns a value of 1 if the sort method is "X-coordinate ascending order", a value of 2 for "X-coordinate descending order", a value of 3 for "Y-coordinate ascending order", and a value of 4 for "Y-coordinate descending order".

Explanation

<Camera channel number>

The camera number from which the image is acquired can be specified using one of the numbers 1 to 16 or a variable.

Statement examples

A = VSORTMTD (1)..... The value of the "iVY Camera sort method" parameter of the search result array for channel 1 camera is assigned to variable A.

B=2

A = VSORTMTD (B)..... The value of the "iVY Camera sort method" parameter of the search result array for channel 2 camera is assigned to variable A.

7.2.3.6 VTRGMOD

● Command

VTRGMOD	VTRGMOD (<i>camera channel number</i>) = <i>trigger mode</i> Trigger mode 1: H/W trigger / 2: S/W trigger
The "iVY Camera trigger mode" parameter is changed.	

Description

This command changes the "iVY Camera trigger mode" parameter of the camera.

When this command is executed, the value of the "iVY Camera trigger mode" parameter is changed.

Explanation

<Trigger mode>

The timing mode at which the image is acquired can be specified using one of the numbers 1 or 2, or a variable.

1 H/W trigger

2 S/W trigger

<Camera channel number>

The camera channel number that will acquire the image can be specified using one of the numbers 1 to 16 or a variable.

Statement examples

VTRGMOD (1) = 1 The channel 1 camera trigger mode is changed to H/W trigger.

A=2

B=2

VTRGMOD (A) = B The channel 2 camera trigger mode is changed to S/W trigger.

● Function

VTRGMOD	VTRGMOD (<i>camera channel number</i>)
The "iVY Camera trigger mode" parameter is obtained.	

Description

This function obtains the "iVY Camera trigger mode" parameter of the camera.

It returns 1 in the case of H/W trigger, and returns 2 in the case of S/W trigger.

Explanation

<Camera channel number>

The camera channel number from which the image is acquired can be specified using one of the numbers 1 to 16 or a variable.

Statement examples

A = VTRGMOD (1)..... The value of the "iVY Camera trigger mode" parameter for channel 1 camera is assigned to variable A.

B=2

A = VTRGMOD (B) The value of the "iVY Camera trigger mode" parameter for channel 2 camera is assigned to variable A.

7.2.3.7 VTRGOUT

● Command

VTRGOUT	VTRGOUT (<i>camera channel number</i>) = <i>setting value</i>
	The "iVY Camera H/W trigger timeout" parameter is changed.

Description

This command changes the timeout period (units: s) for capturing an image.

When this command is executed, the value of the "iVY Camera H/W trigger timeout" parameter is changed.

Explanation

<Setting value>

The trigger timeout setting value (units: s) can be specified using one of the numbers 0 to 36000 or a variable.

Statement examples

VTRGOUT (1) = 5..... The channel 1 camera trigger timeout is set to 5 seconds.

B=10

VTRGOUT (2) = B%..... The channel 2 camera trigger timeout is set to 10 seconds.

● Function

VTRGOUT	VTRGOUT (<i>camera channel number</i>)
	The "iVY Camera H/W trigger timeout" parameter is obtained.

Description

This function obtains the "iVY Camera H/W trigger timeout" parameter and the trigger timeout set by the parameter.

Explanation

<Camera channel number>

The camera channel number from which the image is acquired can be specified using one of the numbers 1 to 16 or a variable.

Statement examples

A = VTRGOUT (1)..... The value of the "iVY Camera H/W trigger timeout" parameter for channel 1 camera is assigned to variable A.

B=2

A = VTRGOUT (B)..... The value of the "iVY Camera H/W trigger timeout" parameter for channel 2 camera is assigned to variable A.

7.2.4 Image processing (Calibration)

7.2.4.1 VCALCALIB

● Command

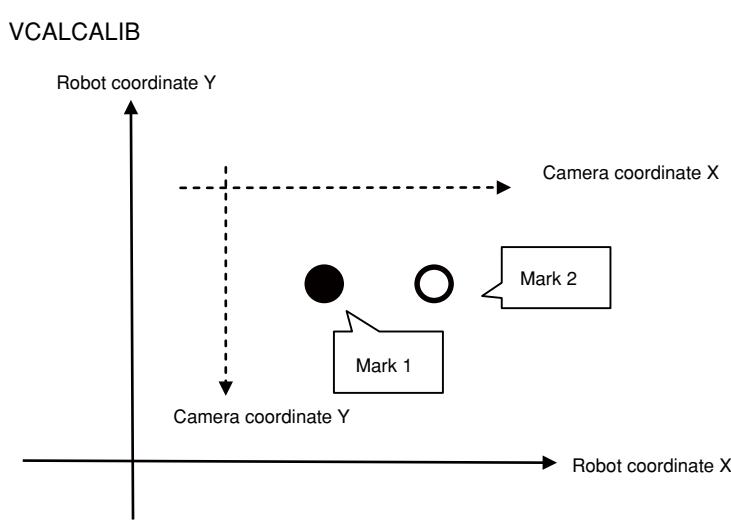
VCALCALIB	<p><code>VCALCALIB [robot number] camera channel number, camera installation method, camera direction, first point number, capture point number</code></p> <p>The camera calibration data is calculated.</p>
-----------	--

Description

This command calculates camera calibration data with the specified settings.

The camera calibration data can be registered by VSETCALIB command and its result can be obtained by VGETCALIB command.

Camera calibration needs the position information on the robot coordinate of two points and X and Y position information of two corresponded points on the camera coordinate.



Explanation

<Robot number>

The robot number for which camera calibration is calculated can be specified using one of the numbers 1 to 4 or a variable. When this is not specified, robot number 1 is specified and writing "[]" is not necessary.

<Camera channel number>

The camera channel number for which camera calibration is calculated can be specified using one of the numbers 1 or 16 or a variable.

<Camera installation method>

The camera installation method can be specified using one of the numbers 0 or 1, or a variable.

0: Fixed camera, 1: 2nd arm camera

<Camera direction>

The camera direction to be installed can be specified using one of the numbers 0 or 1, or a variable.

0: Downward, 1: Upward

<First point number> <Capture point number>

These numbers specify the first point numbers where XY position information is registered for calibration.

The position number ranges are as below;

First point number: 0 to 29996, Capture point number: 0 to 29999

When selecting fixed camera, the capture point number can be omitted. Both numbers can also be specified by a variable. It is required to register each position information shown in the table below beforehand.

Point number	Position information	Units
First point number	Mark 1 XY position information on the robot coordinates	mm
First point number + 1	Mark 2 XY position information on the robot coordinates	mm
First point number + 2	Mark 1 XY position information on the camera coordinates	pixel
First point number + 3	Mark 2 XY position information on the camera coordinates	pixel
Capture point number	Robot position information when capturing the mark 1 and 2 by the camera	mm

Statement examples

- VCALCALIB[2] 1,0,1,30..... The camera calibration data is calculated with specifying robot number 2, camera channel number 1, fixed camera in up direction and first point number P30.
- VCALCALIB 5,1,0,30,40 The camera calibration data is calculated with specifying robot number 1, camera channel number 5, 2nd arm camera in down direction, first point number P30 and capture point number P40.

	Name	A1	A2	A3	A4	A5	A6	Arm Type
P30	Point1_mm	20.143	30.110	0.000	-46.080	0.000	0.000	Lefty
P31	Point2_mm	71.502	31.386	0.000	-46.080	0.000	0.000	Lefty
P32	Point1_pix	201.100	243.512	0.000	0.000	0.000	0.000	None
P33	Point2_pix	421.221	243.981	0.000	10.000	0.000	0.000	None
P40	Search_mm	121.876	137.992	0.000	30.080	0.000	0.000	Lefty



NOTE

This command is available with RCX340 / RCX320 software version 1.40 or later.

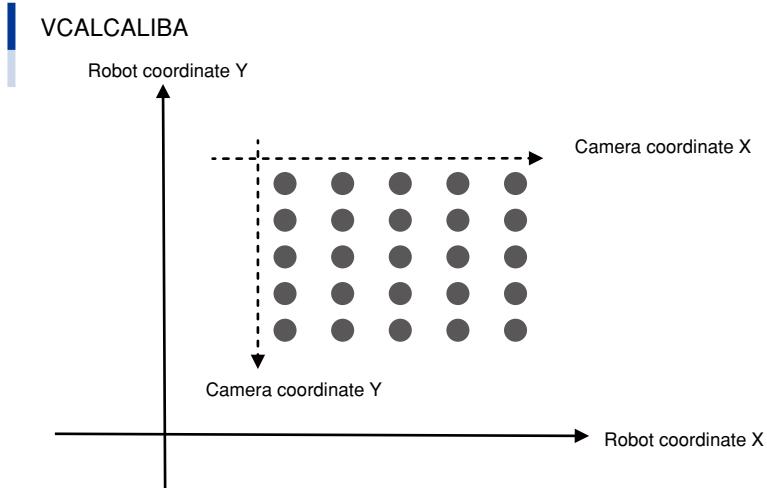
7.2.4.2 VCALCALIBA

● Command

VCALCALIBA	VCALCALIBA [robot number] camera channel number, camera installation method, camera direction, number of used data, first robot point number, first camera point number, capture point number
	The camera calibration data including correction for distortion and tilt is calculated.

Description

This command calculates camera calibration data including correction for distortion and tilt with the specified settings. The data can be registered by VSETCALIB command and its result can be obtained by VGETCALIB command. Camera calibration needs the position information on the robot coordinate of more than 16 points and X and Y position information of the corresponded points on the camera coordinate.



Explanation

<Robot number>

This item specifies the robot number for which camera calibration is calculated. Only one number may be specified (1 to 4). This number can also be specified by a variable. When this is omitted, robot number 1 is specified and writing "[]" is not necessary.

<Camera channel number>

This number specifies the camera channel number for which camera calibration is calculated. Only one number may be specified (1 or 16). This number can also be specified by a variable.

<Camera installation method>

This number specifies the camera installation method and can also be specified by a variable.
0: Fixed camera, 1: 2nd arm camera

<Camera direction>

This number specifies the camera direction to be installed and can also be specified by a variable.

0: Downward, 1: Upward

<Number of used data>

This item specifies the number of point data to be used. Only one number may be specified (16 to 25) and can also be specified by a variable.

<First robot point number> <First camera point number> <Capture point number>

These numbers specify the first point numbers where XY position information is registered for camera calibration.

The position number ranges are as below;

First robot point number/ First camera point number: 0 to 29975, Capture point number: 0 to 29999

When selecting fixed camera, the capture point number can be omitted. All these numbers can also be specified by a variable. It is required to register each position information shown in the table below beforehand.

Point number	Position information	Units
First robot point number	Mark 1 XY position information on the robot coordinates	mm
.....		
First point number + n	Mark n XY position information on the robot coordinates	mm
First camera point number	Mark 1 XY position information on the camera coordinates	pixel
.....		
First camera point number + n	Mark n XY position information on the camera coordinates	pixel
Capture point number	Robot position information when capturing the mark 1 and 2 by the camera	mm

Statement examples

VCALCALIBA[2] 1, 0, 1, 25, 75, 125.....

Calibration data is calculated with specifying robot number 2, camera channel number 1, fixed camera in up direction, the number of used data 25, first robot point number P75 and first camera point number P125.

VCALCALIBA 5, 1, 0, 25, 75, 125, 50.....

Calibration data is calculated with specifying robot number 1, camera channel number 5, 2nd arm camera in down direction, the number of used data 25, first robot point number P75, first camera point number P125, and capture point number P50.

	Name	A1	A2	A3	A4	A5	A6	Arm Type	F1	F2
P50	Search_mm	71.502	31.386	0.000	-46.080	0.000	0.000	Lefty	0	0
P75	Point1_mm	95.481	210.359	0.000	90.000	0.000	0.000	None	0	0
P76	Point2_mm	96.590	237.612	0.000	90.000	0.000	0.000	None	0	0
P77	Point3_mm	97.699	264.865	0.000	90.000	0.000	0.000	None	0	0
P78	Point4_mm	98.808	292.118	0.000	90.000	0.000	0.000	None	0	0
P79	Point5_mm	99.917	319.371	0.000	90.000	0.000	0.000	None	0	0
P80	Point6_mm	59.673	211.816	0.000	90.000	0.000	0.000	None	0	0
P81	Point7_mm	60.782	239.069	0.000	90.000	0.000	0.000	None	0	0
P82	Point8_mm	61.891	266.322	0.000	90.000	0.000	0.000	None	0	0
P83	Point9_mm	63.000	293.575	0.000	90.000	0.000	0.000	None	0	0
P94	Point10_mm	64.109	320.828	0.000	90.000	0.000	0.000	None	0	0
P111	11_mm	23.865	29.177	0.000	0.000	0.000	0.000	None	0	0
P136	Point11_pix	618.018	311.776	0.000	0.78	0.000	0.000	None	0	0
P137	Point12_pix	618.106	0.000	0.555	0.000	0.000	0.000	None	0	0
P138	Point13_pix	793.271	834.233	0.000	0.538	0.000	0.000	None	0	0
P139	Point14_pix	792.141	1049.655	0.000	0.546	0.000	0.000	None	0	0
P140	Point15_pix	1078.665	186.496	0.000	0.632	0.000	0.000	None	0	0
P141	Point16_pix	1077.941	402.240	0.000	0.407	0.000	0.000	None	0	0
P142	Point17_pix	1076.681	618.357	0.000	0.435	0.000	0.000	None	0	0
P143	Point18_pix	1074.995	834.339	0.000	0.549	0.000	0.000	None	0	0
P144	Point19_pix	1073.940	1049.664	0.000	0.505	0.000	0.000	None	0	0
P145	Point20_pix	1360.437	186.968	0.000	0.909	0.000	0.000	None	0	0
P146	Point21_pix	1359.715	402.768	0.000	0.580	0.000	0.000	None	0	0
P147	Point22_pix	1358.472	618.714	0.000	0.434	0.000	0.000	None	0	0

**NOTE**

- This command is available with RCX340 / RCX320 software version 1.40 or later.

- Set the position so that the whole camera's FOV is covered.

7.2.4.3 VCHGPIXTOMM

● Function

VCHGPIXTOMM	VCHGPIXTOMM (<i>camera calibration number, point expression 1, point expression 2</i>)
	The pixel data is converted to the point data at the camera calibration number.

Description

This function converts the pixel data on the point type camera coordinate into the point data on the robot coordinate by specified camera calibration number. The camera calibration data is limited to simple calibration data.

Explanation

<Camera calibration number>

This item specifies the camera calibration number for coordinate conversion. Only one number in the range 0 to 31 can be specified. This number can also be specified by a variable.

<Point expression 1>

This item specifies the point expression where the pixel data [pixel] to be converted is stored.

<Point expression 2>

This item specifies the point expression where the robot position [mm] on camera capturing is stored.

Statement examples

```
VSEARCH 1, 0..... Search and capture work is performed with specifying camera channel 1, model number 0.  
P10 = VGETPIX (0)..... The search result (pixel data) is assigned to P10.  
P20 = WHRXY..... The robot current position is assigned to P20.  
P30 = VCHGPIXTOMM (3, P10, P20)  
..... P10 pixel data is coordinate-converted in camera calibration number 3 and assigned to P30.
```



NOTE

This command is available with RCX340 / RCX320 software version 1.40 or later.

7.2.4.4 VGETCALIB / VGETCALIBA

● Function

VGETCALIB	VGETCALIB (<i>data number</i>)
	The camera calibration data that was calculated by "VCALCALIB" command is obtained.
VGETCALIBA	VGETCALIBA (<i>data category, data number</i>)
	The camera calibration data that was calculated by "VCALCALIBA" command is obtained.

Description

These functions obtain the result of the number specified by camera calibration data that is calculated by VCALCALIB/VCALCALIBA command.

If VCALCALIB/VCALCALIBA command has not been executed, the related errors will be returned when executing VCALCALIB/VCALCALIBA function.

Explanation

<Data category> <Data number>

Specify the data number which camera calibration data obtains, and data numbers are corresponded to the values in table below. The data number can be specified by a variable.

VGETVCALIB function does not specify the data category and obtains only normal data.

Data category		Data number									
Meaning	Cate gory	0	1	2	3	4	5	6	7	8	
Normal data	0	Robot number	Installation method	Camera direction	Scale ratio	Camera angle	PRM1	PRM2	FOV H	FOV V	
Para meter 1	1	U	v	K1	K2						
Para meter 2	2	PRM0	PRM1	PRM2	PRM3	PRM4	PRM5	PRM6	PRM7	PRM8	
Para meter 3	3	Offset X	Offset Y	Scale ratio							
Measured value	4	X Max. deviation	Y Max. deviation	X Min. deviation	Y Min. deviation	Ave. X deviation	Ave. Y deviation	Camera tilt X	Camera tilt Y	Rotation angle	

Statement example

VCALCALIB 1, 0, 1, 30 The camera calibration data is calculated.

A% = VGETCALIB (3) Scale ratio of the camera calibration data is assigned to A%.

VCALCALIBA 1, 0, 1, 25, 75, 125 The camera calibration data is calculated.

B% = VGETCALIB (0, 3) Scale ratio of the camera calibration data is assigned to B%.



NOTE

This command is available with RCX340 / RCX320 software version 1.40 or later.

7.2.4.5 VSETCALIB

● Command

VSETCALIB	VSETCALIB (camera calibration number)
	The camera calibration data that was calculated by the "VCALCALIB" command is registered to the camera calibration number.

Description

This command registers the camera calibration data calculated by VCALCALIB command to the specified camera calibration number.

If VCALCALIB command has not been executed, related alarms will be return when this command is executed.

Explanation

<Camera calibration number>

This item specifies the camera calibration number for which camera calibration data is registered. Only one number may be specified (0 or 31). This number can also be specified by a variable.

Statement example

VCALCALIB 1, 0, 1, 30 The camera calibration data is calculated.

VSETCALIB 3 The camera calibration data is registered to the camera calibration number 3.



NOTE

This command is available with RCX340 / RCX320 software version 1.40 or later.

7.2.4.6 VSETCALIBA

● Command

VSETCALIBA	VSETCALIBA (<i>camera calibration number</i>)
	The camera calibration data that was calculated by the "VCALCALIBA" command is registered to the camera calibration number.

Description

This command registers the camera calibration data calculated by VCALCALIBA command to the specified camera calibration number.

If VCALCALIBA command has not been executed, related alarms will be return when this command is executed.

Explanation

<Camera calibration number>

This item specifies the camera calibration number for which camera calibration data is registered. Only one number may be specified (0 or 31). This number can also be specified by a variable.

Statement example

VCALCALIBA 1, 0, 1, 25, 75, 125 The camera calibration data is calculated.

VSETCALIBA 3..... The camera calibration data is registered to the camera calibration number 3.



NOTE

This command is available with RCX340 / RCX320 software version 1.40 or later.

7.2.5 Image processing (Measurement function)

7.2.5.1 VGETCNTM

● Function

VGETCNTM	VGETCNTM [<i>task number</i>]
	The result whether the workpiece was detected or not in the measuring search executed by the task is obtained.

Description

This function obtains the result whether the workpiece was detected or not by the measuring search executed on the task. If the workpiece is detected, 1 is obtained. If not, 0 is obtained.



NOTE

The search result (number of detected items, detection time, work information, etc.) is maintained for each task that executes a search. To obtain the results of a search executed by a different task, specify the number of the task that executed the search.

Explanation

<Task number>

The task number that executed the search to obtain the result can be specified using one of the numbers 1 to 16 or a variable. The task number may be omitted. If not specifying this number, the number of the task that is executing this command is specified.

Statement example

VSEARCH 1, 2, 3..... This is judged whether or not the workpiece is detected by the measuring search.

IF VGETCNTM>0 THEN

A! = VGETOBJR

ENDIF



NOTE

This command is available with RCX340 / RCX320 software version 1.40 or later.

7.2.5.2 VGETOBJC

● Function

VGETOBJC	VGETOBJC [<i>task number</i>]
	The additional information of the result in the measuring search executed by the task on the camera coordinate value is obtained.

Description

This function obtains the additional information of the result in the measuring search executed by the task on the camera coordinate value.

Explanation

<Task number>

The task number where the measuring search was executed to obtain the result can be specified using one of the numbers 1 to 16 or a variable. If not specifying this number, the number of the task that is executing this command is specified.

The additional information of the measuring search depends on the tool type shown as below.

Measuring tool type	Additional information to be obtained
Line	Length of the detected line
Circle	Radius of the detected circle
Line and line	Angle between two lines or length of a line connecting the two lines
Line and circle	Length of a line connecting the line and circle
Circle and circle	Length of the line connecting the two circles

Statement example

```
VMEASURE 1, 2.....The channel 1 camera acquires and the number 2 measuring tool searches from the
acquired images.
```

```
IF VGETCNTM > 0 THEN
```

```
    A! = VGETOBJC .....If the workpiece is detected by measuring search, the additional information of the result
    (camera coordinate value) is saved to the variable "A!".
```

```
ENDIF
```



NOTE

This command is available with RCX340 / RCX320 software version 1.40 or later.

7.2.5.3 VGETOBJR

● Function

VGETOBJR	VGETOBJR [<i>task number</i>]
	The additional information of the result in the measuring search executed by the task on the robot coordinate value is obtained.

Description

This function obtains the additional information of the result in the measuring search executed by the task on the robot coordinate value.



NOTE

If measuring search was executed without calibration setting, “20.306: Vision calibration not set” error will occur. Since the measuring search result is kept by task, specify the task number where the search was executed to obtain the search result of other tasks.

Explanation

<Task number>

The task number where the measuring search was executed to obtain the result can be specified using one of the numbers 1 to 16 or a variable. If not specifying this number, the number of the task that is executing this command is specified.

The additional information of the measuring search depends on the tool type shown as below.

Measuring tool type	Additional information to be obtained
Line	Length of the detected line
Circle	Radius of the detected circle
Line and line	Angle between two lines or length of a line connecting the two lines
Line and circle	Length of a line connecting the line and circle
Circle and circle	Length of the line connecting the two circles

Statement example

```
VMEASURE 1, 2, 3 ..... The number 3 camera calibration is specified, the channel 1 camera acquires and the
number 2 measuring tool searches from the acquired images.
```

```
IF VGETCNTM > 0 THEN
```

```
    A! = VGETOBJC ..... If the workpiece is detected by measuring search, the additional information of the result
    (robot coordinate value) is saved to the variable "A!".
```

```
ENDIF
```



NOTE

This command is available with RCX340 / RCX320 software version 1.40 or later.

7.2.5.4 VGETPIXM

● Function

VGETPIXM	VGETPIXM [task number]
	The camera coordinate value of the result in the measuring search executed by the task is obtained in a point data format.

Description

This function obtains pixel data (units: pixel) from the search result array of the search executed by the specified task. The pixel data is obtained from the specified array-element in the search result array.

Explanation

<Task number>

The task number where the measuring search was executed to obtain the result can be specified using one of the numbers 1 to 16 or a variable. If not specifying this number, the number of the task that is executing this command is specified.

Statement example

```
VMEASURE 1, 2, ..... The channel 1 camera acquires and the number 2 measuring tool searches from the
acquired images.
```

```
IF VGETCNTM > 0 THEN
```

```
    P10 = VGETPIXM ..... If the workpiece is detected by measuring search, the additional information of the result
    (camera coordinate value) is saved to P10.
```

```
ENDIF
```



NOTE

This command is available with RCX340 / RCX320 software version 1.40 or later.

7.2.5.5 VGETPOS

● Function

VGETPOS	VGETPOS [task number]
	The robot coordinate value of the result in the measuring search executed by the task is obtained in a point data format.

Description

This function obtains the point data (units: mm, Cartesian coordinate) of the result in the measuring search executed by the task on the robot coordinate value.



NOTE

If measuring search was executed without calibration setting, “20.306: Vision calibration not set” error will occur. Since the measuring search result is kept by task, specify the task number where the search was executed to obtain the search result of other tasks.

Explanation

<Task number>

The task number where the measuring search was executed to obtain the result can be specified using one of the numbers 1 to 16 or a variable. If not specifying this number, the number of the task that is executing this command is specified.

Statement example

```
VMEASURE 1, 2, 3..... The number 3 camera calibration is specified, the channel 1 camera acquires and the number 2 measuring tool searches from the acquired images.
```

```
IF VGETCNTM > 0 THEN
```

```
    P10 = VGETPOS .. If the workpiece is detected by measuring search, the additional information of the result (robot coordinate value) is saved to P10.
```

```
ENDIF
```



NOTE

This command is available with RCX340 / RCX320 software version 1.40 or later.

7.2.5.6 VMEASURE

● Command

VMEASURE	VMEASURE <i>camera channel number, measuring tool number, camera calibration number</i>
	The measurement search is performed from the camera images by the measuring tool.

Description

This command executes measurement search from the camera images by the specified measuring tool number. Search is performed by the specified measuring tool number after acquiring the images from the specified camera channel. When camera calibration number is specified, the camera coordinate will be converted to the robot coordinate using the calibration data.

Explanation

<Camera channel number>

The camera channel number from which the images are acquired can be specified using one of the number 1 to 16 or a variable.

<Measuring tool number>

The measuring tool number that is the target of the measurement search can be specified using one of the numbers 0 to 253 or a variable.

<Camera calibration number>

The camera calibration number used for measurement search can be specified using one of the numbers 1 to 16 or a variable. When this number is not specified, the calibration data set by VCALIBNO is used.

Neither specifying the camera calibration number nor setting camera calibration by VCALIBNO means that no camera calibration is set.

**CAUTION**

- The VMEASURE command saves an image to memory number 0. Therefore, if this command is executed after an image has been saved to memory number 0 by VCAPTURE command, that image will be overwritten.
- Search results are cleared if the controller power is turned off.

Statement example

```
VMEASURE 1, 2..... The channel 1 camera acquires and the measuring tool number 2 searches from the
acquired images.

VMEASURE 2, 3, 1..... The channel 2 camera acquires, the measuring tool number 3 searches from the acquired
images and camera calibration number 1 corrects the image.

FOR A% = 1 TO 3
  VMEASURE 1, A%, 10..... Camera channel number 1 acquires and searches a workpiece of the measuring tools A% (1
to 3 in this case) from the acquired images.

  IF VGETCNTM = 1 THEN
    P10 = VGETPOSM ..... When a workpiece is detected, the search result (robot coordinate value) will be saved in P10.
  ENDIF

NEXT
```

**NOTE**

This command is available with RCX340 / RCX320 software version 1.40 or later.

7.2.5.7 VMEASUREM**● Command**

VMEASUREM	VMEASUREM <i>memory number, measuring tool number</i>
	The measurement search is performed from the memory images by the measuring tool.

Description

This command executes measurement search from the memory images by the specified measuring tool number. Search is performed by the specified measuring tool number after capturing the images from the specified memory number. When camera calibration number information is added to the specified memory data number by VCAPTURE command, the camera coordinate will be converted to the robot coordinate using the calibration data.

Explanation**<Memory number>**

The memory number of the image that is the target of the search can be specified using one of the numbers 0 to 15 or a variable. The memory number is used in common no matter what the camera channel is.

<Measuring tool number>

The measuring tool number that is the target of the measurement search can be specified using one of the numbers 0 to 253 or a variable.

Statement example

```
VCAPTURE 1, 10..... The image is acquired from the camera channel 1 to the memory number 10.

VMEASUREM 10, 2 ..... The measuring tool number 2 searches from the memory number 10 images.

VCAPTURE 1, 5, 10..... The image is acquired from the camera channel 1 to the memory number 5.

FOR A% = 1 TO 3
  VMEASUREM 5, A%..... The measuring tool number A% searches from the memory number 5 images.

  IF VGETCNTM = 1 THEN
    P10 = VGETPOSM ..... When a workpiece is detected, the search result (robot coordinate value) will be saved in P10.
  ENDIF

NEXT
```

**NOTE**

This command is available with RCX340 / RCX320 software version 1.40 or later.

7.2.6 Image processing (Blob)

7.2.6.1 VBLOB

● Command

VBLOB	VBLOB camera CH, blob tool number, calibration number
The blob search is performed from the camera images using the specified blob tool number.	

Function

The images are narrowed down from the camera channel with the specified number and the blob search is performed using the specified blob tool number.

When the camera calibration number is specified, the camera coordinate is converted into the robot coordinate using the data with the specified camera calibration number.

Explanation

<Camera channel number>

The camera channel number of the image capturing source is specified. The number that can be specified is one of 1 to 16, and it can also be specified using a variable.

<Blob tool number>

The tool number of the blob tool targeted for the blob search is specified. The number that can be specified is one of 0 to 253, and it can also be specified using a variable.

<Camera calibration number>

The camera calibration number that is used when the blob search is performed is specified. The number that can be specified is one of 0 to 31, and it can also be specified using a variable.

When the camera calibration number is not specified, the calibration data specified by VCALIBNO is used.

When the camera calibration number is not specified and there is no camera calibration setting using VCALIBNO, the setting does not use any camera calibration.



CAUTION

- When VBLOB is executed, the image is saved to memory number 0. When VBLOB is executed after the image has been saved to memory number 0 using VCAPTURE, note that the image of memory number 0 is changed.
- The search results are cleared when the controller power is turned off.

Statement examples

VBLOB 1, 2 The blob search is performed from the images captured by camera channel number 1 using blob tool number 2.

VBLOB 2,3,1..... The blob search is performed from the images captured by camera channel number 2 using blob tool number 3 to perform the correction using camera calibration number 1.

FOR A% = 1 TO 3

VBLOB 1, A%, 10..... The blob with blob tool A% (number 1 to 3 in this example) is searched for from the images captured using camera channel number 1.

IF VGETCNT > 0 THEN

P10 = VGETPOS(0) When the blob is detected, the blob search results (robot coordinate values) are stored to P10.

ENDIF

NEXT



NOTE

This command is available with RCX340 / RCX320 software version 1.78 or later.

7.2.6.2 VBLOBM

● Command

VBLOBM	VBLOBM <i>memory number, blob tool number</i>
	The blob search is performed from the memory images using the specified blob tool number.

Function

The blob search is performed from the images with the specified memory number using the specified blob tool number. When the camera calibration number information is added to the images with the memory number specified by VCAPTURE, the camera coordinate is converted into the robot coordinate using the data of the camera calibration number.

Explanation

<Memory number>

The memory number of the images targeted for the search is specified.

The number that can be specified is one of 0 to 15, it can also be specified using a variable.

<Blob tool number>

The tool number of the blob tool targeted for the blob search is specified. The number that can be specified is one of 0 to 253, and it can also be specified using a variable.

Statement examples

```
VCAPTURE 1, 5, 2 .....The images are saved from camera channel number 1 to memory number 5.  
VBLOBM 5, 2.....The blob search is performed from the images of memory number 5 using blob tool  
number 2.  
IF VGETCNT = 0 THEN  
VBLOBM 5, 3.....When no blob is found, the blob search is performed using blob tool number 3.  
ENDIF  
IF VGETCNT > 0 THEN .....When blobs are detected,  
FOR I% = 0 TO VGETCNT-1 ..All the number of the blob search results (robot coordinate) detected from P10 are stored.  
P[10+I%] = VGETPOS(I%)  
NEXT  
ENDIF
```



NOTE This command is available with RCX340 / RCX320 software version 1.78 or later.

7.2.6.3 VGETAREAC / VGETAREAR

● Command

VGETAREAC	VGETAREAC [<i>task number</i>] (<i>array element number</i>)
VGETAREAR	VGETAREAR [<i>task number</i>] (<i>array element number</i>)
	The blob search is performed from the memory images using the specified blob tool number.

Function

This function acquires the blob area with the specified array element number from the search result array of the blob search that has been executed by the specified task.

The blob area to be acquired is the value (pix) on the camera coordinate or the value (mm²) on the robot coordinate.

VGETAREAC The blob area (pix) on the camera coordinate is acquired from the search result array.

VGETAREAR The blob area (mm²) on the robot coordinate is acquired from the search result array.

Explanation

<Task number>

The task number that executes the search to acquire the results is specified.

The number that can be specified is one of 1 to 16, and it can also be specified using a variable.

The task number can be omitted. When no task number is specified, the task number that executes this command is specified.

<Array element number>

The array element number to acquire the results from the search result array is specified. The value that can be specified is one of 0 to (VGETCNT-1), and it can also be specified using a variable.

Statement examples

```
MAX_AREA% = 1000
VBLOB 1, 2 .....The blob search is performed from the images captured by camera channel number 1
                     using blob tool number 2.
IF VGETCNT > 0 THEN .....When blobs are detected, the area sum of detected blobs is checked. When this value is
                     larger than the specified value, the command is paused.
FOR I% = 0 TO VGETCNT-1
IF VGETAREAC[I%] > MAX_AREA% THEN
HOLD
ENDIF
NEXT
ENDIF
```



NOTE

- The search result array is an array that stores the search results after searching.
For details about the search result array, refer to "7.2.2 Image processing (Obtaining search results)".
- This command is available with RCX340 / RCX320 software version 1.78 or later.

7.2.6.4 VGETLEN / VGETLENR

● Command

VGETLEN	VGETLEN [task number] (array element number)
VGETLENR	VGETLENR [task number] (array element number)
The blob search is performed from the memory images using the specified blob tool number.	

Function

This function acquires the main axis length with the specified array element number from the search result array of the blob search that has been executed by the specified task.

The main axis length to be acquired is the value (pix) on the camera coordinate or the value (mm^2) on the robot coordinate.

Explanation

<Task number>

The task number that executes the search to acquire the results is specified.

The number that can be specified is one of 1 to 16, and it can also be specified using a variable.

The task number can be omitted. When no task number is specified, the task number that executes this command is specified.

<Array element number>

The array element number to acquire the results from the search result array is specified. The value that can be specified is one of 0 to (VGETCNT-1), and it can also be specified using a variable.

Statement examples

```

MAX_LEN! = 150.000
VBLOB 1, 2 .....The blob search is performed from the images captured by camera channel number 1
using blob tool number 2.
IF VGETCNT > 0 THEN .....When blobs are detected, the sum of the main axis length of detected blobs is checked.
When this value is larger than the specified value, the command is paused.
FOR I% = 0 TO VGETCNT-1
IF VGETLENR[I%] > MAX_LEN! THEN
HOLD
ENDIF
NEXT
ENDIF

```



NOTE

- The search result array is an array that stores the search results after searching. For details about the search result array, refer to “7.2.2 Image processing (Obtaining search results)”.
- This command is available with RCX340 / RCX320 software version 1.78 or later.

7.2.6.5 VGETROUNDNESS

● Command

VGETROUNDNESS	VGETROUNDNESS [task number] (array element number)
	The roundness with the specified array element number is acquired from the search result array of the blob search executed by the specified task.

Function

This function acquires the roundness with the specified array element number from the search result array of the blob search executed by the specified task.

The acquired roundness is an integer value ranging from 0 to 100.

Explanation

<Task number>

The task number that has executed the search to acquire the results is specified.

The number that can be specified is one of 1 to 16, and it can also be specified using a variable.

The task number can be omitted. When no task number is specified, the task number that executes this command is specified.

<Array element number>

The array element number to acquire the results from the search result array is specified. The value that can be specified is one of 0 to (VGETCNT-1), and it can also be specified using a variable.

Statement examples

```

MIN_ROUND% = 80
VBLOB 1, 2 .....The blob search is performed from the images captured by camera channel number 1
using blob tool number 2.
IF VGETCNT > 0 THEN .....When blobs are detected, the roundness sum of detected blobs is checked. When this
value is smaller than the specified value, the command is paused.
FOR I% = 0 TO VGETCNT-1
IF VGETROUNDNESS[I%] < MIN_ROUND% THEN
HOLD
ENDIF
NEXT
ENDIF

```



NOTE

- The search result array is an array that stores the search results after searching. For details about the search result array, refer to “7.2.2 Image processing (Obtaining search results)”.
- This command is available with RCX340 / RCX320 software version 1.78 or later.

7.2.7 Lighting

7.2.7.1 LCONTROL

● Command

LCONTROL	LCONTROL ON (<i>light channel number</i>) OFF
	The "iVY Light enable" parameter on/off is changed.

Description

This command switches the "lighting control" on and off at the specified light channel number. If no light channel number is specified, on/off switching occurs at both light channel 1 and light channel 2.

When this command is executed, the value of the "iVY Light enable" parameter for the light is changed.

Explanation

<Light channel number>

The light channel number where the control is to occur can be specified using one of the numbers 1 or 2, or a variable.

Statement examples

LCONTROL (1) ON The Lighting 1 is turned on.

B=2

LCONTROL (B) OFF The Lighting 2 is turned off.

7.2.7.2 LCTRLMOD

● Command

LCTRLMOD	LCTRLMOD <i>mode number</i> LCTRLMOD (<i>light channel number</i>) = <i>mode number</i>
	The "iVY Light mode" parameter is changed.

Description

This command changes the "iVY Light mode" for the specified light channel number. If no light channel number is specified, the lighting control mode is changed for both light channel 1 and light channel 2.

When this command is executed, the value of the "iVY Light mode" parameter for the light is changed.

Explanation

<Mode number>

The mode number to specify the lighting "control mode" can be specified using either 0 or 1, or a variable.

0Coutinuous light mode

1Strobe light mode

<Light channel number>

The light channel number where the control is to occur can be specified using either 1 or 2, or a variable.

Statement examples

LCTRLMOD (1) = 0..... The control mode of channel 1 light is changed to Coutinuous light mode.

A=2

B=1

LCTRLMOD (A) = B The control mode of channel 2 light is changed to Strobe light mode.

● Function

LCTRLMOD	LCTRLMOD (<i>light channel number</i>)
	The "iVY Light mode" parameter is obtained.

Description

This function obtains the "iVY Light mode" parameter of the specified light.

If the specified channel's "iVY Light mode" parameter setting is "continuous lighting mode", this returns 1. If it is "strobe lighting mode", it returns 2.

Explanation

<Light channel number>

The light channel number that will be controlled can be specified using one of the numbers 1 or 2, or a variable.

Statement examples

A = LCTRLMOD (1) The value of the "iVY Light mode" parameter for light channel 1 is assigned to variable A.

B=2

A = LCTRLMOD (B) The value of the "iVY Light mode" parameter for light channel 2 is assigned to variable A.

7.2.7.3 LIGHTHZ

● Command

LIGHTHZ	LIGHTHZ PWM modulated light frequency LIGHTHZ (<i>light channel number</i>) = PWM modulated light frequency
	The "iVY Light Hz" parameter of specified light channel is changed.

Description

This command changes the "iVY Light Hz" parameter for the light of specified light channel number. If no light channel number is specified, the PWM modulated light frequency is changed for the lights of both channel 1 and channel 2.

When this command is executed, the value of the PWM modulated light frequency is changed for the specified light channel.

Explanation

<PWM modulated light frequency>

The PWM modulated light frequency for the light can be specified using one of the numbers 0 or 1, or a variable.

0 62.5 kHz

1 125 kHz

<Light channel number>

The light channel number that will be controlled can be specified using one of the numbers 1 or 2, or a variable.

Statement examples

LIGHTHZ (1) = 0 The PWM modulated "iVY Light Hz" parameter of the light channel 1 is changed to 62.5 kHz.

A=2

B=1

LIGHTHZ (A) = B The PWM modulated "iVY Light Hz" parameter of the light channel 2 is changed to 125 kHz.

● Function

LIGHTHZ	LIGHTHZ (<i>light channel number</i>)
	The "iVY Light Hz" parameter of specified light channel is obtained.

Description

This function obtains the "iVY Light Hz" parameter of the specified light channel

This returns 0 if the "iVY Light Hz" parameter value for the specified light channel is 62.5 kHz; it returns 1 if the parameter value is 125 kHz.

Explanation

<Light channel number>

The light channel number that will be controlled can be specified using one of the numbers 1 or 2, or a variable.

Statement examples

A = LIGHTHZ (1) The specified value of the "iVY Light Hz" parameter for channel 1 light is assigned to variable A.

B=2

A = LIGHTHZ (B) The specified value of the "iVY Light Hz" parameter for channel 2 light is assigned to variable A.

7.2.7.4 LSTRBTIM

● Command

LSTRBTIM	LSTRBTIM <i>light emission time</i> LSTRBTIM (<i>light channel number</i>) = <i>light emission time</i>
The "iVY Light strobe time" parameter is changed.	

Description

This command changes the strobe lighting mode's "light emission time" (units: μ s).

When this command is executed, the value of the "iVY Light strobe time" parameter is changed.

Explanation

<Light emission time>

The light emission time can be specified using one of the numbers 10 to 200000 (units: μ s) or a variable.

<Light channel number>

The light channel number where the control is to occur can be specified using one of the numbers 1 or 2, or a variable. If not specifying this number, the light emission time is changed for both light channel 1 and light channel 2.

Statement examples

LSTRBTIM (1) = 16500..... The "light emission time" at the channel 1 Lighting is changed to 16500 μ s.

A=2

B=20000

LCONTROL (A) = B The "light emission time" at the channel 2 Lighting is changed to 20000 μ s.

● Function

LSTRBTIM	LSTRBTIM (<i>light channel number</i>)
The "iVY Light strobe time" parameter is obtained.	

Description

This function obtains the "iVY Light strobe time" parameter.

It returns the light emission time (units: μ s) when used in strobe lighting mode.

Explanation

<Light channel number>

The light channel number where the control is to occur can be specified using one of the numbers 1 or 2, a variable.

Statement examples

A = LSTRBTIM (1) The value of the "iVY Light strobe time" parameter for channel 1 light is assigned to variable A.

B=2

A = LSTRBTIM (B) The value of the "iVY Light strobe time" parameter for light channel 2 is assigned to variable A.

7.2.7.5 LSYNCCH

● Command

LSYNCCH	<p><i>LSYNCCH synchronized camera parameter</i> <i>LSYNCCH (light channel number) = synchronized camera parameter</i></p>
	The "iVY Light sync camera ch" parameter is changed.

Description

This command changes the "iVY Light sync camera ch" parameter that specifies which cameras synchronize with the light channel. If no light channel number is specified, the parameter is changed for both light channel 1 and light channel 2. When this command is executed, the value of the "iVY Light sync camera ch" parameter is changed.

Explanation

<Synchronized camera parameter>

The synchronized camera parameter for the light can be specified using one of the numbers 0 to 65535, or a variable. (Use 16 bits to specify the camera numbers that synchronize with the lighting, and convert this to a decimal value to specify it.)

Example

Camera channel numbers that synchronize with lighting	16 bits	Synchronized cameras parameter
1Ch, 2Ch	0000 0000 0000 0011	3
1Ch, 4Ch, 10Ch, 16Ch	1000 0010 0000 1001	33289
1Ch to 16Ch	1111 1111 1111 1111	65535

<Light channel number>

The light channel number that will be controlled can be specified using one of the numbers 1 or 2, or a variable.

Statement examples

LSYNCCH (1) = 1 The parameter for the cameras that synchronize with light channel 1 is changed to 1.

A=2

B=15

LSYNCCH (A) = B The parameter for the cameras that synchronize with light channel 2 is changed to 15.

● Function

LSYNCCH	<p><i>LSYNCCH (light channel number)</i></p>
	The "iVY Light sync camera ch" parameter is obtained.

Description

This function obtains the value for the "iVY Light sync camera ch" parameter in a decimal value.

Explanation

<Light channel number>

The light channel number whose settings are obtained can be specified using either 1 or 2, or a variable.

Statement examples

A = LSYNCCH (1) The parameter value for the cameras that synchronize with light channel 1 is assigned to variable A.

B=2

A = LSYNCCH (B) The parameter value for the cameras that synchronize with light channel 2 is assigned to variable A.

7.2.7.6 LVOLUME

● Command

LVOLUME	<p><i>LVOLUME lighting volume</i> <i>LVOLUME (light channel number) = lighting volume</i></p>
	The "iVY Light volume" parameter is changed.

Description

This command changes the continuous lighting mode's "the modulated light amount" (units: %). If no light channel number is specified, the lighting volume is changed for both light channel 1 and light channel 2.

When this command is executed, the value of the "iVY Light volume" parameter is changed.

Explanation

<Lighting volume>

The Lighting volume can be specified using one of the numbers 0 to 100 (units: %), or a variable.

<Light channel number>

The light channel number where the control is to occur can be specified using either 1 or 2, or a variable.

Statement examples

LVOLUME (1) = 70 The "lighting volume" is changed to 70% at light channel 1.

A=2

B=80

LVOLUME (A) = B..... The "lighting volume" is changed to 80% at light channel 2.

● Function

LVOLUME	<i>LVOLUME (light channel number)</i>
	The "iVY Light volume" parameter is obtained.

Description

This function obtains the "iVY Light volume" parameter.

The modulated light value (units: %) for "continuous lighting" mode of the specified light channel is returned.

Explanation

<Light channel number>

The light channel number where the control is to occur can be specified using either 1 or 2, or a variable.

Statement examples

A = LVOLUME (1)..... The value of the "lighting volume" parameter of channel 1 light is assigned to variable A.

B=2

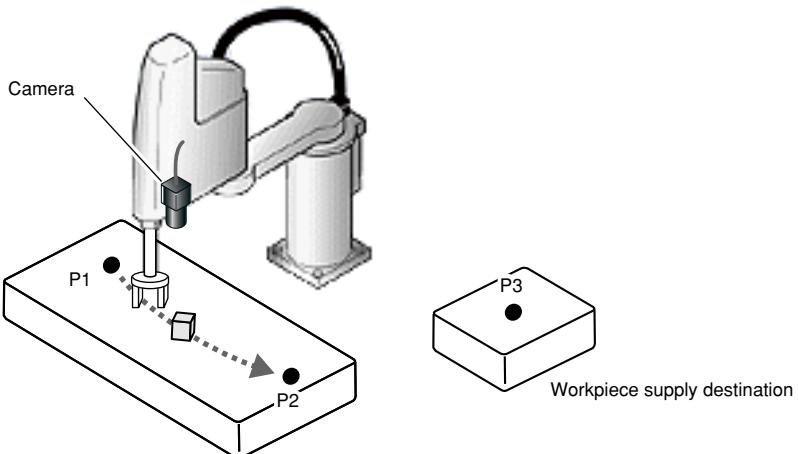
A = LVOLUME (B)..... The value of the "lighting volume" parameter of channel 2 light is assigned to variable A.

7.3 Sample programs

7.3.1 Pick & Place method using search function

■ Overview

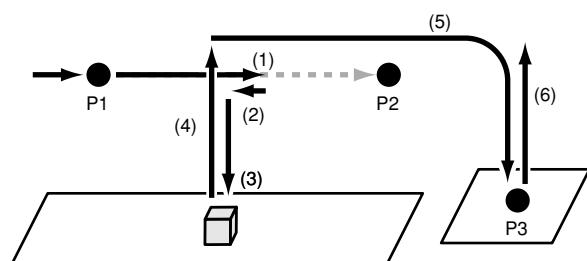
Searches for a workpiece between search start position (P1) and search end position (P2) while moving between those positions. The workpiece which was detected between P1 and P2 is picked up and placed at the workpiece supply destination (P3).



■ Prerequisites

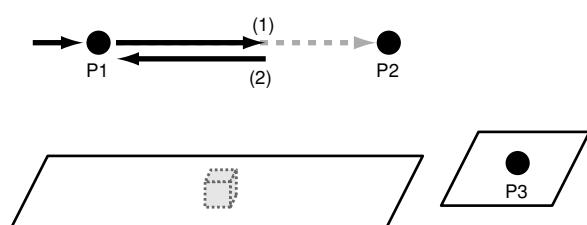
● Robot movement

► When a workpiece is detected



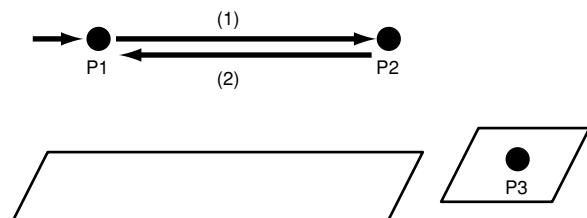
- (1) Rough search movement occurs between search start position (P1) and search end position (P2), and stops if a workpiece is detected.
- (2) A higher-precision search then occurs, and if a workpiece is detected, movement to that workpiece location occurs.
- (3) The Z-axis is lowered, and the workpiece is grasped.
- (4) The Z-axis is raised.
- (5) Arch motion to the workpiece supply destination (P3) then occurs, and the workpiece is released there.
- (6) The Z-axis is raised.

► When a workpiece is detected by the rough search, but not by the subsequent higher-precision search:



- (1) Rough search movement occurs between search start position (P1) and search end position (P2), and stops if a workpiece is detected.
- (2) A higher-precision search then occurs, and if a workpiece is not detected, movement to search start position (P1) occurs, and the search begins again.

► When no workpiece is detected:



- (1) Rough search movement occurs between start position (P1) and search end position (P2).
- (2) If no workpiece is detected at step (1) above, movement to search start position (P1) occurs, and the search begins again.

● Program used

MAIN_PGM... The program (main task) that executes the robot operation and the higher-precision search.

SUB_PGM... The program (sub task) that executes the rough search.

● Points used

P1... Search start position

P2... Search end position

P3... Workpiece supply destination

● Input/output signals used

Output signal description		Output signal status	
		1	0
DO(20)	Workpiece pick-and-place command	Grasp	Release

● Other

- The camera is mounted on robot 2nd arm.
- "Ch.1" is used as the camera channel number.
- Information concerning the workpiece to be detected is registered at model number 2.
- The robot Z-axis height is 100.0 mm at the point where the workpiece is grasped.
- The calibration data is registered at camera calibration number 0.

■ Sample program

Program name <MAIN_PGM>

```
*ST: ..... Label definition
MOVE P,P1..... Movement to P1
SCAN_RET%=0
START <SUB_PGM>,T2..... Start the search task (sub task)
MOVE P,P2,S=10,STOPON SCAN_RET%=1 .... Stop if workpiece is detected while moving to P2.
IF SCAN_RET%=0 THEN ..... If no workpiece is detected,
    CUT T2 ..... End the search task
    GOTO *ST..... Jump to label *ST (perform search again from beginning)
ENDIF
WAIT ARM..... Wait for robot operation end
VSEARCH 1, 2, 0 ..... Perform higher-precision search (camera Ch.1, model number 2,
                     camera calibration number 0)
IF VGETCNT>0 THEN ..... If workpiece is detected,
    MOVE P,VGETPOS (0) ..... Move to detected workpiece position
    DRIVE (3, 100.0)..... Lower Z-axis to 100.0mm height.
    DO(20)=1..... Grasp the workpiece
    DRIVE (3, 0.0) ..... Raise Z-axis to 0.0mm height
    MOVE P,P3,Z=0.0 ..... Perform arch motion movement to P3
    DO(20)=0..... Release the workpiece
    DRIVE (3, 0.0) ..... Raise Z-axis to 0.0mm
    HALT
ENDIF
GOTO *ST ..... Jump to label *ST (search for next workpiece)
```

Program name <SUB_PGM>

```
* WORK_SCAN:..... Label definition
VSEARCHR 1, 2, 0 ..... Perform rough search (camera Ch.1, model number 2, camera
                      calibration number 0)
IF VGETCNT>0 THEN ..... If workpiece is detected,
    SCAN_RET%=1 ..... Activate "search end" flag
    EXIT TASK..... End search task
ENDIF
GOTO *WORK_SCAN..... Jump to label *WORK_SCAN (repeat search)
```

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1. RCXiVY2+ Studio overview

1.1 RCXiVY2+ Studio

RCXiVY2+ Studio is support software for the RCXiVY2+ system.

The RCXiVY2+ system is used to resister the workpiece date at the RCXiVY2+ unit using RCXiVY2+ Studio in advance, and recognize the image of the workpiece according to the data.

RCXiVY2+ Studio offers the following 4 functions:

- **Model registration**

Registers workpiece data at the RCXiVY2+ unit.

- **Search**

Searches the camera's captured images, and images saved to memory, to find registered models (workpieces).

- **Fiducial mark registration**

Registers (at RCXiVY2+ unit) the fiducial mark data required for camera calibrations.

- **Monitoring**

Allows the operator to monitor workpiece search conditions and camera calibration setting related fiducial mark search conditions during automatic robot operation.

In order to use the RCXiVY2+ system, the model workpieces must first be registered at RCXiVY2+ Studio. After registering the model workpieces, perform a search to verify that these models are detected without problem. Next, register the fiducial marks at RCXiVY2+ Studio. After completing the model workpiece and fiducial mark registration procedures, specify the camera calibration settings at the robot controller. When all the required settings have been made, the robot program can be executed to perform automatic robot operation.

For details concerning basic preparation procedures from the point when RCXiVY2+ Studio is purchased, until it is operated, refer to "1.2 Preparations for RCXiVY2+ Studio use".



NOTE

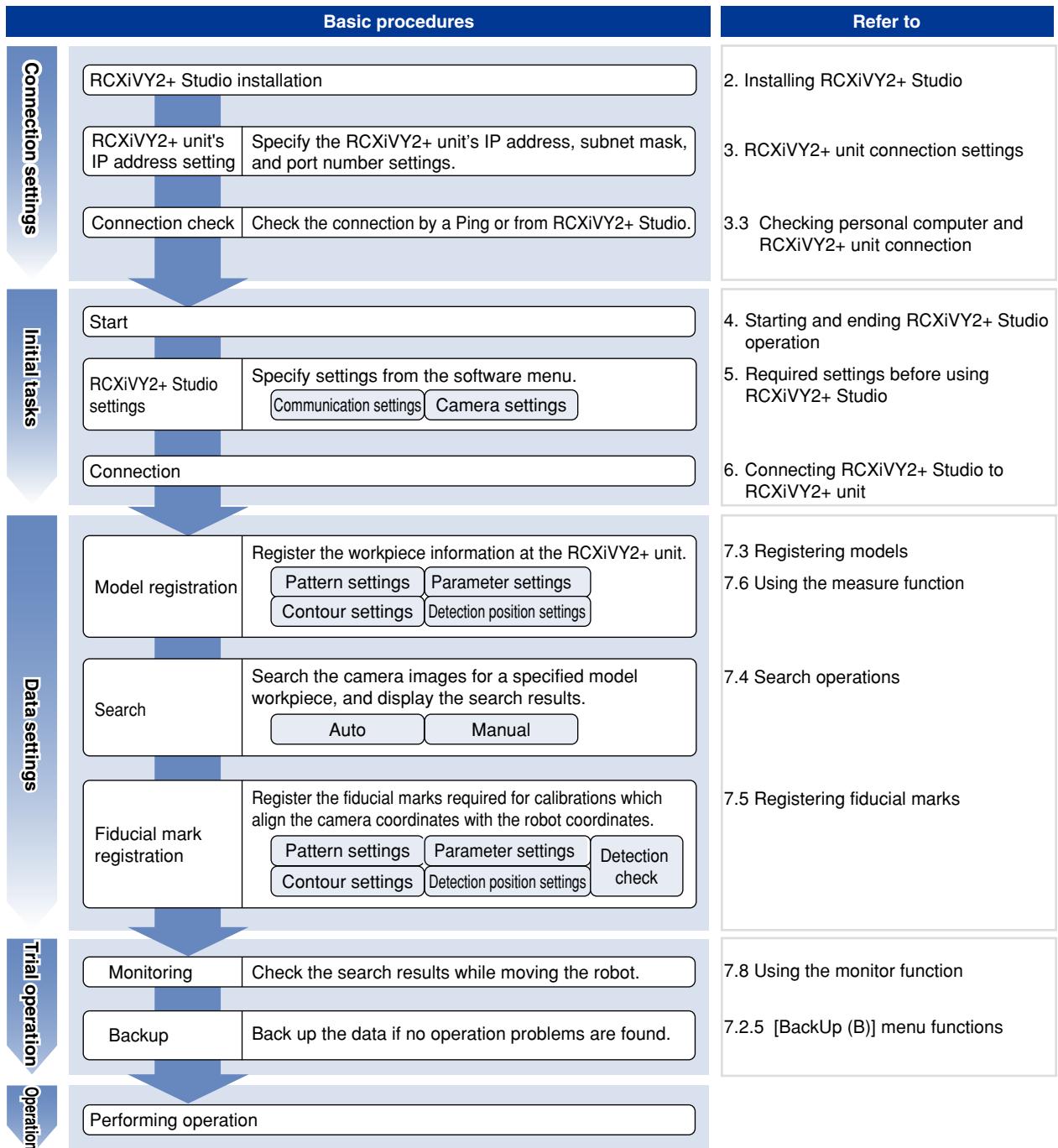
In order to use the RCXiVY2+ system, dedicated robot language commands must be written into the program.

TIP

"Camera calibration" refers to the process in which the coordinates (camera coordinates) of the image acquired by the camera are aligned with the robot coordinates.

1.2 Preparations for RCXiVY2+ Studio use

This section explains the basic preparation procedures from the point when the RCXiVY2+ Studio is purchased, until it is operated. See the illustration given below.



2. Installing RCXiVY2+ Studio

2.1 Items to check before the installation

Before installing RCXiVY2+ Studio, verify that the operating environment of the personal computer where the installation is to occur satisfies the following requirements.

OS	: Microsoft Windows XP / Vista (32 bit / 64 bit) / 7 (32 bit / 64 bit) / 8 (32 bit / 64 bit) / 8.1 (32 bit / 64 bit) / 10 (32 bit / 64 bit)
CPU	: Processor that meets or exceeds the suggested requirements for the OS being used.
Memory	: Suggested amount of memory or more for the OS being used.
Hard disk capacity	: 16MB of available space required on installation drive. * Additional vacant space is required for saving images and data.
Display	: 800 x 600 dot, or higher, 32768 colors (16bit High Color) or higher (recommended)
Communication Port	: Ethernet Port of TCP/IP
* Microsoft Windows XP, Windows Vista, Windows 7, Windows 8, Windows 8.1, and Windows 10 are registered trademarks of the Microsoft Corporation, USA.	
* Ethernet is a registered trademark of the XEROX Corporation, USA.	

2.2 RCXiVY2+ Studio installation procedure

In order to use RCXiVY2+ Studio, you must install RCXiVY2+ Studio on the PC.

The latest installer for RCXiVY2+ Studio can be obtained from the member site in Yamaha Robot Website:

<http://global.yamaha-motor.com/business/robot/>

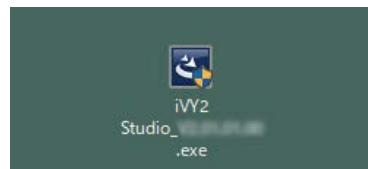


NOTE

It is required to register as a member to download RCXiVY2+ Studio from the member site.

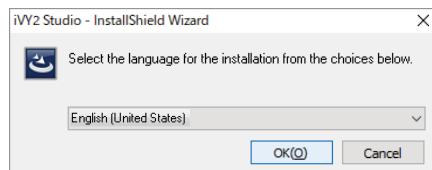
The following Steps describe how to install in a PC running on Windows 10.

step 1 *Exit all the currently-running programs on the PC.*



step 2 *Double-click the downloaded [RCXiVY2+ Studio] to start the setup program.*

The installer wizard shows a screen that lets you choose the display language. Choose the language to display on the wizard and then click (OK). Either (Japanese) or (English) can be chosen as the language.



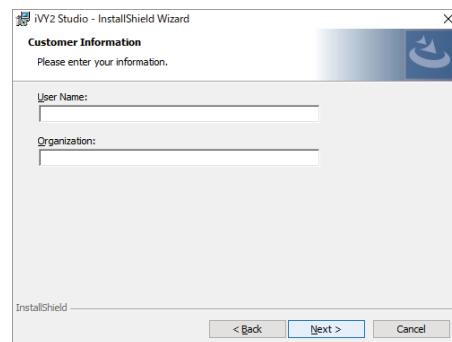
NOTE

- If you choose (English), all subsequent screens of the wizard are displayed in English.
- The language setting is also applied to updates and to the uninstall wizard screens.

Step3 Click [Next] at the [Welcome to the InstallShield Wizard for RCXiVY2+ Studio] screen.



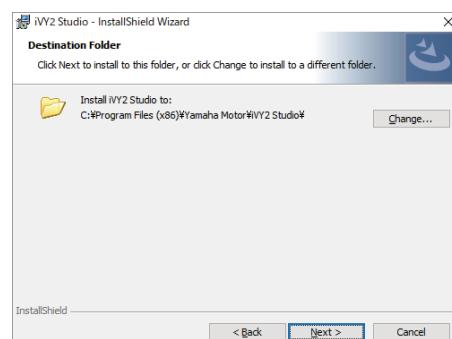
Step4 The [Customer Information] screen.
Enter your user name and organization, and click (Next).



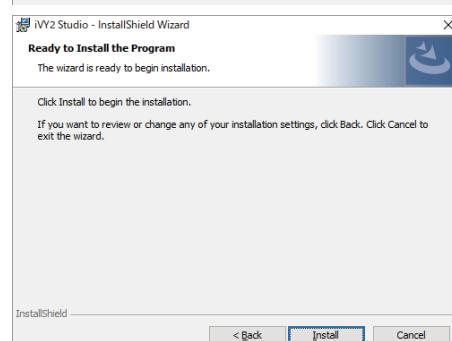
Step5 At the [Destination Folder] screen, specify the folder in which you want to install RCXiVY2+ Studio.

By default, (C:\Program Files\Yamaha Motor\RCXiVY2+ Studio\) is selected.

To change the installation destination, click (Change) and specify the installation destination. When you have finished specifying the installation destination, click (Next).



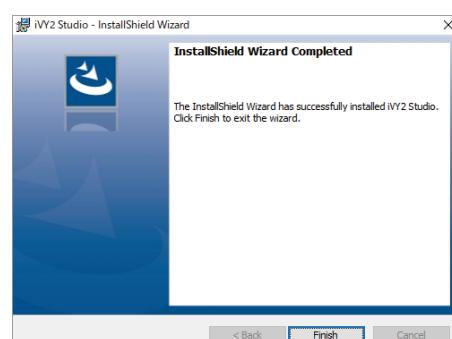
Step6 Installing begins by clicking [Install] on the screen.



Step7 The screen appears when installation is completed, click [Finish] to exit the wizard.

TIP

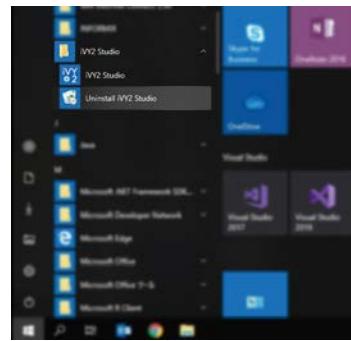
Depending on the PC settings, restarting is necessary.



2.3 Uninstalling RCXiVY2+ Studio

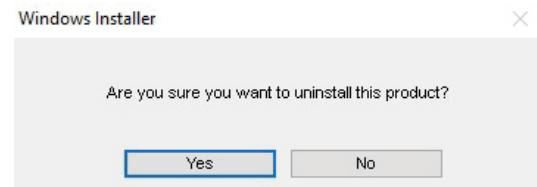
You can uninstall RCXiVY2+ Studio from your PC in either of the following two ways. The following Steps describe how to uninstall in a PC running on Windows 10.

- Step 1** Open [Start Menu] and click [RCXiVY2+ Studio].



- Step 2** Select [Uninstall RCXiVY2+ Studio].
Select the currently installed "iVY2 Studio".

- Step 3** Uninstall RCXiVY2+ Studio.
Follow the on-screen instructions to uninstall the RCXiVY2+ Studio.



2.4 Upgrading the RCXiVY2+ Studio version

When upgrading the RCXiVY2+ Studio version, be sure to uninstall the old-version RCXiVY2+ Studio first, then install the new version.

3. RCXiVY2+ unit connection settings

To connect RCXiVY2+ Studio to the RCXiVY2+ unit, it is necessary to set the RCXiVY2+ unit's IP address, subnet mask, and port number.

The RCXiVY2+ unit connection settings must be specified in the following order.

1. Verify the personal computer's IP address and subnet mask values.
2. Set the RCXiVY2+ unit's IP address, subnet mask, and port number.
3. Verify the connection between the personal computer and the RCXiVY2+ unit.

3.1 Checking personal computer's IP address and subnet mask

There are several kinds of personal computer's IP address checking procedures. This section describes how to check the personal computer's IP address from the command prompt with Windows 7 used as an example. Please read the following steps for your reference.

Step 1 Start up the command prompt.

Click (Start)-(All Programs)-(Accessories)-(Command Prompt).

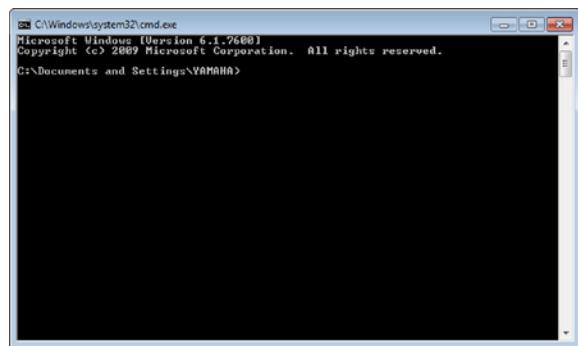
Step 2 Run the "ipconfig" command.

Following >, type "ipconfig" and press .

TIP

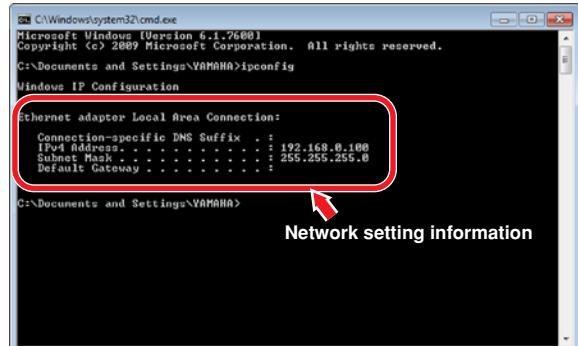
"ipconfig" is a command intended to display the network setting information on the command prompt.

Step 1 Starting up the command prompt



Step 3 The network setting information, such as IP address and subnet mask values, is displayed.

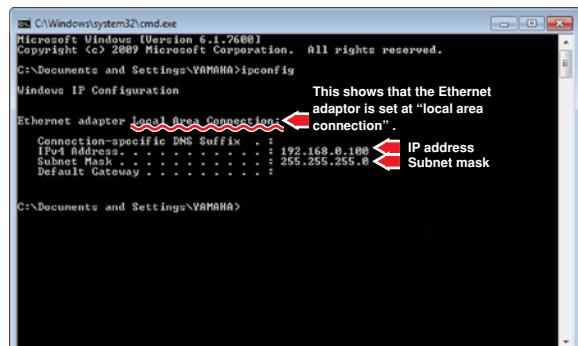
Step 3 Command prompt window (1)



Step 4 Check the setting information, and record the IP address and subnet mask values.

Step 4 Command prompt window (2)

1. Check that the Ethernet adaptor is set at "local area connection". If "local area connection" is not displayed, the network connection may conflict with other connection, such as wireless LAN. In this case, make other connection disabled or make the setting so that other connection can be shared.
2. Check the IP address and subnet mask values and record these set values. The values recorded here are used when setting the RCXiVY2+ unit's connection.



3.2 Setting RCXiVY2+ unit's communication

In order to connect RCXiVY2+ Studio with the RCXiVY2+ unit, it is necessary to specify the RCXiVY2+ unit's IP address, subnet mask, and port number.

Make these settings from RCXiVY2+ Studio.

Communication parameter settings on the RCXiVY2+ unit (server)

	Item name	Default sampling	Notes
1	IP Address	192.168.0.3	Specifies the IP address. The IP address is a number that is unique to each device, which is assigned in order to distinguish multiple devices that are connected on the network. This means that the IP address must be set and managed so that it does not conflict with the IP address of another device.
2	Subnet Mask	255.255.255.0	Selects the subnet mask. The subnet mask is used to divide the network in subunits.
3	PORT [*]	49200	Specifies the TCP port number of the controller. When the client connects to the robot controller, specify this port number together with the IP address.

* If changing the port, we recommend using a port number other than a well-known port (0 to 1023).



CAUTION

When connecting the RCXiVY2+ unit to an existing network, consult the network administrator regarding IP address and other settings.



NOTE

The IP address setting of the RCXiVY2+ unit is made based on the IP address of the computer itself.
IP address....Set the value of the lowest digit to a value other than that of the computer.

The IP address setting of the RCXiVY2+ unit is made from RCXiVY2+ Studio. The method of setting the IP address of the RCXiVY2+ unit is described below.



NOTE

For details on RCXiVY2+ Studio, refer to the YAMAHA Support Software RCXiVY2+ Studio User's Manual.

Step 1 Connect the computer and the robot controller.

Using a dedicated cable or Ethernet cable (category 5e or higher), connect the computer and the robot controller.



NOTE

For details on making the connection, refer to the robot controller manual.

Step 2 Start RCXiVY2+ Studio.

The RCXiVY2+ Studio window appears.

Step 4 [Settings] button



Step 3 Connect to the controller.



NOTE

For details on connecting to the controller, refer to the YAMAHA Support Software RCXiVY2+ Studio User's Manual.

Step 4 Select [Settings].

On the toolbar, from the menu item (RCXiVY2+), select (Settings).

Step 5 *Specify the IP address, subnet mask, and port number.*

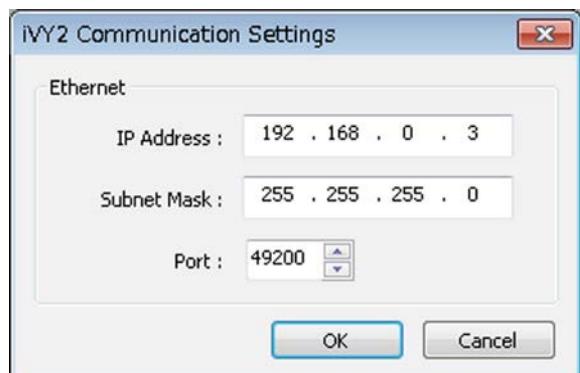
The RCXiVY2+ Communication Settings window appears. Specify the IP address, subnet mask, and port number, and then click (OK) to save the settings.

To discontinue without saving the settings, click (Cancel).

**NOTE**

The IP address setting of the RCXiVY2+ unit is made based on the IP address of the computer itself.

IP address: Set the value of the lowest digit to a value other than that of the computer.

Step 5 *iVY2 Communication Settings*

3.3 Checking personal computer and RCXiVY2+ unit connection

After checking the personal computer's IP address and subnet mask settings and finishing the RCXiVY2+ unit communication settings, verify that normal communication is enabled between the personal computer and the RCXiVY2+ unit.

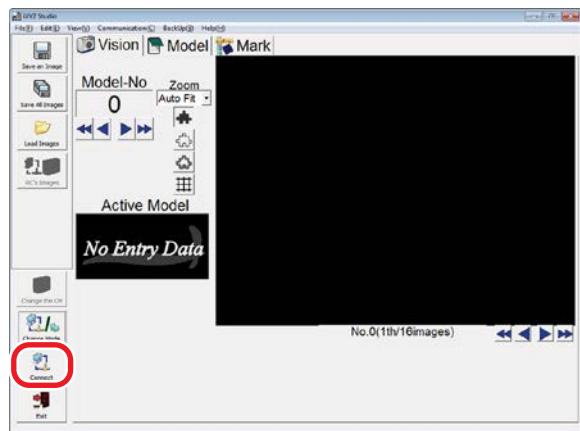
This communication status check can be performed by either of the following methods.

■ Check methods

- Connection check by RCXiVY2+ Studio
- Connection check by ping

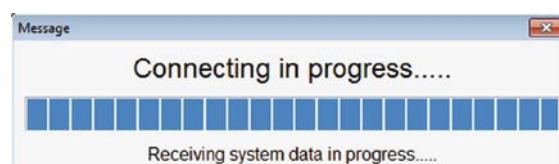
3.3.1 Connection check by RCXiVY2+ Studio

The communication status between the personal computer and RCXiVY2+ unit can be checked by starting RCXiVY2+ Studio. This procedure is given below.

Step 1 *Start RCXiVY2+ Studio.***Step 2** *Click [Connect].***Step 2** *iVY2 Studio initial window***Step 3** *Check the connection status.*

- When the "Connecting in progress..." message appears

Normal connection is possible.

Connection status check (1)

■ When a connection error appears

Normal communication may be disabled. Check the following points.

- Specify the RCXiVY2+ Studio communication settings, then check the connection status again.
For the RCXiVY2+ Studio communication setting procedure, refer to "5.1 Communication settings".
- Review the connection destination RCXiVY2+ unit's IP address setting, then check the connection status again.
For details concerning how to check and change the connection destination RCXiVY2+ unit's IP address, refer to "3.2 Setting RCXiVY2+ unit's communication".
- Review the connection destination RCXiVY2+ unit's subnet mask setting, then check the connection status again.
For details concerning how to check and change the connection destination RCXiVY2+ unit's subnet mask, refer to "3.2 Setting RCXiVY2+ unit's communication".
- Check that the connection destination RCXiVY2+ unit's port number is not duplicated with other software's port number. When necessary, change the port number in a range of 49152 to 65535. After that, check the connection status again.
For details concerning how to check and change the RCXiVY2+ unit's port number, refer to "3.2 Setting RCXiVY2+ unit's communication".
- Check that the personal computer's local area connection is enabled, then check the connection status again.
For details concerning how to check the personal computer's local area connection, refer to "3.1 Checking personal computer's IP address and subnet mask".
- Verify that the Ethernet crossover cable is connected, then check the connection status again.

Connection status check (2)



3.3.2 Connection check by ping

The ping method can also be used to check if normal communication is possible between the personal computer and RCXiVY2+ unit.



NOTE

Ping is a standard network diagnosis tool built in to the OS.

The simple Windows 7 method for using Ping is explained below for reference purposes.

Step 1 Start the command prompt.

Select (Start) – (All Programs) – (Accessories)
– (Command Prompt).

Step 1 Starting the command prompt

```
C:\Windows\system32\cmd.exe
Microsoft Windows [Version 6.1.7601]
Copyright © 2009 Microsoft Corporation. All rights reserved.
C:\Documents and Settings\YAMAHA>
```

Step 2 Execute the ping command.

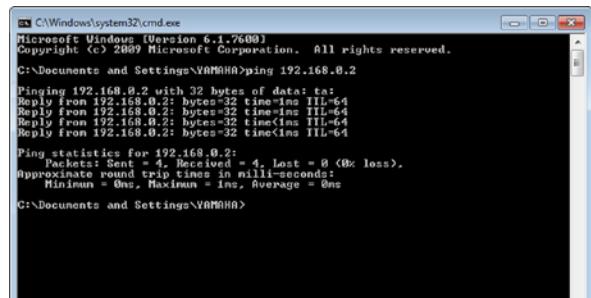
After the ">" prompt, enter "ping xxx.xxx.xxx.xxx", then press the (Enter) key. Enter the RCXiVY2+ unit's IP address as the "xxx.xxx.xxx.xxx" data.

In this example, the following is entered: "ping 192.168.0.2".

Step 3 *Information which indicates the time required for reception, etc., is displayed.*

This information is displayed if the communication status is normal.

Step 3 *When normal communication is established*



```
C:\Windows\system32\cmd.exe
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.
C:\Documents and Settings\YAMAHA>ping 192.168.0.2

Pinging 192.168.0.2 with 32 bytes of data: t=
Reply from 192.168.0.2: bytes=32 time<1ms TTL=64

Ping statistics for 192.168.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

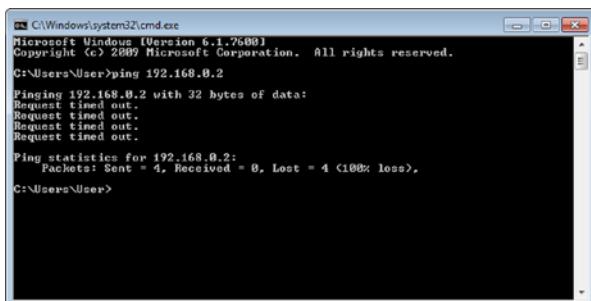
C:\Documents and Settings\YAMAHA>
```

A message such as "Request time out." appears if a normal communication cannot be established.

If this occurs, revise the connection destination RCXiVY2+ unit's IP address communication setting, etc., then check the status again.

For details concerning how to check or change the RCXiVY2+ unit's communication setting, refer to "3.2 Setting RCXiVY2+ unit's communication".

Step 3 *When normal communication is not established*



```
C:\Windows\system32\cmd.exe
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.
C:\Users\User>ping 192.168.0.2

Pinging 192.168.0.2 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.0.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
    C:\Users\User>
```

4. Starting and ending RCXiVY2+ Studio operation

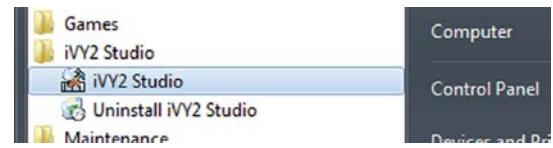
4.1 Starting RCXiVY2+ Studio operation

The procedure for starting RCXiVY2+ Studio operation is given below. The starting instructions given here apply to a computer which is running Windows 7.

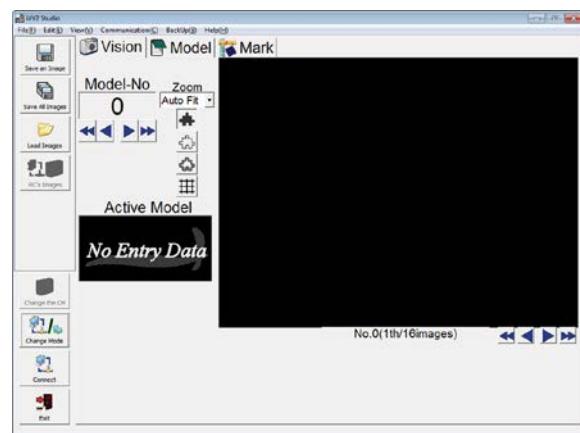
Step 1 Start RCXiVY2+ Studio.

Select (Start) – (All Programs) – (RCXiVY2+ Studio) – (RCXiVY2+ Studio).

▶ **Step 1 Start window in Windows 7**



Step 2 The RCXiVY2+ Studio window appears. ▶ **Step 2 iVY2 Studio start window**



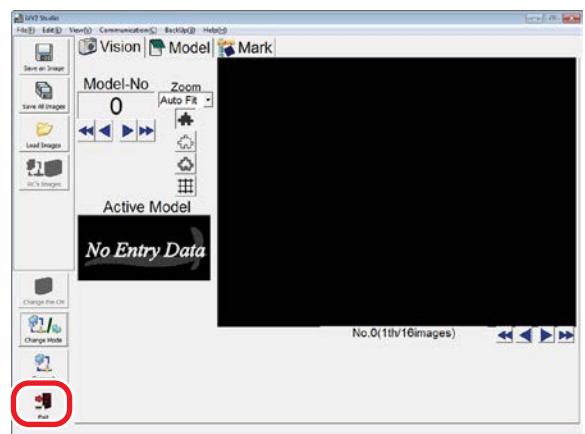
4.2 Ending RCXiVY2+ Studio operation

■ The procedure for ending RCXiVY2+ Studio operation is given below.

Step 1 Click [Exit].

Click (Exit) at the left-side toolbar.

► **Step 1 Ending iVY2 Studio operation**

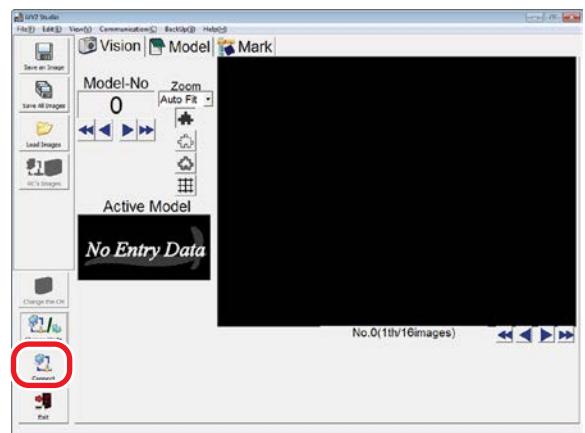


■ The procedure for ending only communication is given below.

Step 1 Kick [Disconnect].

Click (Disconnect) at the left-side toolbar.

► **Step 1 Ending iVY2 Studio operation**



5. Required settings before using RCXiVY2+ Studio

Communication and camera settings must be specified before RCXiVY2+ Studio can be used.

The communication settings must be specified before RCXiVY2+ Studio is connected to the RCXiVY2+ unit, and the camera settings are to be specified after connecting RCXiVY2+ Studio to the RCXiVY2+ unit.

5.1 Communication settings

The communication settings consist of the connection destination RCXiVY2+ unit information (IP address, subnet mask, port number).

For details concerning how to check the connection destination RCXiVY2+ unit's IP address, subnet mask, and port number, refer to "3.2 Setting RCXiVY2+ unit's communication".

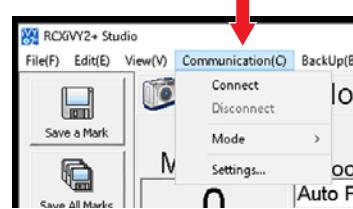


NOTE

The communication settings must be specified before connecting RCXiVY2+ Studio to the RCXiVY2+ unit.

Step 1 From the [Communication (C)] menu, select [Settings].

▶ **Step 1** [Communication (C)] - [Settings]



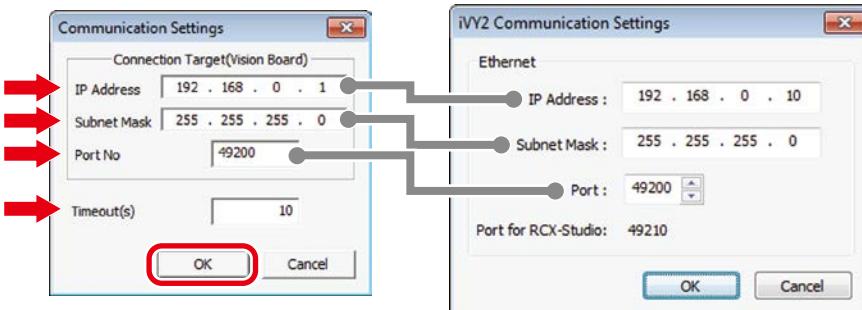
Step 2 Specify the connection destination RCXiVY2+ unit information, then click [OK].

The communication settings window then appears.

Enter the connection destination RCXiVY2+ unit information. In the "Timeout" field, enter the number of seconds until the RCXiVY2+ Studio connection is disconnected forcibly if no response is returned from the vision board.

To quit the setting operation, click (Cancel).

▶ **Step 2** Communication settings window



5.2 Camera settings

The camera settings consist of the camera information (trigger mode, exposure time, timeout, sort method).



NOTE

The camera settings are specified after connecting RCXIVY2+ Studio to the robot controller.

Step 1 From the [File (F)] menu, select [Set Camera].

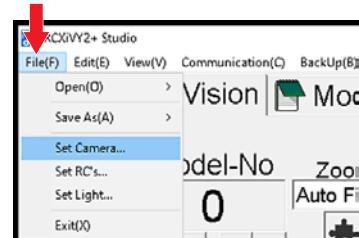


NOTE

(Set Camera) can be set only while connected.

▶ Step 1

The [File (F)] – [Set Camera] menu window



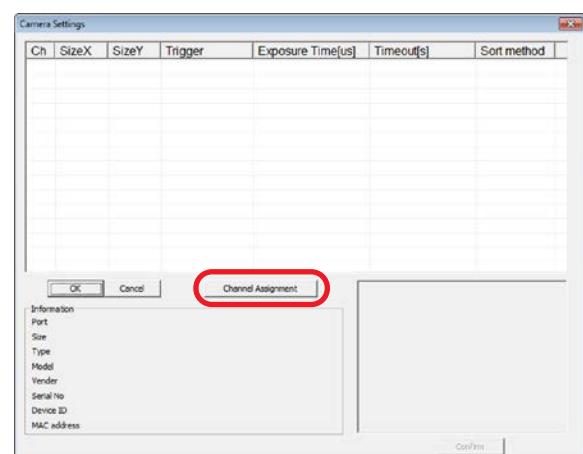
Step 2 In the Camera Settings window, click [Channel Assignment].

The Camera Settings window appears.

Since you need to assign channels to the cameras, click (Channel Assignment).

▶ Step 2

Camera Settings window
(camera channel unassigned)



Step 3 Assign a channel to each camera, and click [OK].

The camera channel assignment window appears.

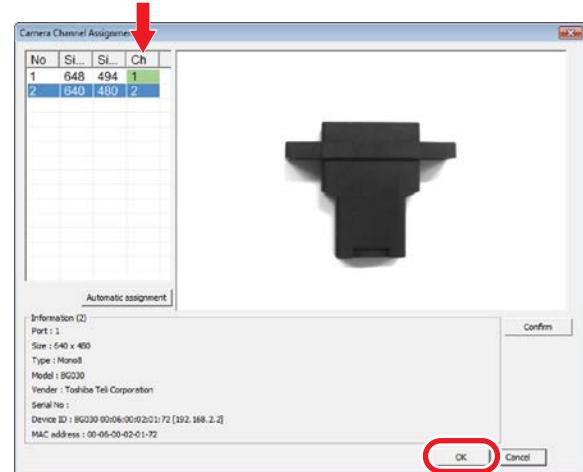
A list of the connected cameras appears. In the Ch column select the camera channel. A camera channel in the range of 1 to 16 can be selected, and a channel that is already selected for another camera cannot be selected.

When clicking (OK), the selected camera channels are assigned.

To discontinue without assigning camera channels, click (Cancel).

▶ Step 3

Camera Channel Assignment window
(camera channel unassigned)



NOTE

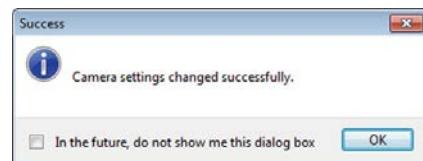
- If you click (Automatic assignment), the camera channels are assigned automatically.
- When you select a camera in the list, information of the selected camera is shown in the Information field.
- When you select a camera in the list, the (Confirm) button becomes active; if you click (Confirm), the image of the selected camera is displayed.
- While the camera image is displayed, other operations cannot be performed until (Capture) is clicked.

Step 4 Complete the camera channel assignments.

When the camera channel assignments have been set successfully, the following window appears.

Click (OK) to complete the camera channel assignments.

Step 4 Camera channel assignment completed



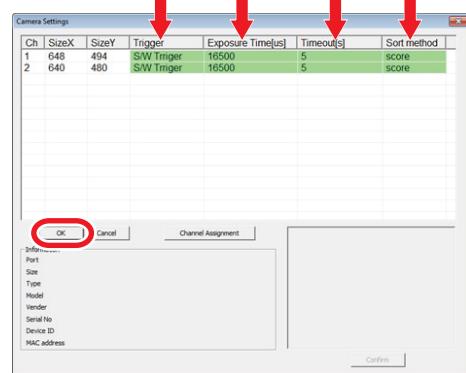
Step 5 Make settings for the cameras, and click [OK].

The Camera Settings window shows the cameras to which camera channels are assigned.

Set the trigger mode, exposure time, timeout, and sort method. For details on the trigger mode, exposure time, timeout, and sort method, refer to A RCXiVY2+ SYSTEM EXPLANATION SECTION "4.5 RCXiVY2+ Studio camera settings".

To discontinue camera settings, click (Cancel).

Step 5 Camera Settings window (camera channels unassigned)



NOTE

- When you select a camera in the list, information for the selected camera is displayed in the Information field.
- When you select a camera in the list, the (Confirm) button becomes active; if you click (Confirm), the image of the selected camera is displayed in the camera image display area.
- While the camera image is displayed, other operations cannot be performed until (Capture) is clicked.

Step 6 End the camera settings operation.

The following window appears if the camera settings have been changed successfully.

Click (OK) to end the camera settings operation.

Step 6 Ending the camera settings operation



CAUTION

If the camera for which settings were made is not connected when the controller is restarted, the camera channel settings are cleared.

5.3 RC settings

In RC settings, specify the display output when outputting from the RCXiVY2+ unit's DIV output connector to a monitor.

Step 1 On the [File (F)] menu, choose [Set RC's].

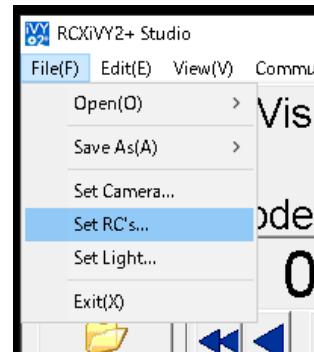


NOTE

(Set RC's) is available only while connected.

▶ Step 1

[File (F)] - [Set RC's...]



Step 2 Make RC settings, and click [OK].

The RC's Settings window appears.

The display layout specifies the display layout when outputting from the RCXiVY2+ unit's DIV output connector to a monitor. (I- Channel 1) and (I- Channel 2) are shown only if selecting (Specify 2 Channels) as the display layout. Specify the channel of the camera that will provide the monitor output. To discontinue RC settings, click (Cancel).

Menu	Submenu	Function
Display Layout	Newest image	The most recent image captured by the camera is output to the monitor.
	Specify 2 Channels	Specifies the camera channels that are output to the monitor; the most recent images captured by the selected cameras are output to the monitor.
	Newest + Previous	The most recent image captured by the camera and the previous image are output to the monitor.
	Newest + Newest NG	The most recent image captured by the camera, and the most recent image that was determined to be NG, are output to the monitor.
I- Channel 1		Selects the camera that is output to channel 1.
I- Channel 2		Selects the camera that is output to channel 2.

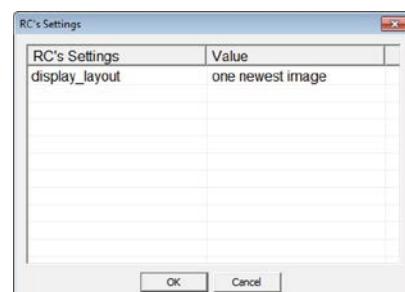


NOTE

NG occurs if not even one workpiece is detected when a search is executed, or if the system failed to capture an image.

▶ Step 2

RC's Settings window

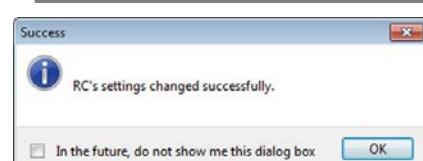


Step 3 Complete the RC settings.

When the RC settings are changed successfully, the following window appears. Click (OK) to complete the RC settings.

▶ Step 3

Completion of the RC settings



5.4 Light settings

Here you can specify settings for lighting (mode, frequency, type, light volume, time, and camera to be synchronized). Light settings can be made only while connected.

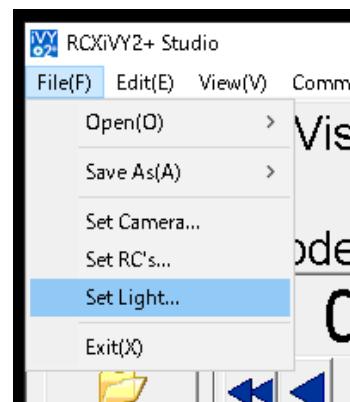
Step 1 On the [File (F)] menu, choose [Set Light].



NOTE
(Set Light) can be set only while connected.

▶ Step 1

[File (F)] - [Set Light]



Step 2 Specify the various light settings, and click [OK].

The light settings window appears.

For details on the mode, frequency, type, light volume, time, and camera to be synchronized, refer to A RCXiVY2+ SYSTEM EXPLANATION SECTION "5.4 Lighting control board parameter settings".

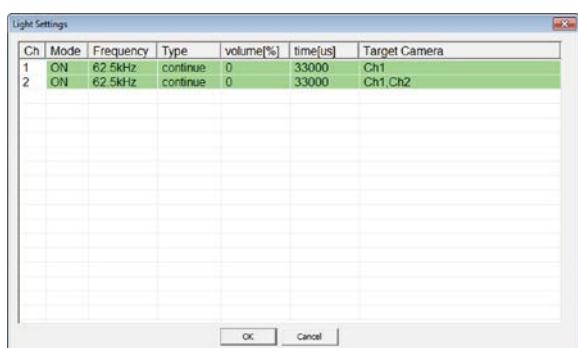
To discontinue the light settings, click (Cancel).



NOTE
Only a camera that is assigned to a camera channel can be selected as a camera to synchronize.

▶ Step 2

Light Settings window

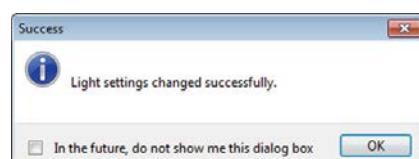


Step 3 Complete the light settings.

When the light settings were changed successfully, the following window appears. Click (OK) to complete the light settings.

▶ Step 3

Completion of the light settings



6. Connecting RCXiVY2+ Studio to RCXiVY2+ unit

Before connecting RCXiVY2+ Studio to the RCXiVY2+ unit, check the following points.

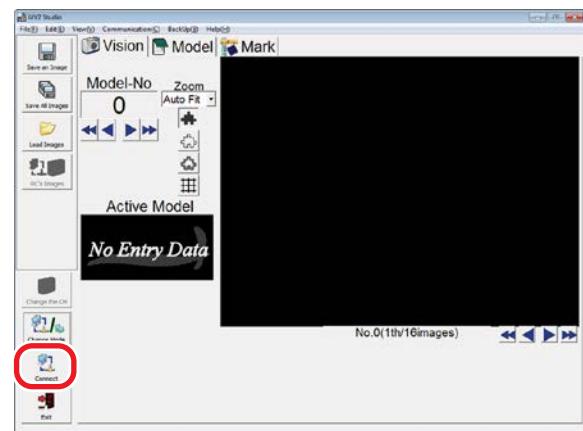
- Are the RCXiVY2+ unit and personal computer connected by an Ethernet crossover cable?
For details concerning this Ethernet crossover cable connection, refer to A RCXiVY2+ SYSTEM EXPLANATION SECTION "3.2.1.4 Wiring to the personal computer connector".
- Is the personal computer's local area connection enabled?
For details concerning how to check the personal computer's local area connection, refer to "3.1 Checking the personal computer's IP address and subnet mask".

6.1 RCXiVY2+ Studio and RCXiVY2+ unit connection procedure

Step 1 Click [Connect].

Click (Connect) at the window's left-side toolbar.

▶ Step 1 RCXiVY2+ Studio and RCXiVY2+ unit connection



If camera settings have not been made, a message appears. Click (OK) to make the Camera Settings window appear, and make camera settings. Refer to "5.2 Camera settings" for detail.

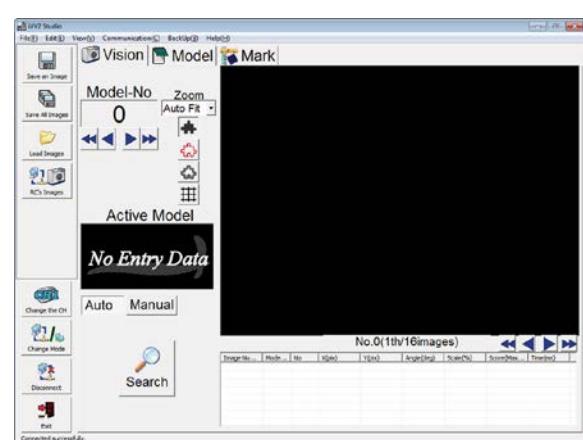
▶ Step 1 "The camera is not set" message



Step 2 Switch between mode windows.

- If RCXiVY2+ Studio is in Edit mode
Vision mode, Model mode, or Mark mode window appears.

▶ Step 2 Vision mode window

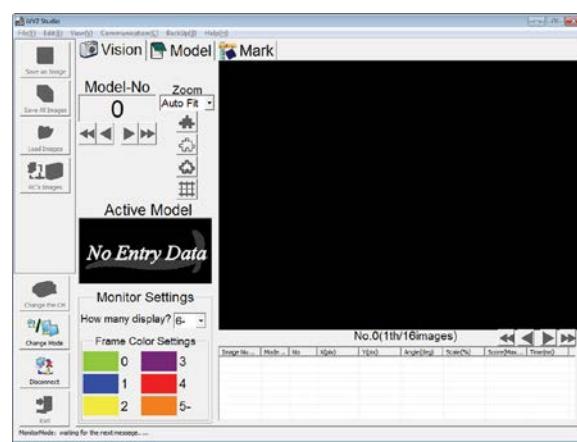


CAUTION

If RCXiVY2+ Studio is in Edit mode, and the RCXiVY2+ engine version does not match the RCXiVY2+ Studio version, a warning message is displayed at the time of connection. In this case, the functions of RCXiVY2+ Studio might not operate correctly.

- When RCXiVY2+ Studio is in Monitor mode
The Monitor mode window appears.
In Monitor mode, the message "Monitor Mode" is displayed in the lower left of the window.

▶ Step 2 Monitor mode window



NOTE

Connection may be unstable in systems with multiple Ethernet ports. Unused ports should therefore be set as "disable". To disable unused ports, go to (Control Panel)-(Network and Sharing Center)-(Change Adaptor Settings), double-click the connection name, and then click (Disable) (on Windows 7). To enable the port, double-click the disabled connection.

7. Using RCXiVY2+ Studio

RCXiVY2+ Studio has two main modes and six subordinate modes. The names and functions of each modes are given below.

The modes used under the Edit mode.

Vision mode	Performs the test search of the workpiece using the search settings that have been registered in the Model registration mode.
Model mode	Registers the workpiece search settings using the edge search.
Mark mode	Registers the search settings of fiducial mark necessary for the camera calibration.
Measurement mode	Registers the measurement function settings based on the search settings that have been registered in the Model mode.
Blob mode	Registers the workpiece search settings using the blob search.

The modes used under the Monitor mode.

Monitor mode	Checks the search status during robot automatic operation or calibration setting.
---------------------	---

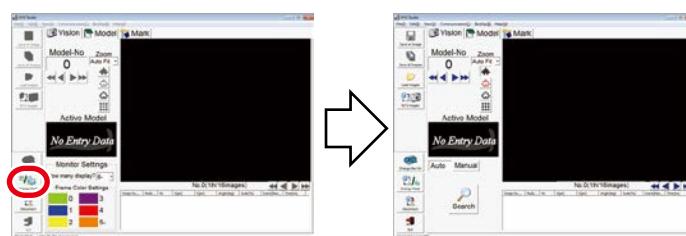
When selecting a mode other than the Monitor mode, set RCXiVY2+Studio to the Edit mode. When RCXiVY2+Studio is in the Monitor mode, click the [Change Mode] button to switch to the Edit mode.

7.1 Basic operations

7.1.1 Switching modes

■ Switching between Edit mode and Monitor mode

To switch between the Edit mode and Monitor mode, click the [Change Mode] button.



■ Switching to each mode in Edit mode

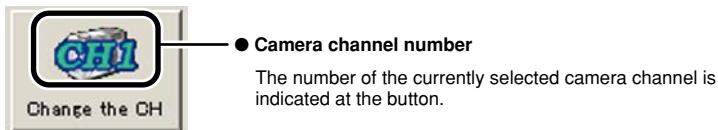
To switch to the Vision mode, Model registration mode, Measurement function mode, or Blob mode, click the relevant tab at the top of the screen.

The mode of the foremost tab is the currently selected mode.



7.1.2 Switching camera channel

The selected camera channel can be changed by clicking [Change the CH] at the window's left-side toolbar. Select the camera channel which is to be used. The number of the currently selected camera channel is indicated at the button. This operation cannot be performed in Monitor mode.

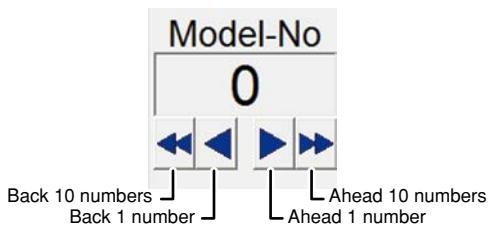


7.1.3 Changing a model number or mark number

A model number can only be changed in Vision and Model modes. A mark number can only be changed in Mark mode. Neither of these operations can be performed in Monitor mode.

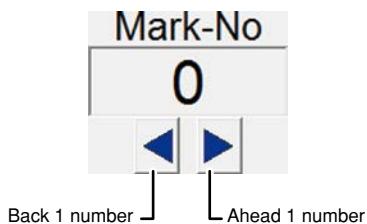
■ Changing a model number

Change a model number by clicking the arrow buttons located beneath it. The model number range is 0 to 253.



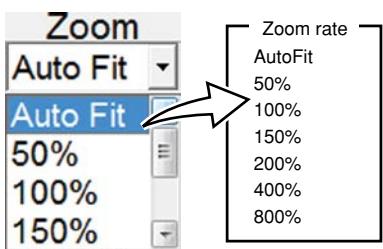
■ Changing a mark number

Change a mark number by clicking the arrow buttons located beneath it. The mark number range is 0 or 1.



7.1.4 Changing the display zoom setting

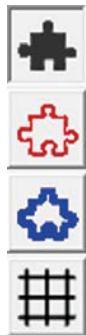
The display zoom setting can be changed to display an image at the specified zoom level. If set to "Auto Fit", the zoom setting is automatically determined according to the image size.



7.1.5 Switching the display

The display switching buttons located beneath the zoom setting area can be clicked to turn each of the displays (background, edge, contour, and grid) off and on. This operation is not possible in Monitor mode.

■ Switching the display (Vision mode / Model mode / Measurement mode)



- Background
Turns the acquired image display on and off.
- Edge
Turns the extracted edge display on and off.
- Contour
Turns the contour (specified by the contour setting) display on and off.
- Grid
Turns the grid display on and off.
A red cross-hairs displays when the grid display is turned on, indicating the center position of the display screen.

Example: The background display can be turned off and the edge display turned on to enable easy checking of the extracted edge. Use these buttons to check settings and results.

■ Switching the display (Blob mode)



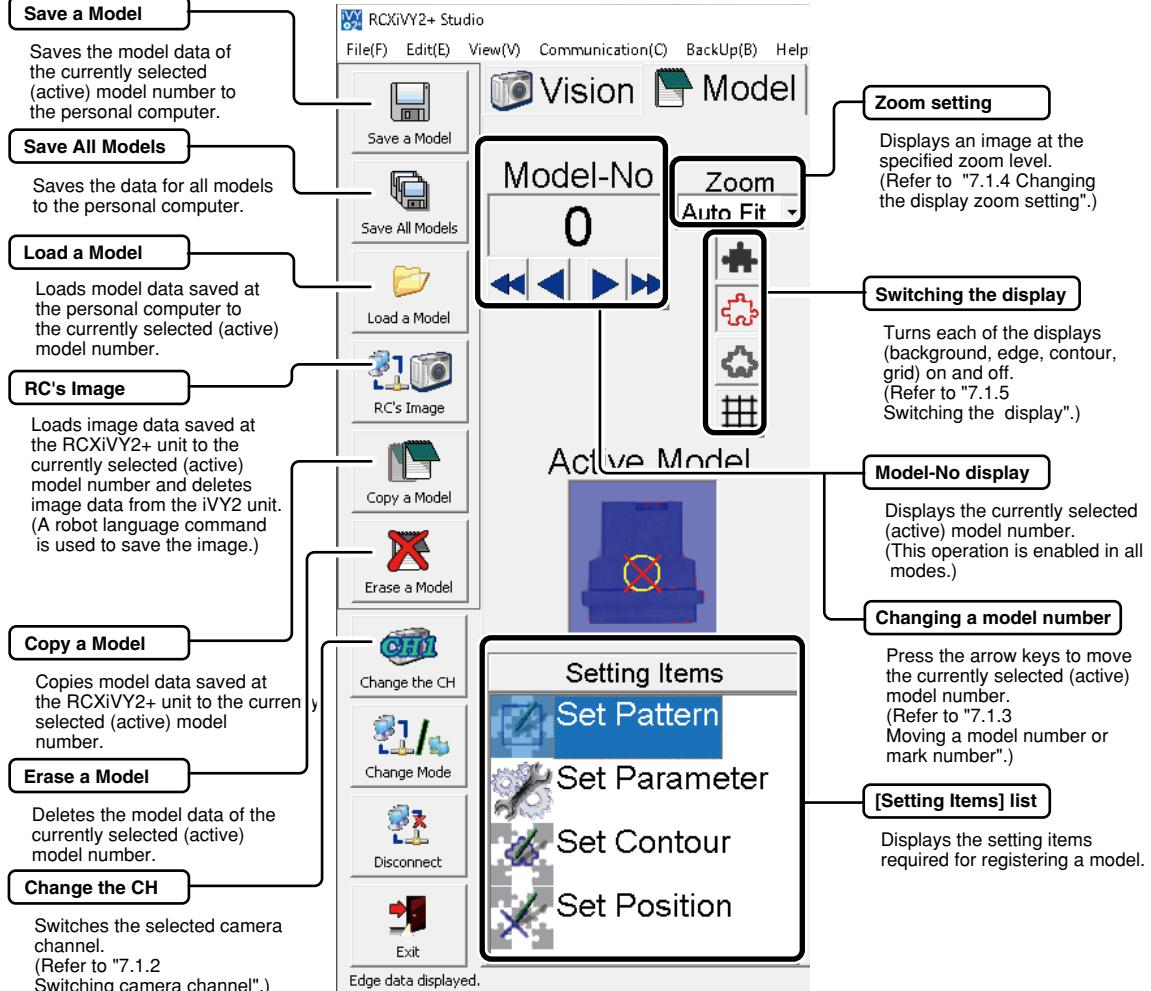
- Binarization
Turns the images after binarization on and off.
- Fill up
Turns the images after hole filling on and off.
- Detection position
Turns the detection position and oval fitting result on and off.
- Grid
Turns the grid display on and off.
A red cross-hairs displays when the grid display is turned on, indicating the center position of the display screen.

7.1.6 Model mode, Mark mode, Measurement mode, Blob mode

This section explains the basic Model mode operations.

* Some notations may vary depending on the Mark mode, Measurement mode, and Blob mode, but the operation can be performed using the same procedure.

Model mode functions



7.1.6.1 Saving a model

This operation saves the model data of the currently selected (active) model number to the personal computer.

Step 1 Click [Save a Model].



NOTE

Model data can also be saved from the (File (F)) menu, by selecting (Save As (A)) – (Model...).

► Step 1 [Save a Model] button



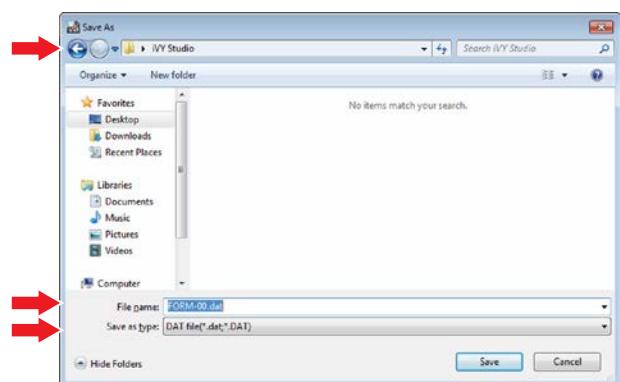
Step 2 Save the model data of the currently selected (active) model number.

Save the model data of the currently selected (active) model number.

At the "Save As" window which appears, specify the "Save in", "File name", and "Save as type".

Specify any desired location as the "Save in". Specify any desired name as the "File name". Verify that the "Save as type" is specified as a "DAT file (*.dat, *.DAT)".

► Step 2 Specifying destination to save data



Step 3 Click [Save].

To discontinue the model save operation, click (Cancel).

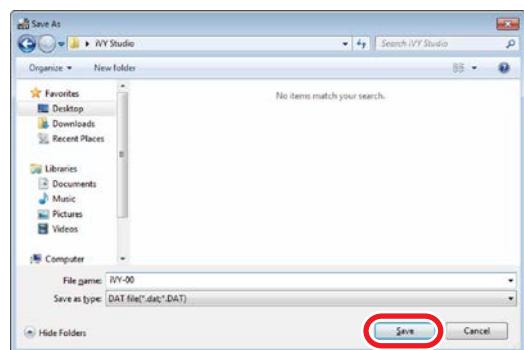
If a same-name file already exists at the specified save location, the overwrite confirmation message appears. To proceed with overwriting, click (Yes). If overwriting is not desired, click (No).



CAUTION

Model data can be lost if the robot controller or personal computer power is turned off, or if a cable or connector is disconnected, during a model data save operation. Never turn off the power or disconnect a cable while model data is being saved.

► Step 3 Saving a model



7.1.6.2 Saving all models

This operation saves the data for all models to the personal computer.

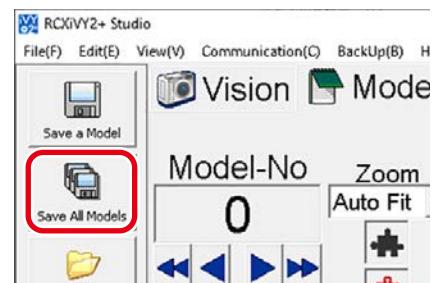
Step 1 Click [Save All Models].



NOTE

All models data can also be saved from the (File (F)) menu, by selecting (Save As (A)) – (All Models...).

► Step 1 [Save All Models] button

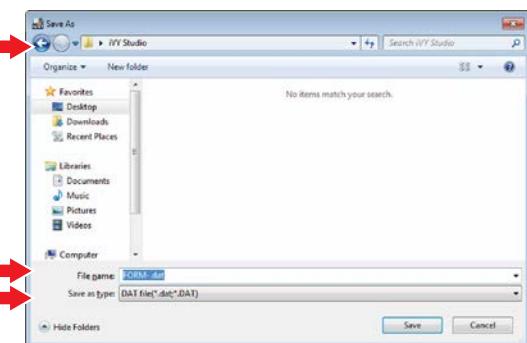


step2 Save the data for all models.

At the "Save As" window which appears, specify the "Save in", "File name", and "Save as type".

Specify any desired location as the "Save in". Specify any desired name as the "File name". Individual files are created for each model's data, and the model numbers are added at the end of the file names (for model number 000, "000" is added at the end of the file name).

Verify that the "Save as type" is specified as a "DAT file (*.dat, *.DAT)".

Step 2 Specifying destination to save data**step3 Click [Save].**

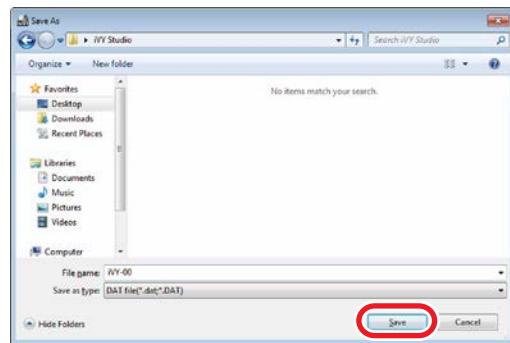
To discontinue the all models save operation, click (Cancel).

**NOTE**

If a same-name file already exists at the specified save location, the existing file's data is overwritten.

**CAUTION**

Model data can be lost if the robot controller or personal computer power is turned off, or if a cable or connector is disconnected, during a model data save operation. Never turn off the power or disconnect a cable while model data is being saved.

Step 3 Saving all models**7.1.6.3 Loading a model**

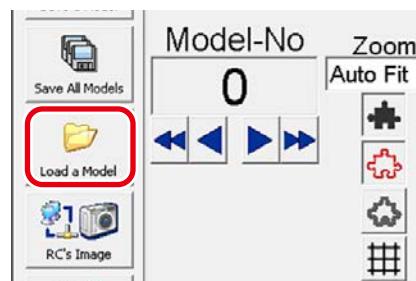
This operation loads model data saved at the personal computer to the currently selected (active) model number.

**NOTE**

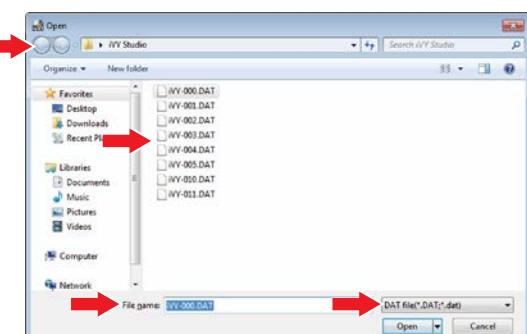
The model number to which the model data is to be loaded must be selected in advance. For this procedure, refer to Chapter 7, "7.1.2.2 Changing a model number or mark number".

step1 Click [Load a Model].**NOTE**

Model data can also be loaded from the (File (F)) menu by selecting (Open (O)) - (Model...).

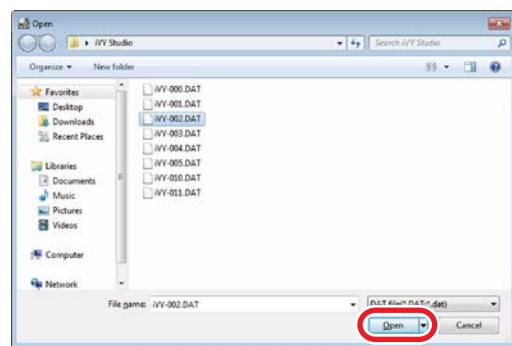
Step 1 [Load a Model] button**step2 Select the model data to be loaded.**

At the "Open" window which appears, select the model data to be loaded. Only "DAT" type model data files (files with an extension of "*.dat" or "*.DAT") can be loaded.

Step 2 Selecting the model data to be loaded

Step 3 Click [Open].

To discontinue the model loading operation, click (Cancel).

► Step 3 Loading the model data**Step 4 Model data loading occurs.**

The model data is loaded to the currently selected (active) model number.

**CAUTION**

Model data can be lost if the robot controller or personal computer power is turned off, or if a cable or connector is disconnected, during a model data loading operation. Never turn off the power or disconnect a cable while model data is being loaded.

7.1.6.4 RC image operations – loading images

Click [RC's Image] to load image data from the RCXiVY2+ unit memory to the currently selected (active) model number, and to delete image data from the RCXiVY2+ unit memory.

The procedure for loading saved image data from the RCXiVY2+ unit to the currently selected (active) model number is given below.

TIP

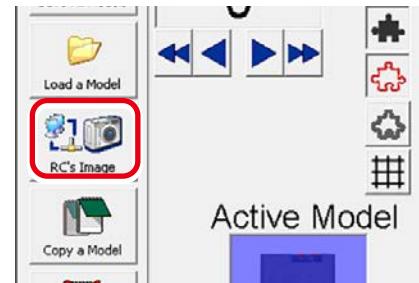
Image data is saved to the RCXiVY2+ unit by a dedicated robot language command.

**NOTE**

In order to load image data, the model number to which the image data is to be loaded must be selected in advance. For this procedure, refer to "7.1.3 Changing a model number or mark number".

Step 1 Click [RC's Image].**NOTE**

RC image operations (loading/deletion) can also be performed from the (File (F)) menu by selecting (Open (O)) – (RC's Images...).

► Step 1 [RC's Image] button**Step 2 Select the image data to be loaded, then click [Load].**

At the "Image File Manager (in Robot Controller)" window which appears, select the image data to be loaded.

Only "BMP" type image data files (files with an extension of ".bmp" or ".BMP") can be loaded.

After selecting the image data to be loaded, click (Load).

To discontinue the image data loading operation, click (Return).

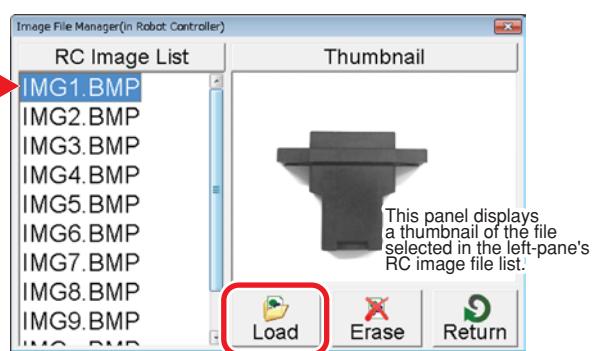
► Step 2 Selecting the image data to be loaded**NOTE**

Image data can also be loaded by double-clicking on that image data's file name.

Step 3 Image data loading occurs.

The image data is loaded to the currently selected (active) model number.

**CAUTION**

Image data can be lost if the robot controller or personal computer power is turned off, or if a cable or connector is disconnected, during an image data loading operation. Never turn off the power or disconnect a cable while image data is being loaded.

7.1.6.5 RC image operations – deleting images

Click [RC's Image] to load image data from the RCXiVY2+ unit memory to the currently selected (active) model number, and to delete image data from the RCXiVY2+ unit.

The procedure for deleting saved image data from the RCXiVY2+ unit is given below.

TIP

Image data is saved to the RCXiVY2+ unit by a dedicated robot language command.

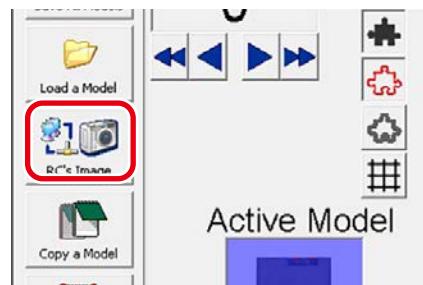
Step 1 Click [RC's Image].



NOTE

RC image operations (loading/deletion) can also be performed from the (File (F)) menu by selecting (Open (O)) – (RC's Images...).

Step 1 [RC's Image button]



Step 2 Select the image data to be deleted, then click [Erase].

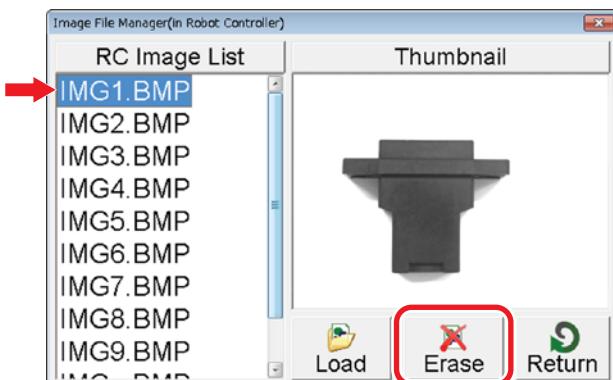
At the "Image File Manager (in Robot Controller)" window which appears, select the image data to be deleted. Multiple image data can be selected.

Only "BMP" type image data files (files with extension of ".bmp" or ".BMP") can be deleted.

After selecting the image data to be deleted, click [Erase].

To discontinue the image data deletion operation, click [Return].

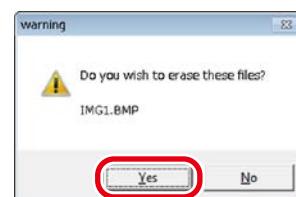
Step 2 Selecting image data to be deleted



Step 3 At the deletion confirmation message which appears, click [Yes] to proceed with the deletion.

To discontinue the deletion operation, click [No].

Step 3 Deletion confirmation message



7.1.6.6 Copying a model

This operation copies model data from the RCXiVY2+ unit to the currently selected (active) model number.



NOTE

The model number to which the model data is to be copied must be selected in advance. For this procedure, refer to "7.1.3 Changing a model number or mark number".

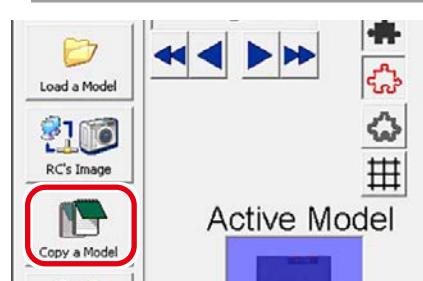
Step 1 Click [Copy a Model].



NOTE

Model data can also be copied from the (File (F)) menu by selecting (Open (O)) – (RC's Model...), or from the (Edit (E)) menu by selecting (Copy) – (Model...).

Step 1 [Copy a Model] button



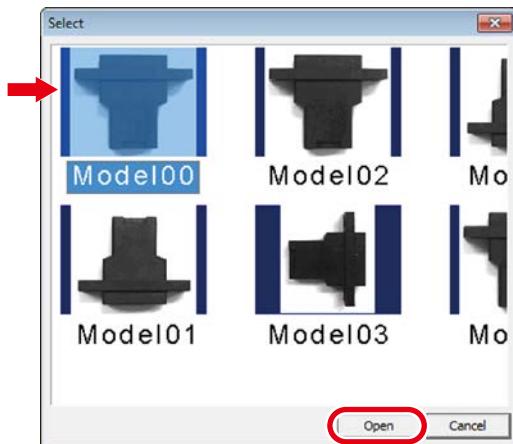
Step2 Select the copy source model data, then click [Open].

When the "Select" window then appears, select the copy source model data.
To discontinue the model copy operation, click (Cancel).



NOTE

Model data can also be copied by double-clicking on the copy source model data.

▶ **Step 2** Selecting the copy source model data**Step3** The selected model number data is copied to the currently selected (active) model number.

CAUTION

Model data can be lost if the robot controller or personal computer power is turned off, or if a cable or connector is disconnected, during a model data copy operation. Never turn off the power or disconnect a cable while model data is being copied.

7.1.6.7 Erasing a model

This operation deletes the model data of the currently selected (active) model number.



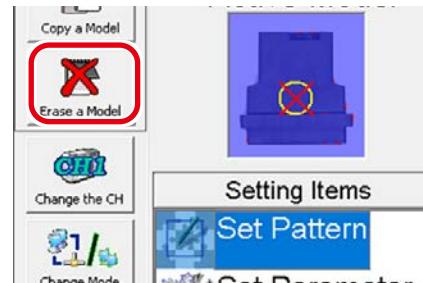
NOTE

The model number to be deleted must be selected in advance. For this procedure, refer to "7.1.3 Changing a model number or mark number".

Step1 Click [Erase a Model].

NOTE

Model data can also be deleted from the (Edit (E)) menu by selecting (Erase) - (Model).

▶ **Step 1** [Erase a Model] button**Step2** When the deletion confirmation message appears, click [Yes] to perform the deletion.

To discontinue the deletion operation, click (No).

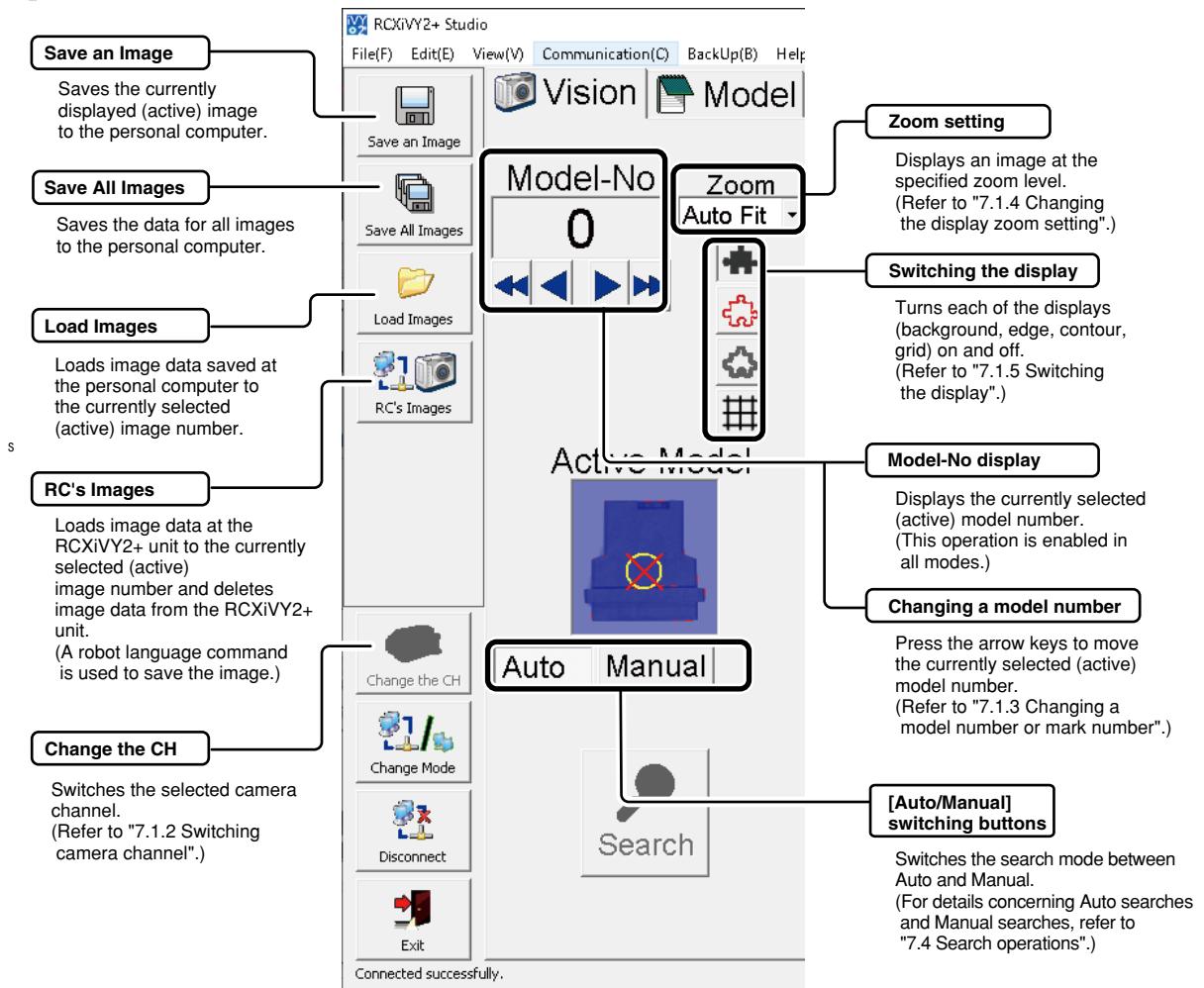
▶ **Step 2** Deletion confirmation message**Step3** The model data is deleted.

The data of the currently selected (active) model number is deleted.

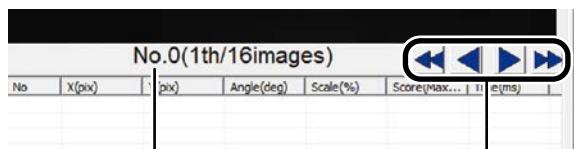
7.1.7 Vision mode

This section explains the basic Vision mode operations.

Vision mode functions (left side)



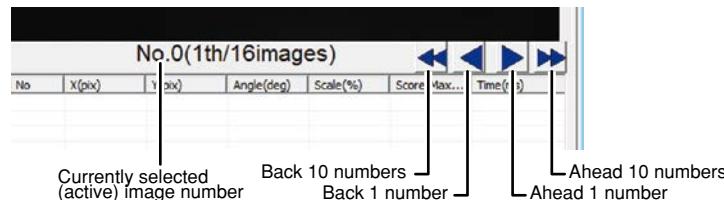
Vision mode functions (lower right)



7.1.7.1 Moving an image number

The arrow keys to the right of the image number can be clicked to move that image number. The image number range is 0 to 15.

Moving an image number



7.1.7.2 Saving an image

This operation saves the currently displayed image to the personal computer.

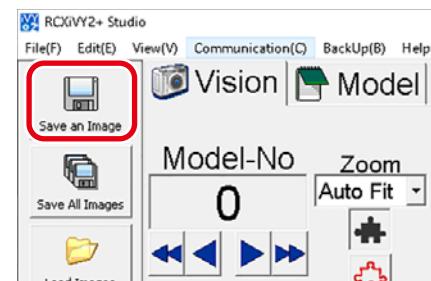
Step 1 Click [Save an Image].



NOTE

Images can also be saved from the (File (F)) menu, by selecting (Save As (A)) – (Image...).

▶ Step 1 [Save an Image] button

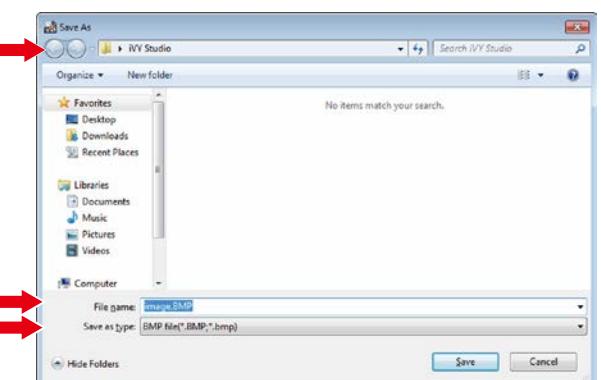


Step 2 Save the currently displayed (active) image.

At the "Save As" window which appears, specify the "Save in", "File name", and "Save as type".

Specify any desired location as the "Save in". Specify any desired name as the "File name". Verify that the "Save as type" is specified as a "BMP file (file with extension of *.bmp, *.BMP)".

▶ Step 2 Specifying destination to save data

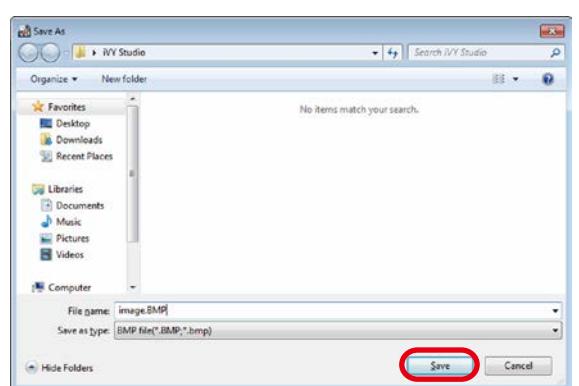


Step 3 Click [Save].

To discontinue the image save operation, click (Cancel).

If a same-name file already exists at the specified save location, the overwrite confirmation message appears. To proceed with overwriting, click (Yes). If overwriting is not desired, click (No).

▶ Step 3 Saving image data



CAUTION

Image data can be lost if the robot controller or personal computer power is turned off, or if a cable or connector is disconnected, during an image data save operation. Never turn off the power or disconnect a cable while image data is being saved.

7.1.7.3 Saving all images

This operation saves the data for all images to the personal computer.

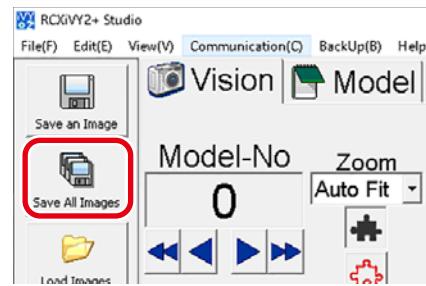
Step 1 Click [Save All Images].



NOTE

All images can also be saved from the (File (F)) menu, by selecting (Save As (A)) - (All Images...).

▶ Step 1 [Save all Images] button



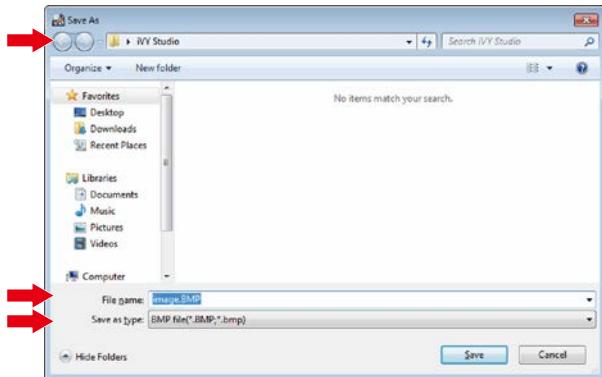
Step 2 Save the data for all the images.

At the "Save As" window which appears, specify the "Save in", "File name", and "Save as type".

Specify any desired location as the "Save in". Specify any desired name as the "File name". A sequentially numbered file is created for each image, and these sequential numbers (01, 02, ...) are added at the end of the file names.

Verify that the "Save as type" is specified as a "BMP file (file with extension of *.bmp, *.BMP)".

▶ Step 2 Specifying destination to save data



Step 3 Click [Save].

To discontinue the all images save operation, click (Cancel).

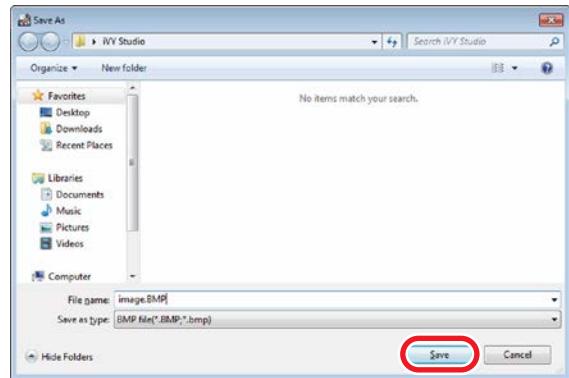
If a same-name file already exists at the specified save location, the overwrite confirmation message appears. To proceed with overwriting, click (Yes). If overwriting is not desired, click (No).



CAUTION

Image data can be lost if the robot controller or personal computer power is turned off, or if a cable or connector is disconnected, during an image data save operation. Never turn off the power or disconnect a cable while image data is being saved.

▶ Step 3 Saving the data for all images



7.1.7.4 Loading images

This operation loads image data saved at the personal computer to the currently selected (active) image number.



NOTE

When loading the data for a single image, the image number to which the image data is to be loaded must be selected in advance. For this procedure, refer to "7.1.7.1 Moving an image number".

When loading the data for multiple images, that data is loaded sequentially (from image No.00), after resetting (clearing) all the existing image data.

Step 1 Click [Load Images].



NOTE

Image loadings can also be performed from the (File (F)) menu by selecting (Open (O)) - (Images...).

Step 1 [Load Images] button

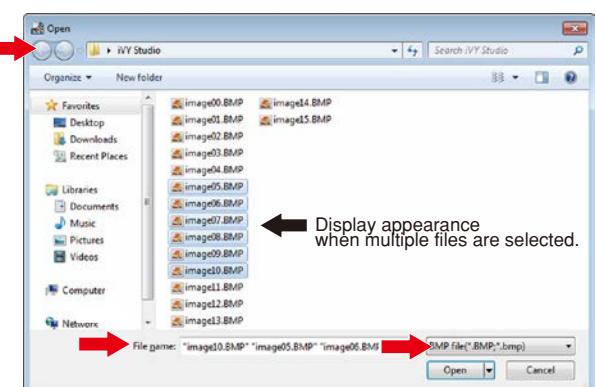


Step 2 Select the images to be loaded.

At the "Open" window which appears, select the image data to be loaded.

Only "BMP" type image data files (files with an extension of ".bmp" or ".BMP") can be loaded.

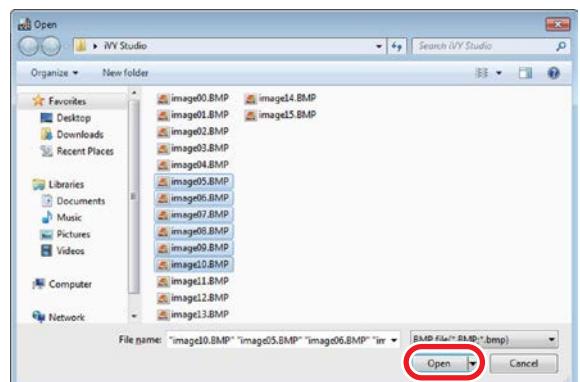
Step 2 Selecting the image data to be loaded (1)



Step 3 Click [Open].

To discontinue the image loading operation, click (Cancel).

Step 3 Selecting the image data to be loaded (2)



Step 4 Image data loading occurs.

The image data is loaded to the currently selected (active) image number.

If multiple image data are selected, each image data is loaded sequentially from the currently selected image number.



CAUTION

Image data can be lost if the robot controller or personal computer power is turned off, or if a cable or connector is disconnected, during an image loading operation. Never turn off the power or disconnect a cable while image data is being loaded.

7.1.7.5 RC image operations – loading images

Click [RC's Images] to load image data from the RCXiVY2+ unit memory to the currently selected (active) image number, and to delete image data from the RCXiVY2+ unit memory.

The procedure for loading saved image data from the RCXiVY2+ unit to the currently selected (active) image number is given below.

TIP

To save image data into the RCXiVY2+ unit, use the robot language "VSAVEIMG" statement.



NOTE

The image number to which image data (one image) is to be loaded must be selected in advance. For this procedure, refer to "7.1.7.1 Moving an image number".

When loading multiple image data, all the currently loaded image data is reset, and the new image data is loaded with sequential image numbers, beginning from No.00.

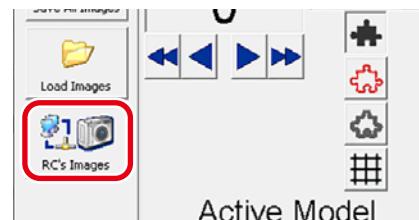
Step 1 Click [RC's Images].



NOTE

RC image operations (loading/deletion) can also be performed from the (File (F)) menu by selecting (Open (O)) – (RC's Images...).

▶ Step 1 [RC's Images] button



Step 2 Select the image data to be loaded, then click [Load].

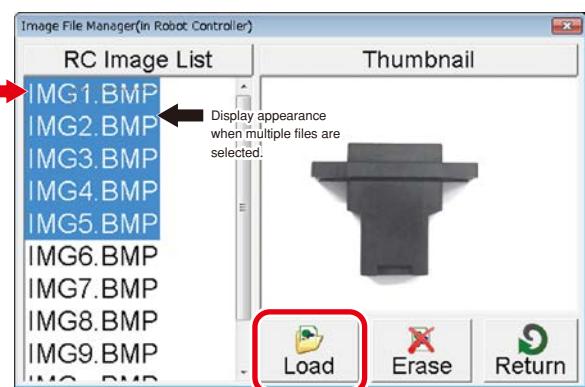
At the "Image File Manager (in Robot Controller)" window which appears, select the image data to be loaded. Multiple image data can also be selected.

Only BMP type image data files (files with an extension of ".bmp" or ".BMP") can be loaded.

After selecting the image data to be loaded, click (Load).

To discontinue the image data loading operation, click (Return).

▶ Step 2 Selecting the image data to be loaded



NOTE

Image data can also be loaded by double-clicking on that image data's file name.

Step 3 Image data loading occurs.

The image data is loaded to the currently selected (active) image number.

When loading multiple image data, all the currently loaded image data is reset, and the new image data is loaded to sequential image numbers, beginning from No.00.



CAUTION

Image data can be lost if the robot controller or personal computer power is turned off, or if a cable or connector is disconnected, during an image data loading operation. Never turn off the power or disconnect a cable while image data is being loaded.

7.1.7.6 RC image operations – deleting images

Click [RC's Images] to load image data from the RCXiVY2+ unit memory to the currently selected (active) image number, and to delete image data from the RCXiVY2+ unit.

The procedure for deleting saved image data from the RCXiVY2+ unit is given below.

TIP

To save image data into the RCXiVY2+ unit, use the robot language "VSAVEIMG" statement.

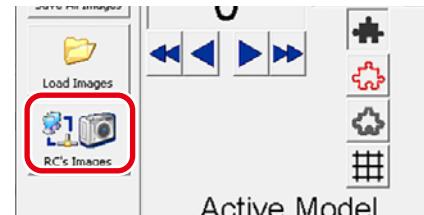
Step 1 Kick [RC's Images].



NOTE

RC image operations (loading/deletion) can also be performed from the (File (F)) menu by selecting (Open (O)) - (RC's Images...).

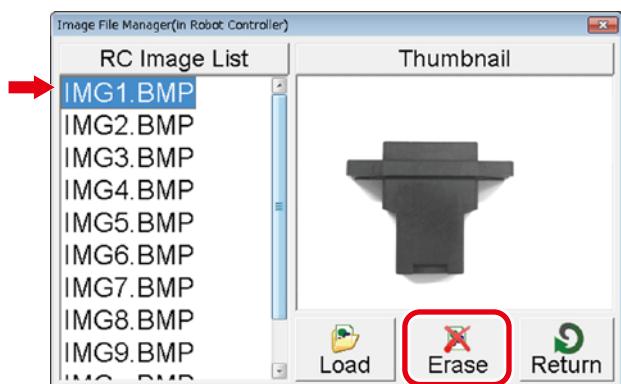
▶ **Step 1** [RC's Images] button



Step 2 Select the image data to be deleted, then click [Erase].

At the "Image File Manager (in Robot Controller)" window which appears, select the image data to be deleted. Multiple image data can be selected.
Only BMP type image data files (files with extension of ".bmp" or ".BMP") can be deleted.
After selecting the image data to be deleted, click [Erase].
To discontinue the image data loading operation, click [Return].

▶ **Step 2** Selecting the image data to be deleted



Step 3 At the deletion confirmation message which appears, click [Yes] to proceed with the deletion.

To discontinue the deletion operation, click (No).

▶ **Step 3** Deletion confirmation message



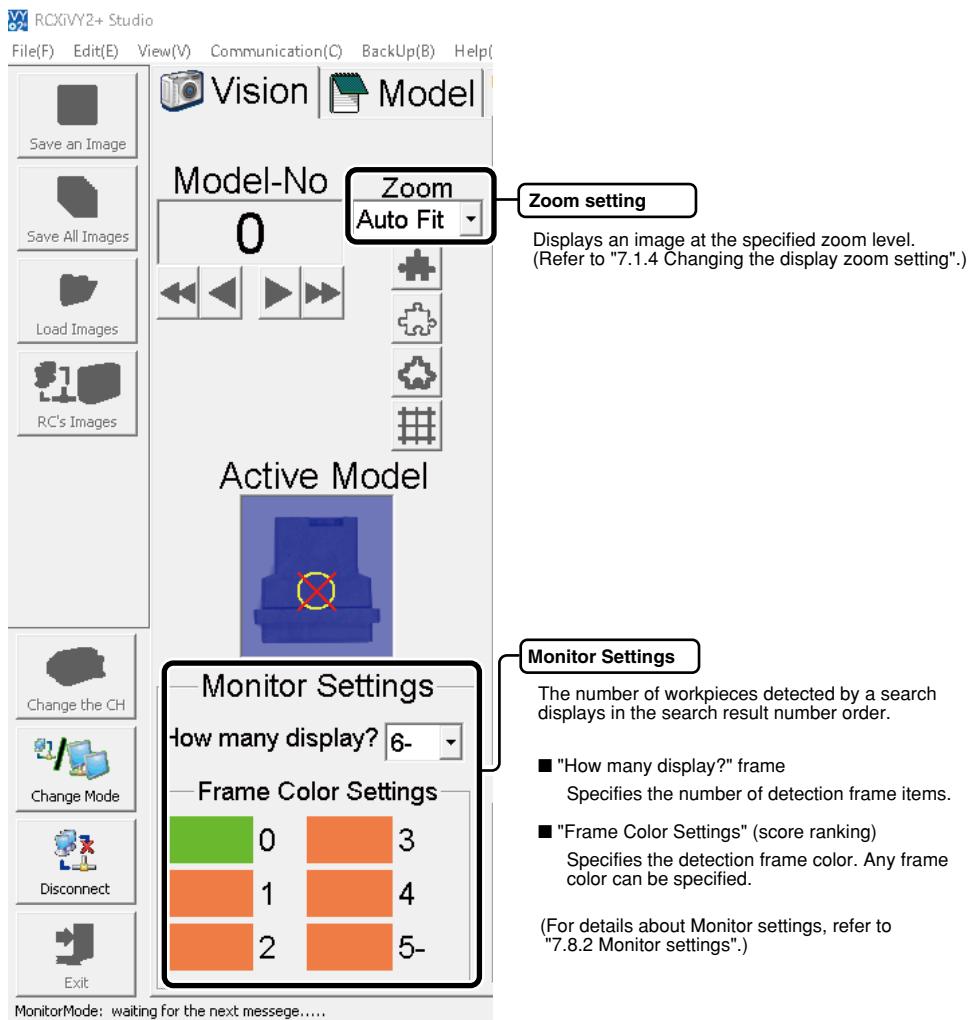
Step 4 Image data deletion occurs.

The specified image file is deleted from the RCXiVY2+ unit memory.

7.1.8 Monitor mode

This section explains the basic Monitor mode operations.

Monitor mode functions



7.2 Menu operations

This section explains the functions which can be performed from the various RCXiVY2+ Studio menus. RCXiVY2+ Studio has the following six menus: [File (F)], [Edit (E)], [View (V)], [Communication (C)], [BackUp (B)], [Help (H)].

Menu bar

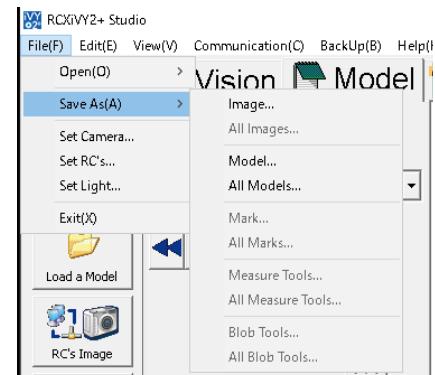
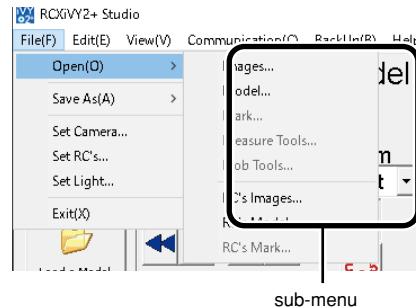


7.2.1 [File (F)] menu functions

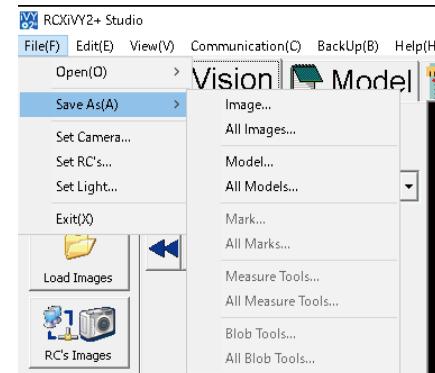
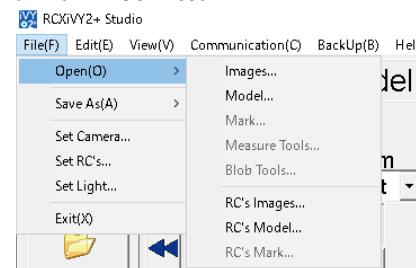
Functions which can be performed from the [File (F)] menu are shown below.

[File (F)] menu windows

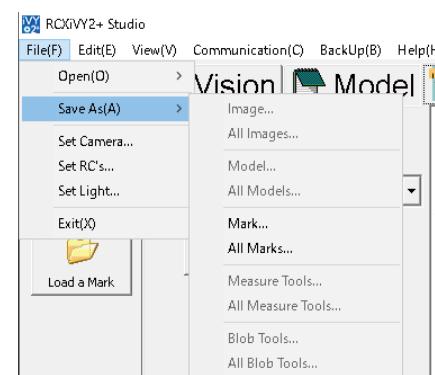
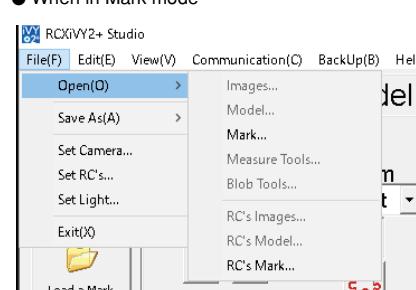
● When in Model mode



● When in Vision mode



● When in Mark mode



Menu	Sub Menu	Function	Usable Modes		
			Model	Vision	Mark
Open (O)	Images...	Loads image data saved at the personal computer to the currently selected (active) model number. This procedure is the same as that explained in "7.1.7.4 Loading images".	●		
		Loads image data saved at the personal computer to the currently selected (active) image number. This procedure is the same as that explained in "7.1.7.4 Loading Images".		●	
	Model...	Loads model data saved at the personal computer to the currently selected (active) model number. This procedure is the same as that explained in "7.1.6.3 Loading a model".	●	●	
	Mark data...	Loads fiducial mark data saved at the personal computer to the currently selected (active) mark number. This procedure is the same as that explained in "7.1.6.3 Loading a model".			●
	RC's Images...	Loads image data saved at the RCXiVY2+ unit to the currently selected (active) model number, and deletes image data from the iVY2 unit. This procedure is the same as that explained in "7.1.6.4 RC image operations – loading images", and "7.1.6.5 RC image operations – deleting images".	●		
		Loads image data saved at the RCXiVY2+ unit to the currently selected (active) image number, and deletes image data from the RCXiVY2+ unit. This procedure is the same as that explained in "7.1.7.5 RC image operations – loading images", and "7.1.7.6 RC image operations – deleting images".		●	
	RC's Model...	Copies model data saved at the RCXiVY2+ unit to the currently selected (active) model number. This procedure is the same as that explained in "7.1.6.6 Copying a model".	●	●	
	RC mark data...	Copies fiducial mark data saved at the iVY2 unit to the currently selected (active) mark number. This procedure is the same as that explained in "7.1.6.6 Copying a model".			●
Save as (A)	Images...	Saves the currently displayed (active) image to the personal computer. This procedure is the same as that explained in "7.1.7.2 Saving an image".	●	●	
	All images...	Saves all stored images to the personal computer. This procedure is the same as that explained in "7.1.7.3 Saving all images".		●	
	Model...	Saves the model data of the currently selected (active) model number to the personal computer. This procedure is the same as that explained in "7.1.6.1 Saving a model".	●	●	
	All models...	Saves the data for all models to the personal computer. This procedure is the same as that explained in "7.1.6.2 Saving all models".	●	●	
	Mark...	Saves the fiducial mark data of the currently selected (active) mark number to the personal computer. This procedure is the same as that explained in "7.1.6.1 Saving a fiducial mark".			●
	All marks...	Saves the data for all fiducial marks to the personal computer. This procedure is the same as that explained in "7.1.6.2 Saving all fiducial marks".			●
Set camera...		Specifies the camera settings. This procedure is the same as that explained in "5.2 Camera settings".	---	---	---
Set RC's...		Specifies the monitor display settings.	---	---	---
Set Light...		Specifies the light settings.	---	---	---
Exit (X)		Ends RCXiVY2+ Studio operation.	---	---	---

**CAUTION**

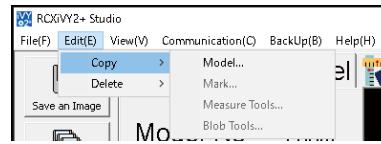
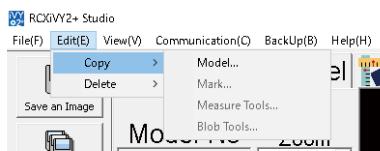
Data can be lost if the robot controller or personal computer power is turned off, or if a cable or connector is disconnected, during data loading and saving operations. Never turn off the power or disconnect a cable while loading or saving data.

7.2.2 [Edit (E)] menu functions

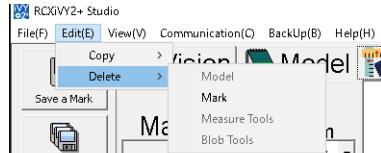
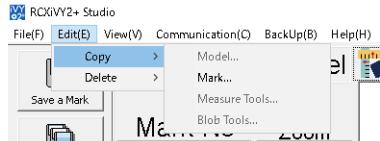
Functions which can be performed from the [Edit (E)] menu are shown below.

[Edit (E)] menu windows

Model / Vision modes



Mark mode



Menu	Sub Menu	Function	Usable Modes		
			Model	Vision	Mark
Copy	Model...	Copies model data saved at the RCXiVY2+ unit to the currently selected (active) model number. This procedure is the same as that explained in "7.1.6.6 Copying a model".	●	●	
	Mark...	Copies fiducial mark data saved at the RCXiVY2+ unit to the currently selected (active) mark number. This procedure is the same as that explained in "7.1.6.6 Copying a model".			●
Delete	Model	Deletes the model data of the currently selected (active) model number. This procedure is the same as that explained in "7.1.6.7 Erasing a model".	●	●	
	Mark	Deletes the fiducial mark data of the currently selected (active) mark number. This procedure is the same as that explained in "7.1.6.7 Erasing a model".			●



CAUTION

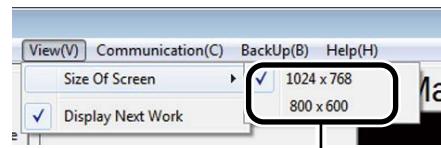
Data can be lost if the robot controller or personal computer power is turned off, or if a cable or connector is disconnected, during data copy operations. Never turn off the power or disconnect a cable while copying data.

7.2.3 [View (V)] menu functions

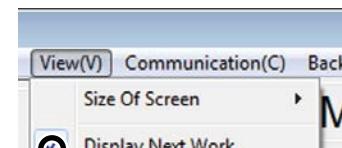
Functions which can be performed from the [View (V)] menu are shown below.

A check mark shown by a sub-menu item indicates that the corresponding menu item is selected.

[View (V)] menu windows



Sub menu



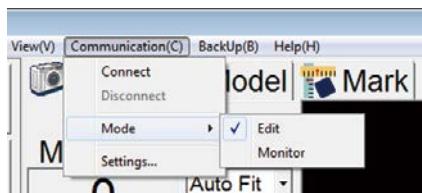
Check mark

Menu	Sub Menu	Function
Size Of Screen	1024x768	Adjusts the screen to the 1024 x 768 screen size.
	800x600	Adjusts the screen to the 800 x 600 screen size.
Display Next Work		Displays or hides the next workpiece presence and detailed information when executing the search in Vision mode.

7.2.4 [Communication (C)] menu functions

Functions which can be performed from the [Communication (C)] menu are shown below.

■ When not connected



■ When connected



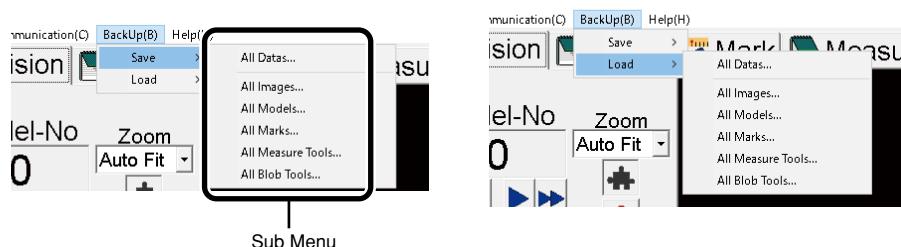
Menu	Sub Menu	Function
Connect		Connects RCXiVY2+ Studio to the RCXiVY2+ unit.
Disconnect		Disconnects communication between RCXiVY2+ Studio and the RCXiVY2+ unit.
Mode	Edit	Switches to Edit mode.
	Monitor	Switches to Monitor mode.
Settings...		Specifies the communication settings. This procedure is the same as that explained in "5.1 Communication settings".

7.2.5 [BackUp (B)] menu functions

The [BackUp (B)] menu functions can be used to back up various data, and to load backed up data to the RCXiVY2+ unit. The backup function is enabled only when RCXiVY2+ Studio is connected to the RCXiVY2+ unit. After restoring backed up data (including system settings), the RCXiVY2+ unit must be restarted.

Functions which can be performed from the [BackUp (B)] menu are shown below.

[BackUp (B)] menu windows



Menu	Sub Menu	Function
Save	All Data...	Saves all memory data (model data, image data, fiducial mark data, measure tool data, and blob data) from the RCXiVY2+ unit memory to the personal computer.
	All Images...	Saves all image data from the RCXiVY2+ unit memory to the personal computer.
	All Models...	Saves all model data from the RCXiVY2+ unit memory to the personal computer.
	All Marks...	Saves all the fiducial mark data from the RCXiVY2+ unit memory to the personal computer.
	All Measure Tools data...	Saves all measure tool data from the RCXiVY2+ unit memory to the personal computer.
	All Blob Tools ...	Saves all blob data from the RCXiVY2+ unit memory to the personal computer.
Load	All Data...	Loads all data (model data, image data, fiducial mark data, measure tool data, and blob data) from the RCXiVY2+ unit to the personal computer.
	All Images...	Loads all image data from the RCXiVY2+ unit to the personal computer.
	All Models...	Loads all model data from the RCXiVY2+ unit to the personal computer.
	All Marks...	Loads all fiducial mark data from the RCXiVY2+ unit to the personal computer.
	All Measure Tools data...	Loads all measure tool data from the RCXiVY2+ unit to the personal computer.
	All Blob Tools ...	Loads all blob data from the RCXiVY2+ unit to the personal computer.



CAUTION

Data can be lost if the robot controller or personal computer power is turned off, or if a cable or connector is disconnected, during data loading and saving operations. Never turn off the power or disconnect a cable while loading or saving data.

7.2.5.1 [Save] functions

The [BackUp (B)] – [Save] menu procedures are explained below.

Step 1 Select the data to be saved from the [BackUp (B)] – [Save] menu.

Select the data to be saved.

Step 2 Save the specified data.

At the "Save As" window which appears, specify the "Save in", "File name", and "Save as type".

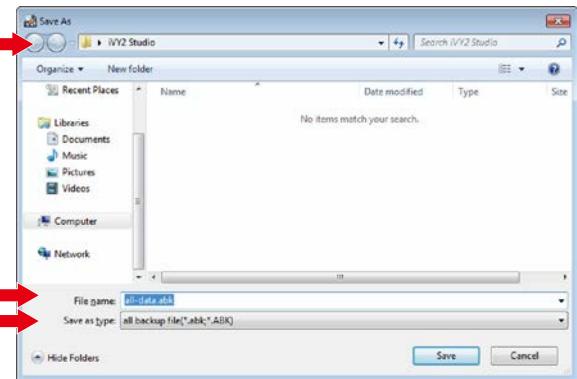
Specify any desired location as the "Save in". Specify any desired name as the "File name". The "Save as type" varies according to the type of data being saved.

Data Types	File Type
All Data	all backup file (*.abk, *.ABK)
All Images	all images backup file (*.ibk, *.IBK)
All Models	all models backup file (*.fbk, *.FBK)
All Marks	all marks backup file (*.mbk, *.MBK)
All Measure Tools data...	all measure tools backup file (*.tbk, *.TBK)
All Blob Tools ...	all blob tools vackup file (*.bbk, *.BBK)

Step 1 [BackUp (B)] – [Save] menu window



Step 2 Specifying destination to save data

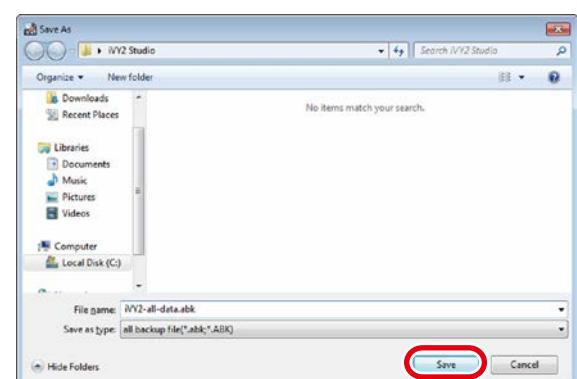


Step 3 Click [Save].

To discontinue the save operation, click (Cancel).

If a same-name file already exists at the specified save location, the overwrite confirmation message appears. To proceed with overwriting, click (Yes). If overwriting is not desired, click (No).

Step 3 Saving fiducial mark data



Step 4 The data is saved.

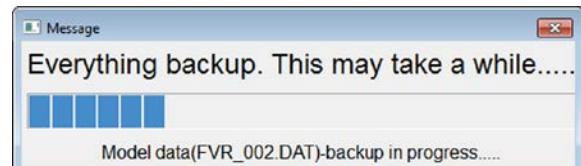
The "Everything backup. This may take a while..." message appears while the backup operation is in progress.



CAUTION

Data can be lost if the robot controller or personal computer power is turned off, or if a cable or connector is disconnected, during data save operations. Never turn off the power or disconnect a cable while saving data.

Step 4 Data backup in progress



7.2.5.2 [Load] functions

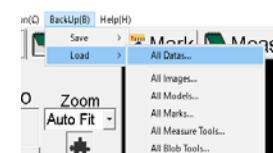
The [BackUp (B)] – [Load] menu procedures are explained below.

Only data which was saved from the [BackUp (B)] – [Save] menu can be loaded by this function.

Step 1 Select the data to be loaded from the [BackUp (B)] – [Load] menu.

Select the data to be loaded to the RCXiVY2+ unit.

▶ **Step 1 [BackUp (B)] – [Load] menu window**



Step 2 Specify the data to be saved.

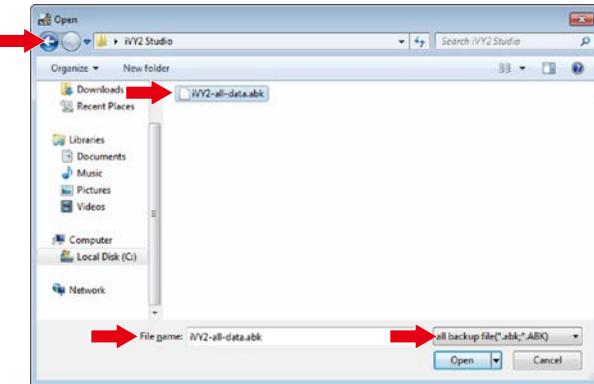
At the "Open" window which appears, specify the data file to be loaded. The "file type" of the data to be loaded is indicated in the window.

Data Types	File Type
All Data	all backup file (*.abk, *.ABK)
All Images	all images backup file (*.ibk, *.IBK)
All Models	all models backup file (*.fbk, *.FBK)
All Marks	all marks backup file (*.mbk, *.MBK)
All measure tool data...	all measure tools backup file (*.tbk, *.TBK)
All blob data ...	all blob tools vackup file (*.bbk, *.BBK)

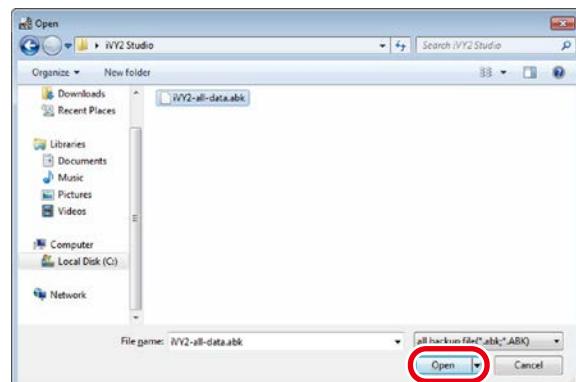
Step 3 Click [Open].

To discontinue the data loading operation, click (Cancel).

▶ **Step 2 Selecting the data file to be loaded (1)**



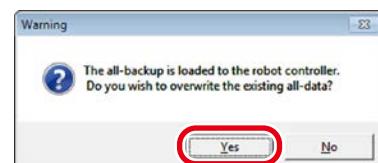
▶ **Step 3 Selecting the data file to be loaded (2)**



Step 4 If the overwrite confirmation message appears, click [Yes].

Click (Yes) to proceed with overwriting, or (No) if overwriting is not desired.

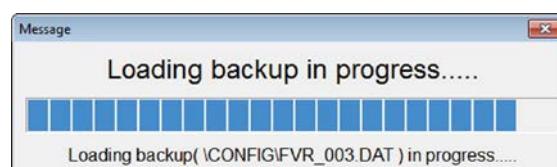
▶ **Step 4 Overwrite confirmation message window**



Step 5 Data loading occurs.

The "Loading backup in progress..." message appears during the data loading operation.

▶ **Step 5 Data loading in progress**



CAUTION

Data can be lost if the robot controller or personal computer power is turned off, or if a cable or connector is disconnected, during data loading operations. Never turn off the power or disconnect a cable while loading data.

**NOTE**

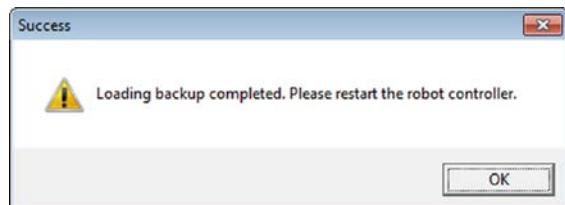
Data which is not recognized as significant "load data" remains in the RCXiVY2+ unit memory.
(Example) At "All Models" loading operation:

Before loading	Is model number 10 registered at the iVY2 unit?	<input type="radio"/>	<input checked="" type="radio"/>	-	-
During loading	Is model number 10 included in the "all-models" data?	<input type="radio"/>	-	<input checked="" type="radio"/>	-
After loading	Model number 10 data at robot controller	Data is overwritten	Data is unchanged	Data is overwritten	Data remains unregistered

Step 6 The "loading completed" message appears.

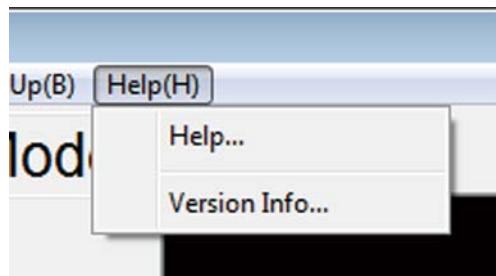
The "loading completed" message appears if the data loading is completed successfully. Click (OK) at this time.

When the system settings is included in the loaded data, end the RCXiVY2+ Studio and RCXiVY2+ unit communication, then restart the robot controller.

Step 6**Data loading completed
(if the restart is required)****7.2.6 [Help (H)] menu functions**

Functions which can be performed from the [Help (H)] menu are shown below.

Menu	Function
Help...	Displays RCXiVY2+ Studio "Help" information.
Version Info...	Displays the RCXiVY2+ Studio version, the RCXiVY2+ unit's RCXiVY2+ engine version, and the firmware version.

[Help (H)] menu window**Version Info window**

7.3 Registering models

This section explains how to register models.

A model registration operation consists of registering the camera-captured workpiece image data at the RCXiVY2+ unit. The following 4 settings must be specified in order to register models.

■ Set Pattern

A workpiece image is captured, and the range of the image to be registered is specified.

■ Set Parameter

The edge extraction and search parameter settings are specified.

■ Set Contour

The workpiece contour is specified.

The RCXiVY2+ system performs searches based on the workpiece edge information. The search precision can be increased by limiting the edges used.

■ Set Position

The reference position for the workpiece position information used at searches is specified.

The settings required for model registration must be performed in the following order.

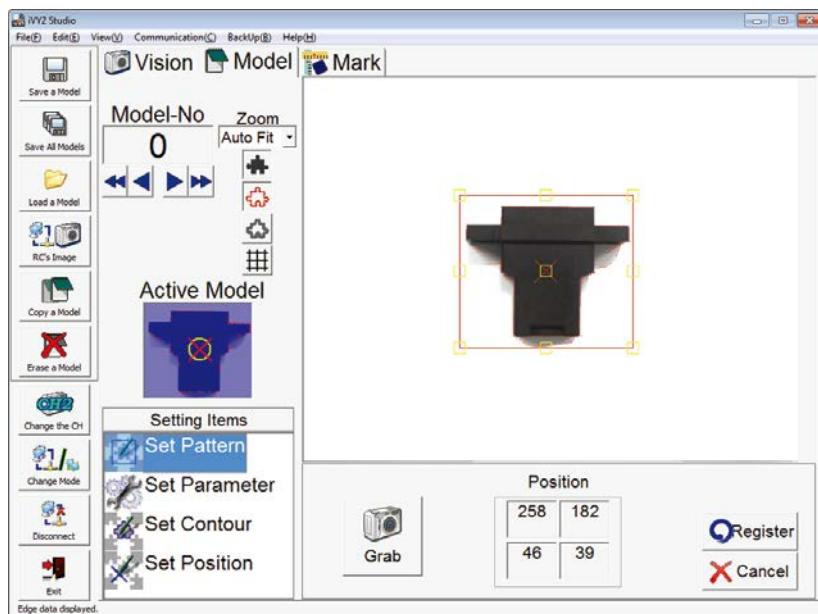


NOTE

The above settings must be specified again if specified in the wrong order. Be sure to specify the settings in the order shown above.

In order to register a model, RCXiVY2+ Studio must be in Edit mode. For details on how to do this, refer to "7.1.1 Switching modes".

Model registration window



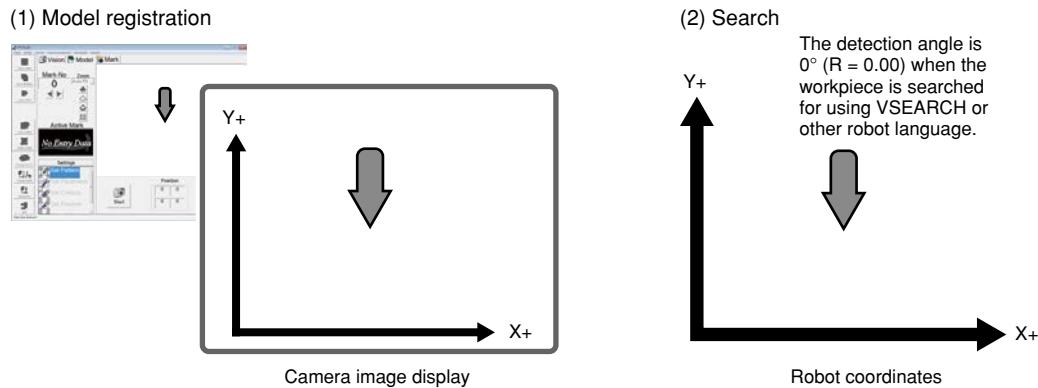
7.3.1 Model registration and R-axis angle

The orientation of the workpiece you have registered its model with RCXiVY2+ Studio becomes a detection angle of 0° (robot coordinates, R = 0.00) at the time of the search using the robot language, such as VSEARCH. Therefore, in particular, if a workpiece you want to register its model has a directionality (non-circle workpiece), pay special attention to the orientation of the workpiece when registering a model.

For example, assuming that the operation steps are performed from the model registration to the search as follows:

- (1) Register an arrow type workpiece with RCXiVY2+ Studio as shown in the figure below.
- (2) Search for this workpiece using the robot language, such as VSEARCH.

At this time, the detection angle when the workpiece is searched for using the robot language, such as VSEARCH becomes 0° (robot coordinates, R=0.00) regardless of the camera mounting method, mounting position, and mounting angle.

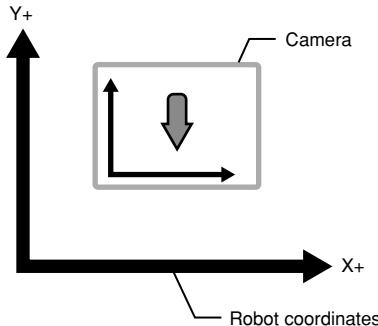


TIP

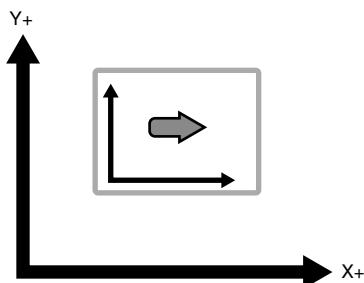
The detection angle when the search operation is executed in Vision mode of RCXiVY2+ Studio becomes the difference between the orientation of the workpiece you have registered its model and the workpiece shown on the camera image display.

According to the description above, the following shows examples of detection angles by the workpiece orientation and camera mounting angle.

● Camera mounting angle is 0°.

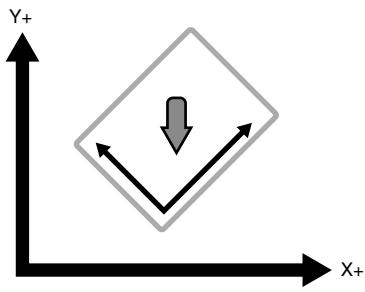


	Detection angle
Search in Vision mode of RCXiVY2+ Studio	0°
Search using robot language	0° (R=0.00)



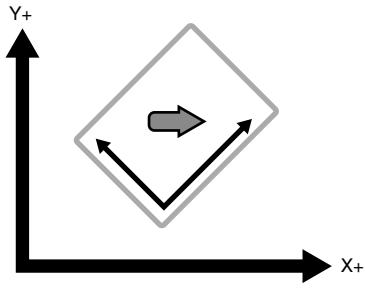
	Detection angle
Search in Vision mode of RCXiVY2+ Studio	90°
Search using robot language	90° (R=90.00)

- Camera mounting angle is 45°.



	Detection angle
Search in Vision mode of RCXiVY2+ Studio	-45°
Search using robot language	0° * (R=0.00)

* -45° (Search detection angle in Vision mode of RCXiVY2+ Studio)
+ 45° (Camera angle) = 0° (Robot coordinates)

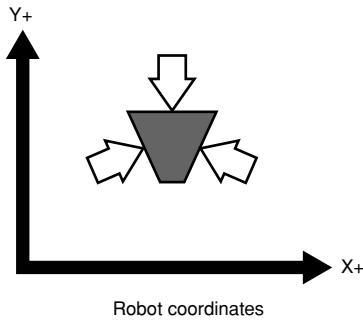
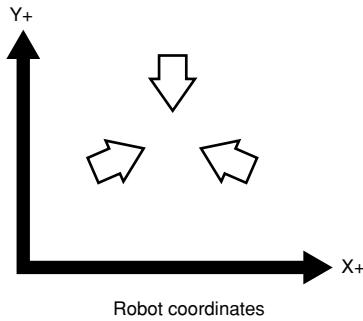


	Detection angle
Search in Vision mode of RCXiVY2+ Studio	45°
Search using robot language	90° * (R=90.00)

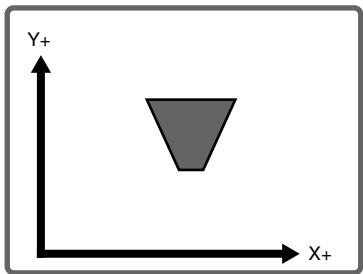
* 45° (Search detection angle in Vision mode of RCXiVY2+ Studio)
+ 45° (Camera angle) = 90° (Robot coordinates)

Example)

Assuming that a tool which chucks a workpiece at 3 points in the directions shown in the lower left figure exists when the R-axis satisfies "R=0.00", the following describes that a trapezoidal workpiece is chucked using this tool as shown in the lower right figure.



In this case, a workpiece in the orientation shown in the figure below is registered in the model registration.

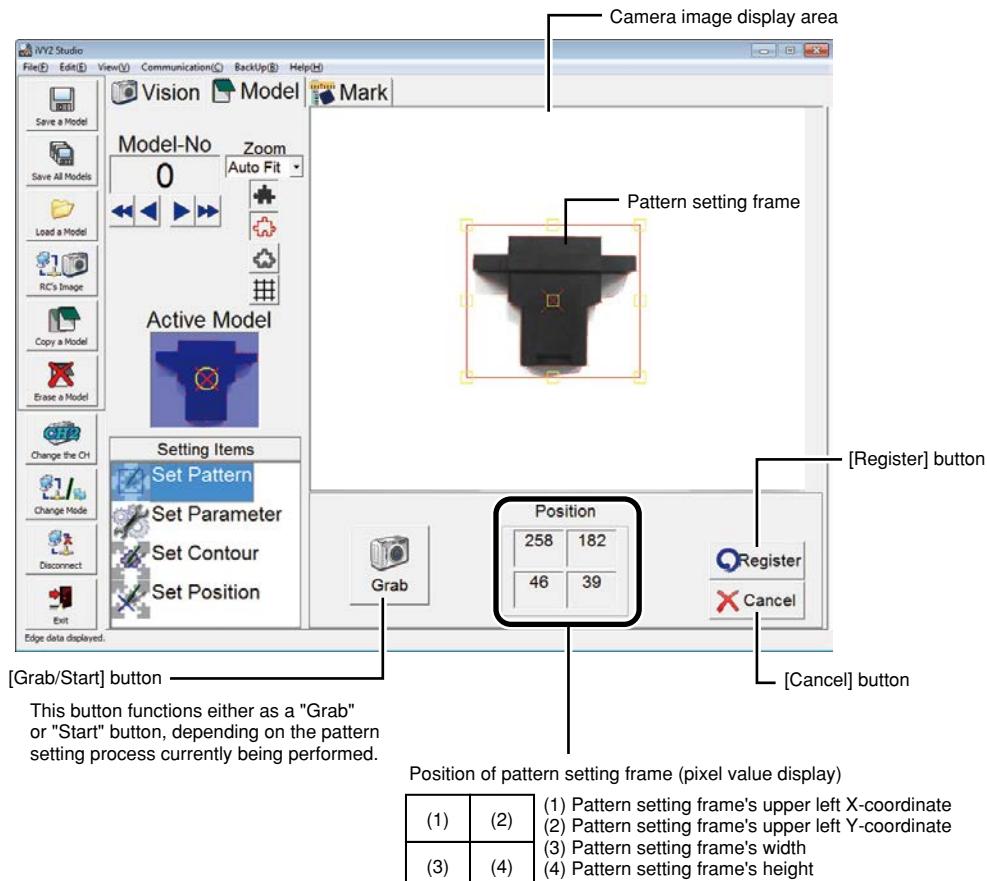


Model registration with iVY2 Studio
(Camera image display)

7.3.2 Pattern setting

The pattern setting specifies the image range to be registered within a workpiece image that has been captured by the camera, and registers that image range data at the RCXiVY2+ unit.

Model registration – Pattern setting window



The pattern setting procedure is given below.

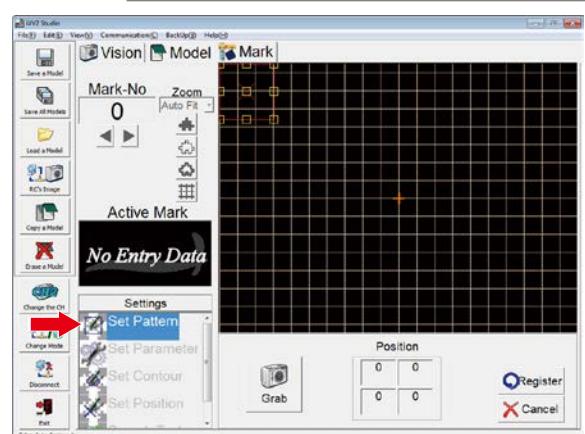


NOTE

Check the following items before beginning the pattern setting procedure.

- Verify that the model number to be registered is selected. If it is not selected, select it. For this procedure, refer to "7.1.3 Changing a model number or mark number".
- Verify that the grid display is on at the camera image display area. For this procedure, refer to "7.1.5 Switching the display".

Step 1 In Model mode, select "Set Pattern" ▶ Step 1 Selecting "Set Pattern"



Step 2 Click [Grab].

Step 3 Place the registration-object workpiece directly beneath the camera, then click [Start].

With the registration-object workpiece placed directly beneath the camera, adjust the workpiece orientation while observing the camera image display. For details concerning the orientation of the registration-object workpiece, refer to "7.3.1 Model registration and R-axis angle". To discontinue the workpiece image capture operation, press the keyboard's (ESC) key before clicking (Start).



CAUTION

When registering the workpiece, do not place it at 4 corners of the camera's field of view (FOV). If the workpiece is put at 4 corners of the camera's FOV, the registration-object workpiece image may become distorted depending on the type of lens to be used. When registering the workpiece, place the registration-object workpiece directly beneath the camera and capture the workpiece image.

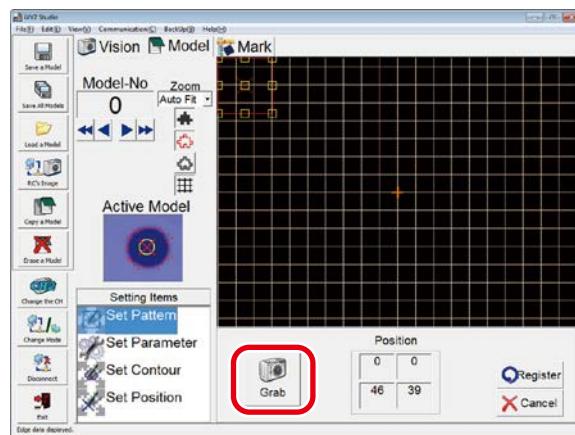
TIP

Adjusting the workpiece angle is easier with the grid display on.

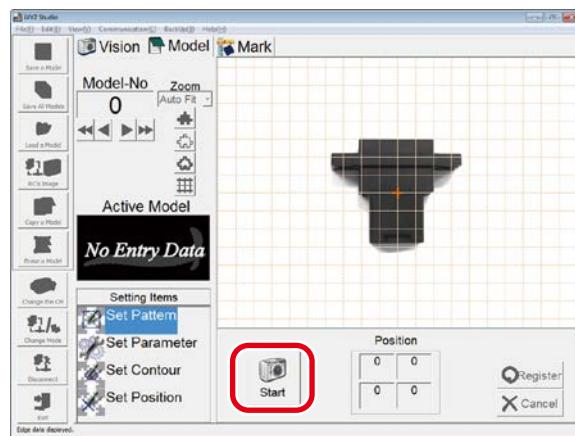
Step 4 Align the pattern setting frame with the workpiece to be registered.

To change the size of the pattern setting frame (red frame), use the mouse to drag the yellow boxes which appear on the frame lines.

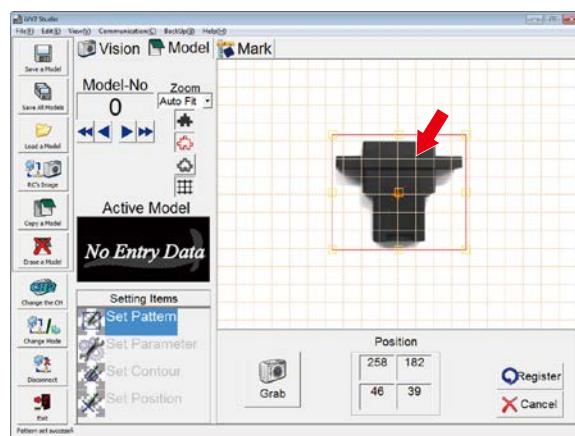
Step 2 [Grab] button



Step 3 Capturing the workpiece image



Step 4 Aligning the pattern setting frame

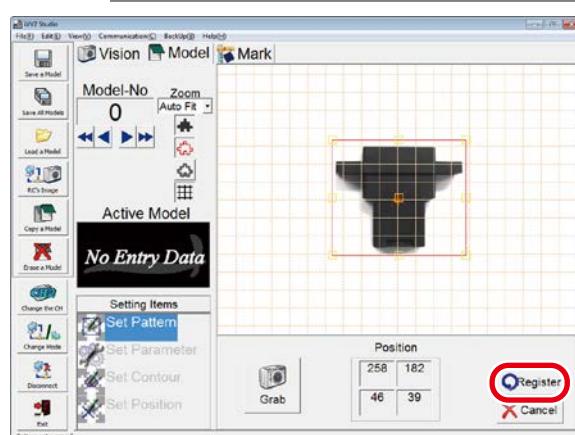


Step 5 Click [Register].

The data is transmitted to the RCXIVY2+ unit when (Register) is clicked.

To discontinue the registration operation, click (Cancel).

Step 5 Registering a pattern

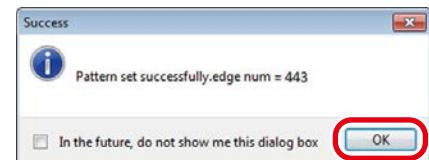


Step 6 The "Pattern set successfully" message appears.

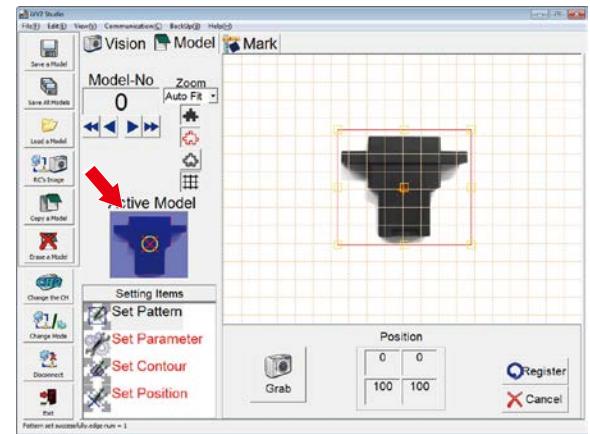
The "Pattern set successfully" message appears when the pattern registration is completed. Click [OK] at this time.

Registration is completed when the "Active Model" workpiece image is displayed in the workpiece view area.

► **Step 6** Pattern registration completed (1)



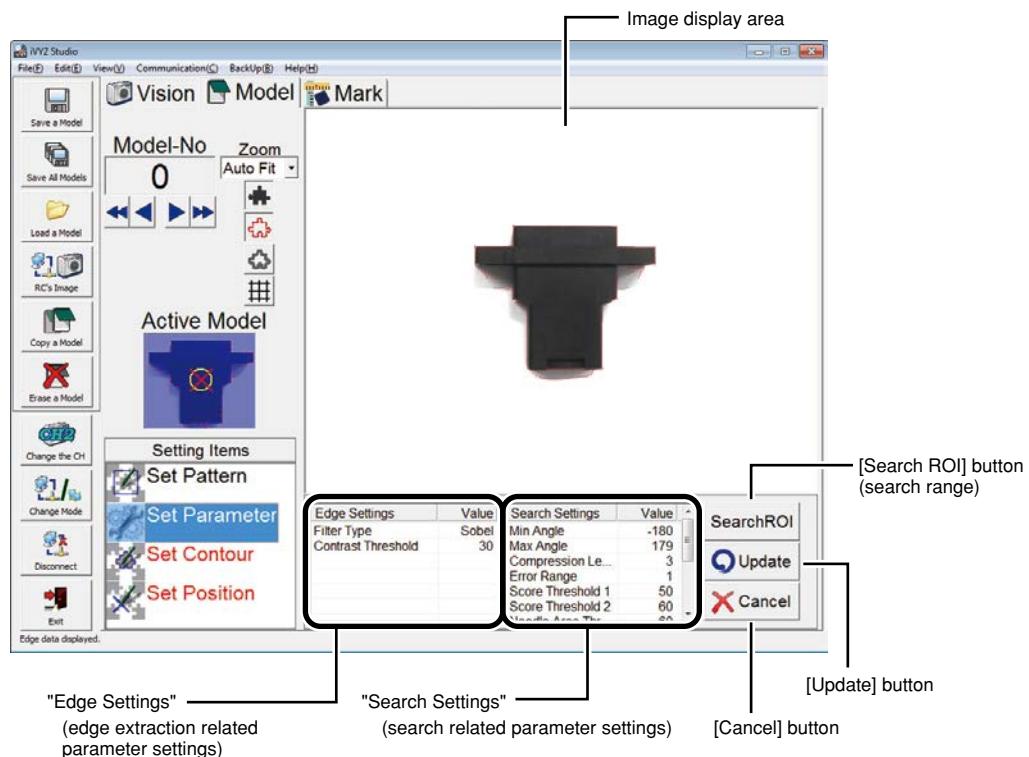
► **Step 6** Pattern registration completed (2)



7.3.3 Parameter settings

The parameter setting comprises the edge extraction and search parameter settings. The degree of edge extraction changes in accordance with changes made in the edge settings. The search results which are output change in accordance with changes made in the search settings.

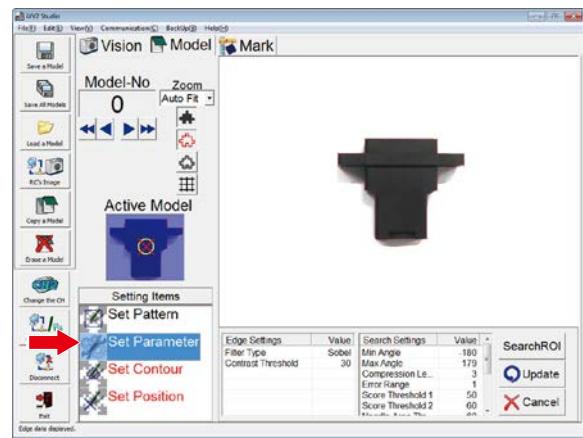
Model registration – Parameter settings window



The parameter setting procedure is given below.

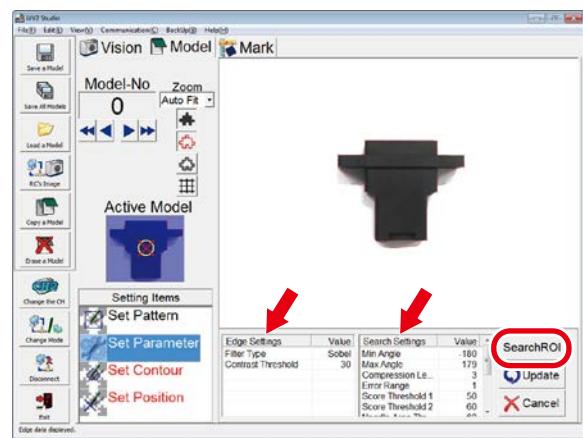
step 1 In Model mode, select "Set Parameter" from Setting Items.

► Step 1 Selecting "Set Parameter"



step 2 Specify the parameter settings.
Specify the following 3 parameter settings.

► Step 2 Setting the parameters



■ Edge Settings

The edge extraction related parameter settings are specified here.

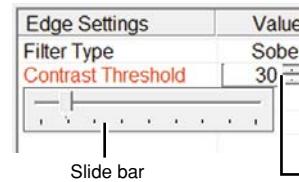
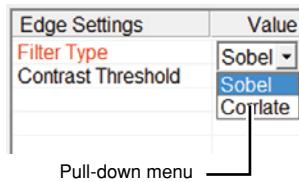
Click on the item for which a setting is to be specified. That item then is displayed in red, and Edit mode is established. Settings for parameters requiring numeric inputs can be specified by entering the numeric values from the keyboard, or by using the slide bar or spin button. Other parameter settings are specified by selections made from pull-down menus. The descriptions of each setting item, refer to A RCXiVY2+ SYSTEM EXPLANATION SECTION "5.5.1 Edge settings".

■ Search Setting

The search related parameter settings are specified here.

Click on the item for which a setting is to be specified. That item then is displayed in red, and Edit mode is established. Settings for parameters requiring numeric inputs can be specified by entering the numeric values from the keyboard, or by using the slide bar or spin button. Other parameter settings are specified by selections made from pull-down menus. The descriptions of each setting item, refer to A RCXiVY2+ SYSTEM EXPLANATION SECTION "5.5.2 Search settings".

Pull-down menu, Slide bar, Spin button



■ Search range settings

This setting specifies the search range.

A search for the specified workpiece occurs within the range specified here. The default search range setting is the camera's full FOV.

1. Click [Search ROI].

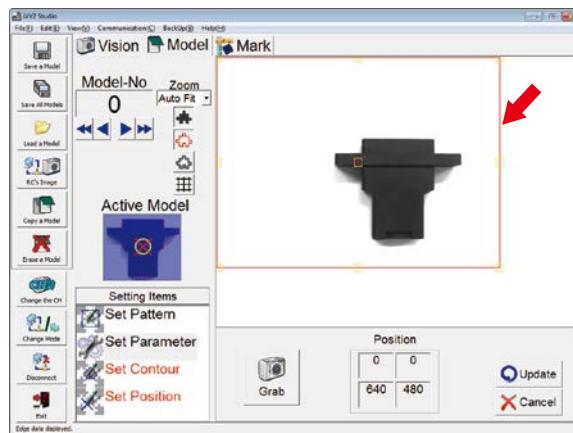
2. Specify the desired search range (red frame area).

To change the size of the range setting frame (red frame), use the mouse to drag the yellow boxes which appear on the frame lines. To move the range setting frame, use the mouse to drag the yellow box which appears in the center.

TIP

The search range (red frame) setting operation is easier if performed while changing the zoom setting.

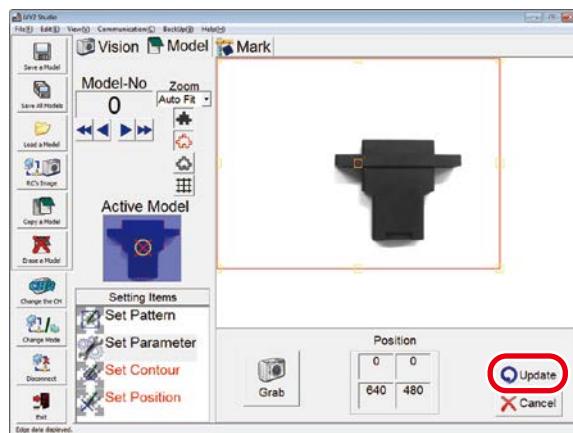
Setting the search range (1)



3. Click [Update] to register the setting changes which have been made.

To discontinue the setting operation, click [Cancel]. The original (before change) settings are then reestablished.

Setting the search range (2)



4. The "Area set successfully" message appears.

When the "Area set successfully" message appears, click [OK].

Search range setting completed



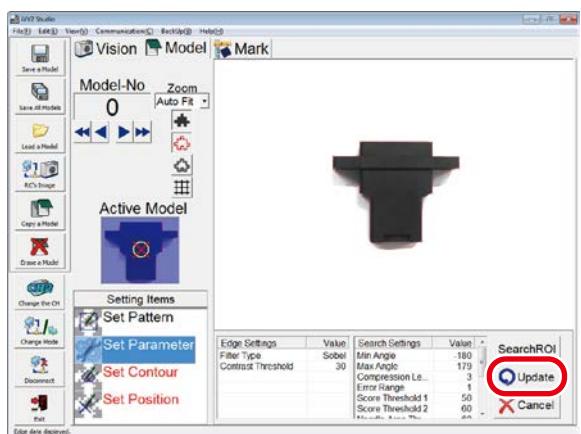
step3 Click [Update].

Click (Update) to register the setting changes which have been made. To discontinue the setting operation, click (Cancel). The original (before change) settings are then reestablished.



NOTE

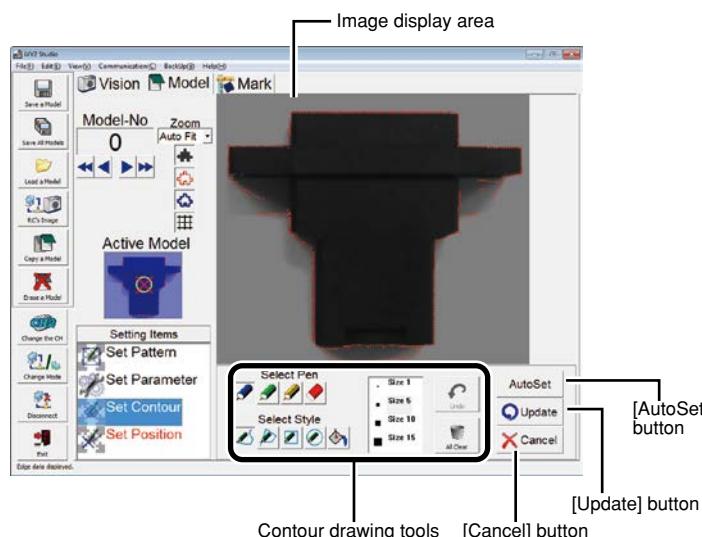
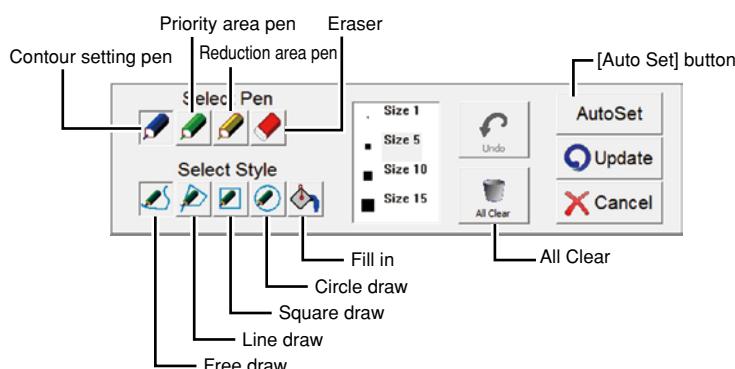
Once the search range has been changed at **Step 2** above, the original settings will not be reestablished even if (Cancel) is clicked at the parameter settings window shown above. To restore the original settings, the search range must be set again.

Step 3 Registering the parameter settings**step4 The "Parameters set successfully" message appears.**

The "Parameters set successfully" message appears when the parameter settings are completed. Click (OK) at this time.

Step 4 Parameter settings completed**7.3.4 Contour setting**

This setting specifies the workpiece contour which is used in searches. Automatically detected edges appear in red. Search operations use the edge (red area) located within the contour specified by this contour setting. The default contour setting specifies the use of all edges.

Model registration – Contour setting window**Contour drawing tools**

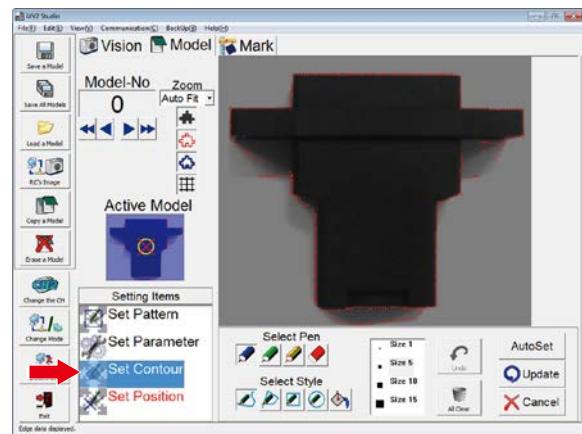
The contour setting procedure is given below.

Step 1 In Model mode, select "Set Contour" from Setting Items.

Step 2 Verify that the [Background], [Edge], and [Contour] displays are on (buttons are clicked).

Click (Background), (Edge), and (Contour) to display the image, extracted edge, and the contour to be specified. For this procedure, refer to "7.1.5 Switching the display".

Step 1 Selecting "Set Contour"



Step 3 Use the "contour draw" tools to select a contour.

Instructions for using the draw tools are given below.

■ Select Pen

- Contour setting pen: Paints (in blue) the area to be used from among the automatically detected edges.
 - Priority area pen: Paints (in green) the area to be used from among the automatically detected edges. The areas painted in green are used as priority areas at search operations. In other words, these areas are viewed as important edge areas during search. In cases where multiple similar-shaped workpieces exist, use this pen to accurately identify the separate models.
 - Reduction area pen: Paints (in yellow) the area to be used from among the automatically detected edges. The areas painted in yellow are used as unnecessary areas during search. In other words, no edges should be found in these areas. Use this pen when not searching for model workpieces having scratches or when reducing the score.
- (The score reduction can be adjusted by the "reduction weight" parameter.)



NOTE

If the areas drawn by the contour setting pen, priority area pen and reduction area pen overlap, then the area last drawn has priority.

- Eraser: Erases the color painted by the pen. (Automatically detected edges are not erased.)

■ Select Style

Selects the styles (shapes) which are drawn by the pen (contour setting pen, priority area pen and reduction area pen), and which are erased by the eraser.

- Free draw: Use to draw free shapes with the pen of the selected size. Draw by dragging the mouse. The eraser can be used in the same manner.

Free drawing



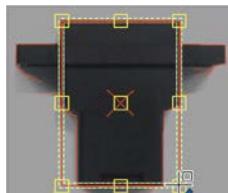
- Line draw: Use to draw a straight line between start and end points. Draw by dragging the mouse. The eraser can be used in the same manner. The red line indicates the straight line's drawing destination, and the green box indicates the straight line thickness. The yellow boxes at both ends of the straight line can be used to change the direction or length of the straight line. The box at the center can be used to move the straight line. To register the straight line, click at any point away from the line, or press the keyboard's (Enter) key. To cancel a drawn straight line (before it is registered), press the keyboard's (ESC) key.

Line drawing



- Square draw: Use to draw a square by dragging the mouse diagonally away from the start point. The eraser can be used in the same manner. The red line indicates the square's drawing destination, and the green box indicates the square line thickness. The outer perimeter yellow boxes can be used to change the size of the square, and the center box can be used to move the square. To register the square, click at any point away from the square, or press the keyboard's (Enter) key. To cancel a drawn square (before it is registered), press the keyboard's (ESC) key.

Square drawing



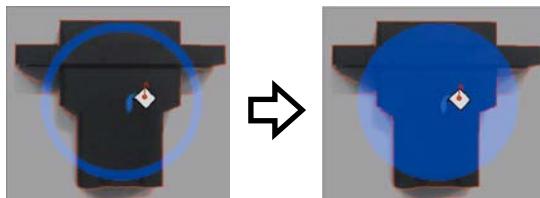
- Circle draw: Use to draw a circle by dragging the mouse diagonally away from the start point. The eraser can be used in the same manner. The red line indicates the circle's drawing destination, and the green box indicates the circle line thickness. The outer perimeter yellow boxes can be used to change the size of the circle, and the center box can be used to move the circle. To register the circle, click at any point away from the circle, or press the keyboard's (Enter) key. To cancel a drawn circle (before it is registered), press the keyboard's (ESC) key.

Circle drawing



- Fill in: Use to fill in (paint) an enclosed area by clicking inside that area. Erasing occurs in the same manner when the eraser is selected.

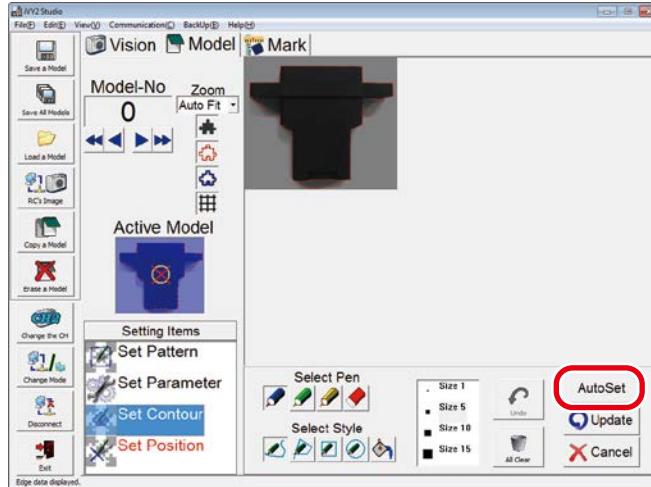
Filling in



- Size selection
Specifies the pen's line thickness and the eraser size.
- Undo
Restores the status which existed prior to the operation which was just performed. The most recent operations (up to 5 operations) can be undone.
- All Clear
Clears (deletes) all drawn objects.
- Auto contour setting
If the workpiece contour has a shape that is defined to some extent, it can easily be drawn by the auto contour setting.
(This function works well when the contour shape resembles a circle, square or cross.)
To use the auto contour setting, proceed as follows:

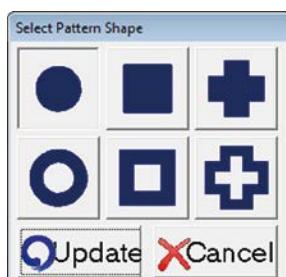
1. Click (Auto Set).

Selecting "Set Contour"



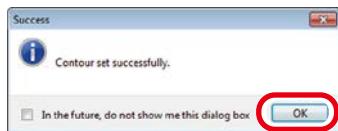
2. The "Select Pattern Shape" window appears. Select the button that is closest to the shape for auto contour setting.

"Select Pattern Shape" window



3. Click (Update).
Clicking (Update) executes auto contour setting.
To stop the auto contour setting, click (Cancel).
Clicking (Update) also changes the search settings "START angle" and "END angle" parameters.
4. A message appears indicating the setting is completed.
When the auto contour setting is completed, the message "Contour set successfully" appears.
Click (OK).

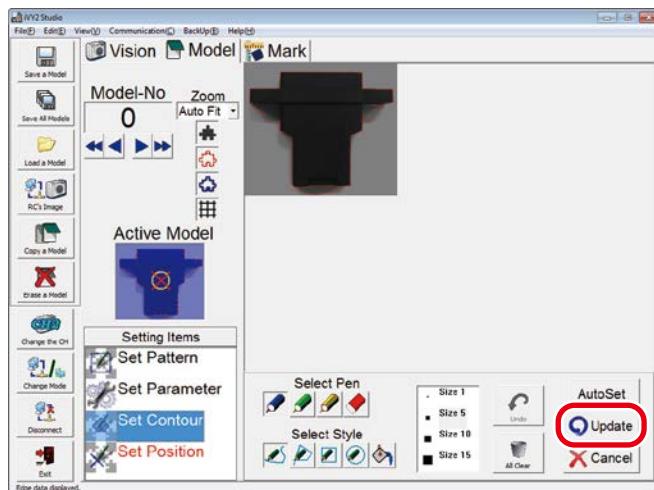
Auto contour setting completed



step4 Click [Update].

Click (Update) to register setting changes which have been made.
To discontinue the setting operation, click (Cancel).

Registering the contour setting



step5 The "Contour set successfully" message appears.

The "Contour set successfully" message appears when the contour setting is completed. Click (OK) at this time.

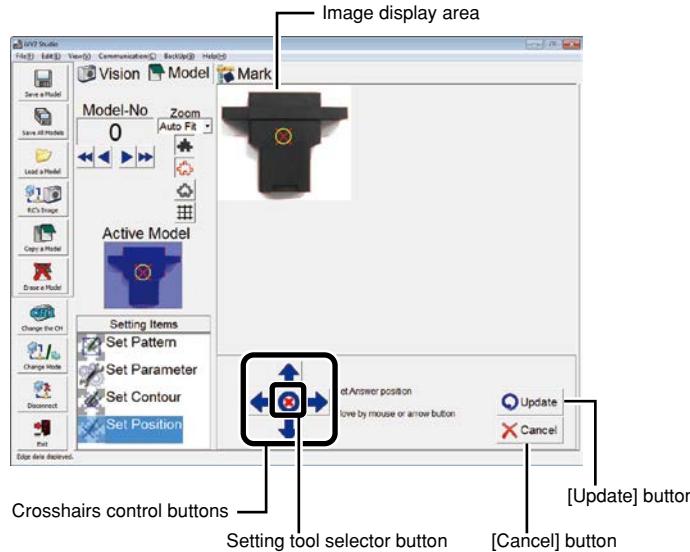
Contour setting completed



7.3.5 Detection position setting

This setting specifies the workpiece position information's reference position which is used in searches. When a search is performed, the robot movement points, etc., are generated based on this information.

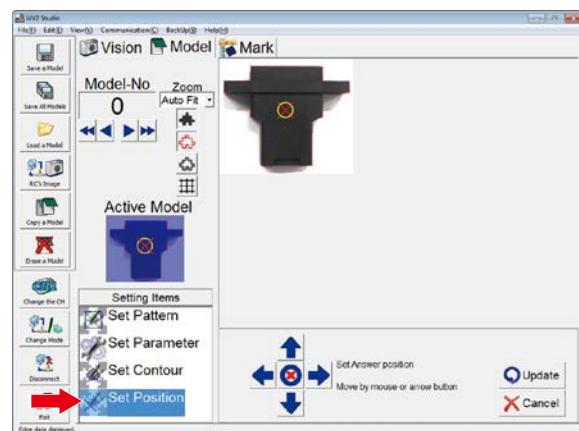
Model registration – Detection position setting window



The detection position setting procedure is given below.

Step 1 In Model mode, select "Set Position" from Setting Items.

► **Step 1 Selecting "Set Position"**

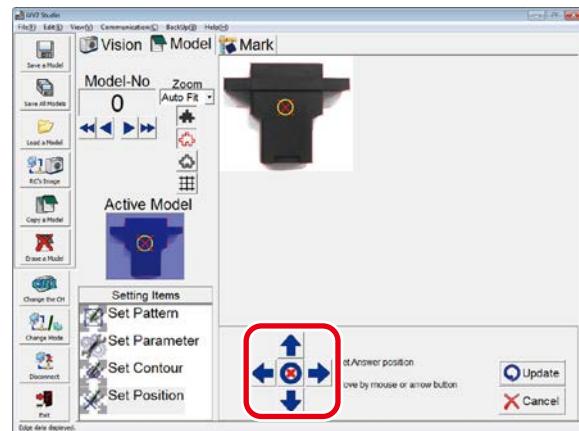


Step 2 Set the detection position.

Use the crosshairs control buttons (arrow buttons) at bottom of window to move the detection position.

The detection position can be specified by a point or rectangle designation. Each time the setting tool selector button at the center of the crosshairs control buttons is pressed, the designation method toggles between the point and rectangle method. The procedures for moving the detection position with each designation method (point/ rectangle) are shown below.

► **Step 2 Setting the detection position**



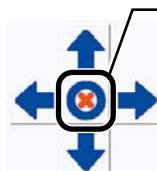
NOTE

When the search, such as VSEARCH is executed, information on workpiece position is created based on the detection position set in this step.

The position of the point data obtained by VGETPOS, etc. becomes the detection position of this workpiece. Therefore, when the movement to the position of VGETPOS is executed by the movement command, such as MOVE, the top end of the robot will move to the detection position of this workpiece. (The point data of the Z-axis becomes the Z-axis height of the robot when the search operation is executed.)

- Point designation method: Use the crosshairs control buttons (◀▶↑↓) at the bottom of the window to move the detection position. The detection position can also be moved by dragging the mark (detection position mark) with the mouse.

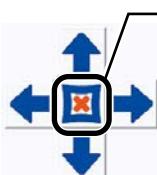
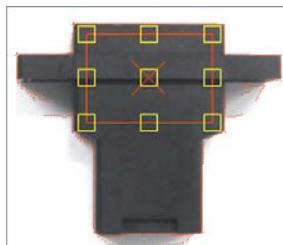
Setting the detection position by point designation



Appearance when the point designation method is selected.

- Rectangle designation method: With the rectangle designation method, the detection position is at the center of the rectangular frame. The size of the rectangular frame (red) can be changed by dragging the yellow squares at its perimeters. The rectangular designation frame can be moved by using the crosshairs control buttons (◀▶↑↓) at the bottom of the window, or by dragging the yellow square at the center of the rectangular frame.

Detection position setting by rectangle designation

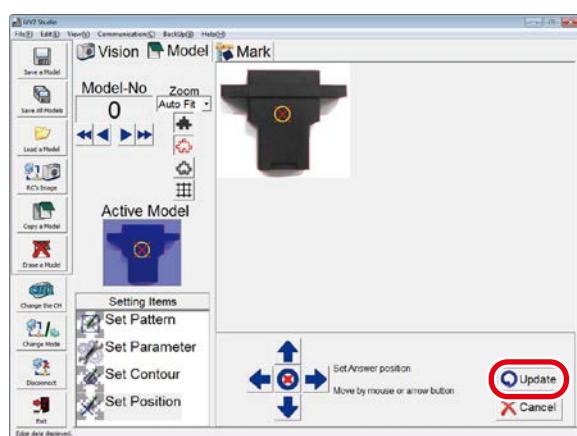


Appearance when the rectangle designation method is selected.

Step 3 Click [Update].

Click (Update) to set the detection position. To discontinue the setting operation, click (Cancel).

Step 3 Registering the detection position setting



Step 4 The "Output origin position set successfully" message appears.

The "Output origin position set successfully" message appears when the detection position setting operation is completed. Click (OK) at this time.

Step 4 Detection position setting completed



7.4 Search operations

This section explains how to perform searches.

A "search" consists of searching for registered model workpieces in the camera's captured images, and in the images saved to memory.

A search is performed to verify that registered model workpieces can be detected (have been registered successfully). Searches can be performed in the following 2 ways.

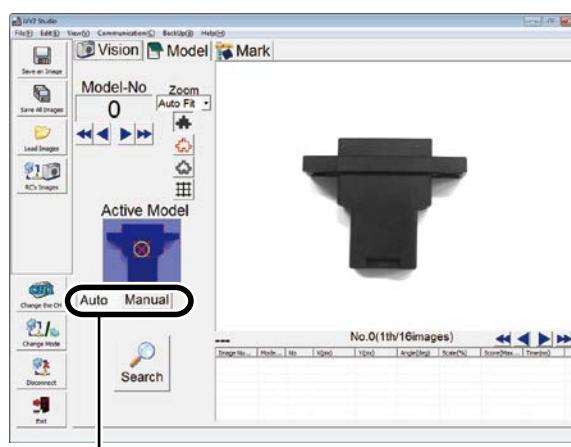
■ [Auto] search

A button is pressed to search for a registered model workpiece in the camera's captured images.

■ [Manual] search

Searches for a registered model workpiece in either the camera's captured images, or in the images already saved to memory. When using this search method, the number of images to be captured and the number of search-object images must be specified.

Search window



[Auto/Manual] switching buttons

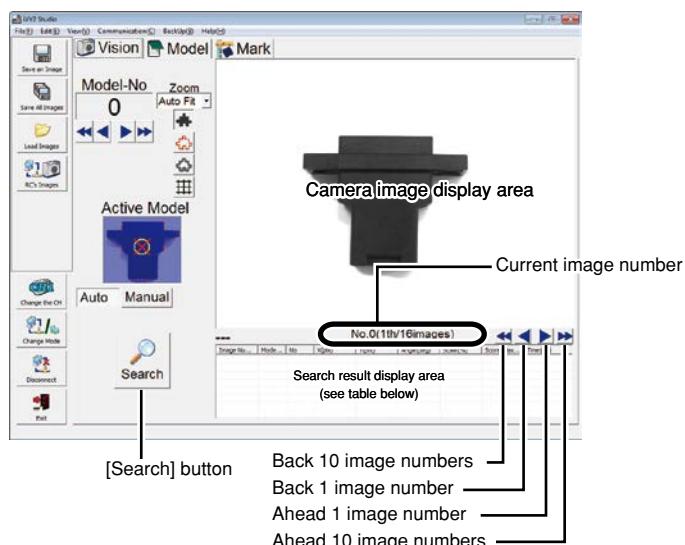
Use these buttons to switch between the Auto and Manual search modes.

In order to perform a search, RCXiVY2+ Studio must be in Edit mode. For details on how to do this, refer to "7.1.1 Switching modes".

7.4.1 Auto search

An Auto search can be performed simply by clicking a button.

Vision mode – Auto search window



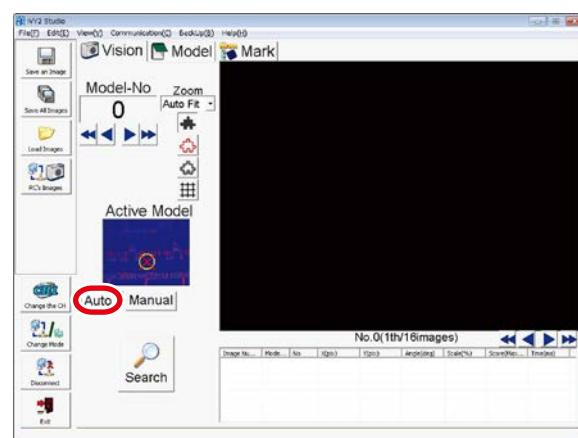
Search result display details

Item	Description
Image Number	The searched image number is indicated.
Model Number	The searched model is indicated.
No.	The detected workpiece's ranking (in descending score order) within the searched images is indicated.
X (pix)	The detected workpiece's X-position in the camera coordinate system is indicated.
Y (pix)	The detected workpiece's Y-position in the camera coordinate system is indicated.
Angle (deg)	The detected workpiece's angle (within a -180.000° to 179.999° range) is indicated.
Scale (%)	The proportional size relative to the specified model workpiece number is indicated.
Score (Max100)	The degree of correlation with the specified model workpiece number is indicated.
Time (ms)	The time required to perform the search is indicated.

The Auto search procedure is given below.

step 1 In Vision mode, select "Auto" setting.

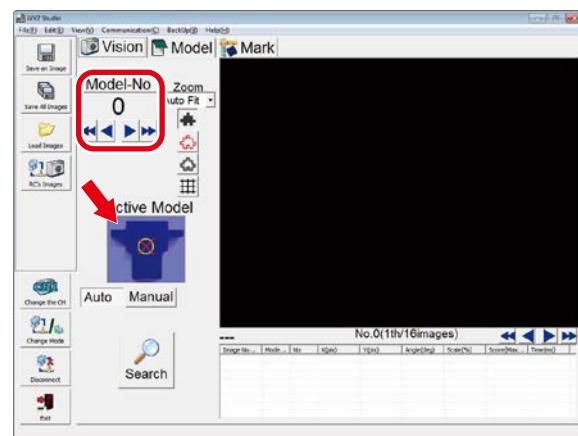
► **Step 1 Selecting "Auto search"**



step 2 Select the model number to be searched for.

An image of the search-object model number's workpiece is displayed in the "Active Model" area. Verify that the displayed workpiece image corresponds to the model to be searched for. If the search-object model number has not yet been selected, select it. For this procedure, refer to "7.1.3 Changing a model number or mark number".

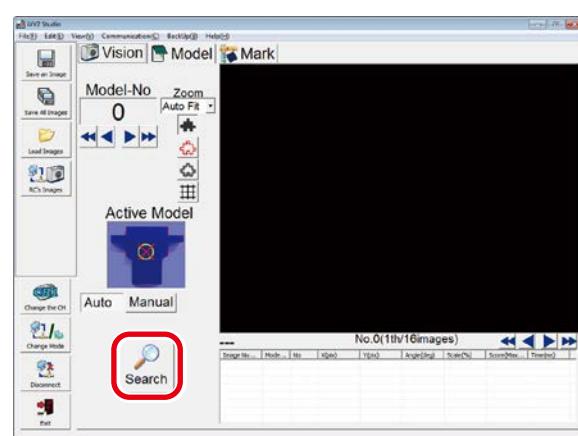
► **Step 2 Select model number**



step 3 Place the workpiece within the camera's FOV, then click [Search].

When [Search] is clicked, the image is loaded to the current (active) image number, and the search occurs.

► **Step 3 Performing an auto search**



CAUTION

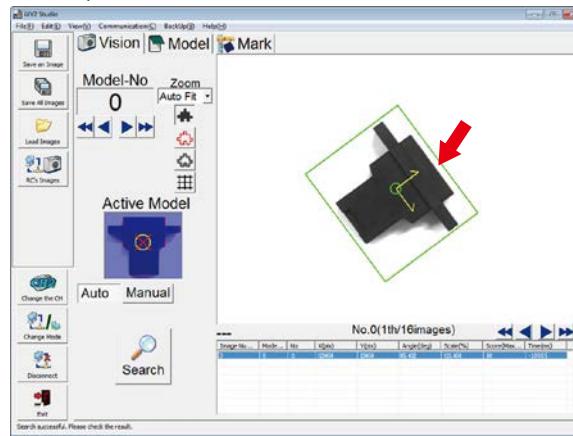
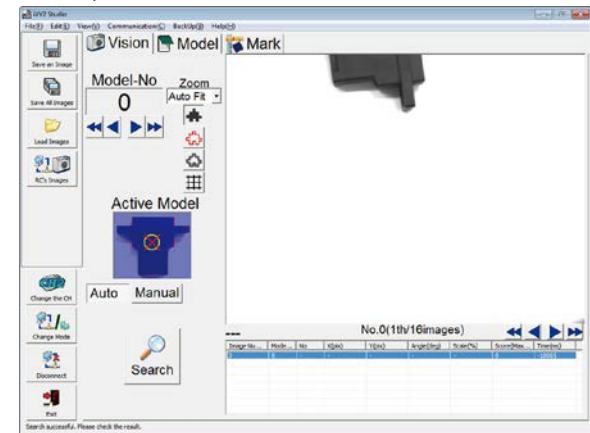
When performing the search operation, do not place the workpiece at 4 corners of the camera's FOV. If the workpiece is put at 4 corners of the camera's FOV, the workpiece image may become distorted depending on the type of lens to be used.

Step4 Check the search results.

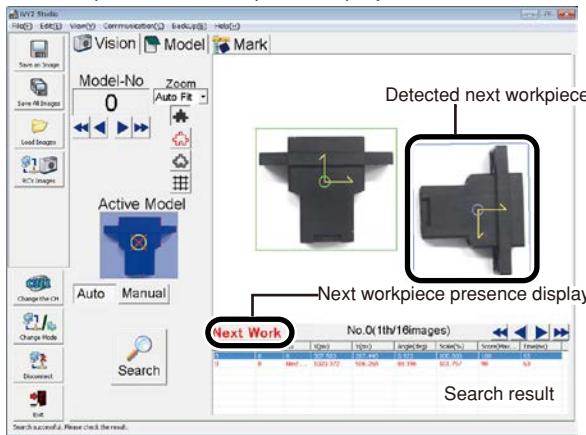
Check the detected results at the search results display area.

The workpiece is enclosed in a green frame if the search was successful. The green frame does not display if the search was unsuccessful.

If the search detected multiple workpieces, click on each line of the search results display area to move the green frame to that workpiece.

■ Example of successful search detection**■ Example of failed search detection**

When the next workpiece display function is enabled and the next workpiece is present, the search results become as follows.

■ Example of next workpiece display

For details about how to turn on or off the next workpiece display function, refer to "7.2.3 [View (V)] menu functions".

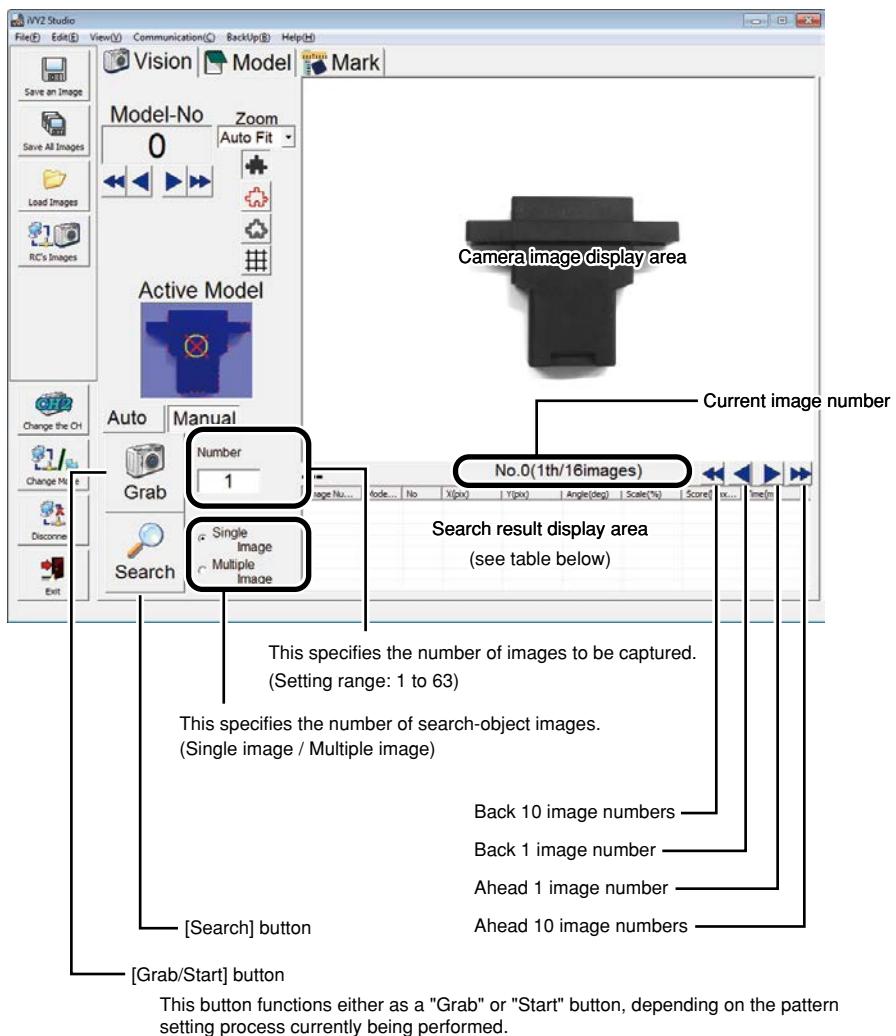
**NOTE**

- The next workpiece is present when all conditions shown below are satisfied after searching.
The number of detected workpieces is less than the detection workpieces quantity parameter value.
There are workpieces rejected by the score threshold value 2 (priority area threshold value when the priority area is set).
- Even when there are multiple rejected workpieces, the next workpiece to be detected is only one workpiece with the highest score among them.

7.4.2 Manual search

When using the Manual search method, the number of images to be captured and the number of search-object images must be specified.

Vision mode – Manual search window



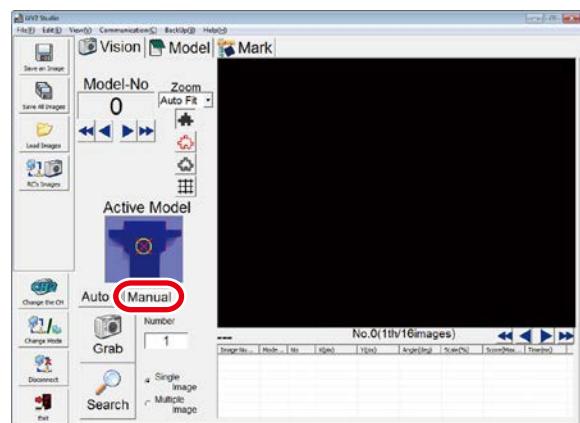
Search result display details

Item	Description
Image Number	Indicates the searched image number.
Model Number	Indicates the searched model.
No.	Indicates the detected workpiece's ranking (in descending score order) within the searched images.
X (pix)	Indicates the detected workpiece's X-position in the camera coordinate system.
Y (pix)	Indicates the detected workpiece's Y-position in the camera coordinate system.
Angle (deg)	Indicates the detected workpiece's angle (within a -180.000° to 179.999° range).
Scale (%)	Indicates the proportional size relative to the specified model workpiece number.
Score (Max100)	Indicates the degree of correlation with the specified model workpiece number.
Time (ms)	Indicates the time required to perform the search.

The Manual search procedure is given below.

Step 1 In Vision mode, select "Manual" setting.

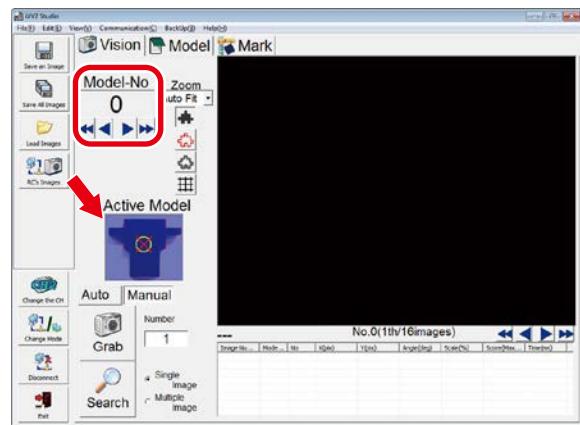
Step 1 Selecting "Manual search"



Step 2 Select the model number to be searched for.

An image of the search-object model number's workpiece is displayed in the "Active Model" area. Verify that the displayed workpiece image corresponds to the model to be searched for. If the search-object model number has not yet been selected, select it. For this procedure, refer to "7.1.3 Changing a model number or mark number".

Step 2 Select model number



Step 3 Capture the image.

Any of the following image capturing methods can be used.

■ Capturing images with the camera

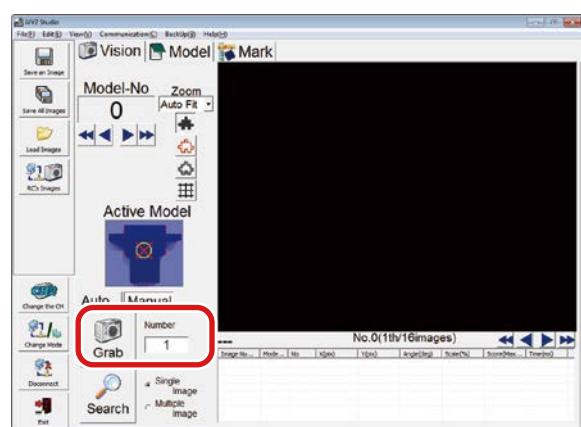
1. Specify the number of images (1 to 16) to be captured, then click (Grab).
2. Place the workpiece in the camera's FOV.
3. Click (Start).
To discontinue a workpiece image capture operation, press the keyboard's (ESC) key before (Start) has been clicked.
4. The specified number of images is captured sequentially in a continuous manner. The capture timing varies according to the camera settings. Previously loaded images are deleted when a new image capture operation occurs, and the new images are assigned sequential numbers, beginning from image number 00.
If an image capture standby continues for some reason when the camera setting's trigger mode is set to "H/W trigger", the keyboard's (ESC) key can be pressed for 1 second or longer to discontinue the capture operation.

Capturing images with the camera



CAUTION

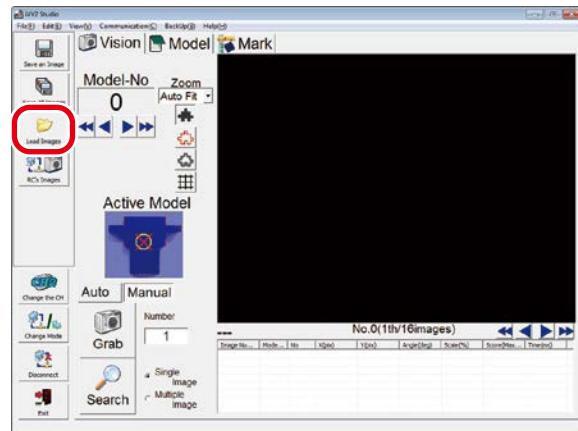
When capturing images with the camera, do not place the workpiece at 4 corners of the camera's FOV. If the workpiece is put at 4 corners of the camera's FOV, the workpiece image may become distorted depending on the type of lens to be used.



■ Loading image data from the personal computer

Click (Load Images) at the left-side toolbar, then specify the images to be loaded. When loading a single image, the current (active) image number is loaded. When loading multiple images, previously loaded images are deleted, and the new images are loaded sequentially, beginning from image number 00. For details regarding the image loading procedure, refer to "7.1.7.4 Loading images".

Loading image data from the personal computer

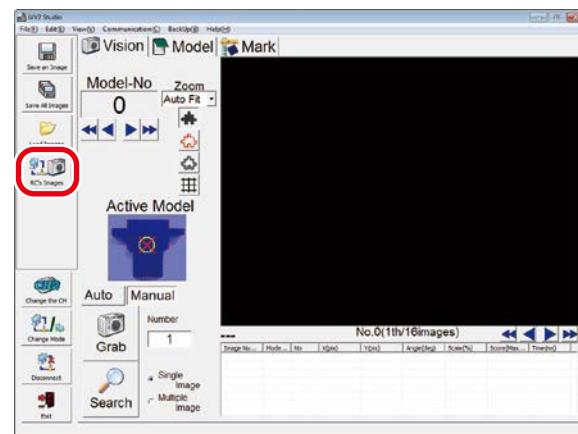


■ Loading images from the RCXiVY2+ unit

Click (RC's Images), then select the image to be loaded. When loading a single image, the current (active) image number is loaded. When loading multiple images, previously loaded images are deleted, and the new images are loaded sequentially, beginning from image number 00.

For details regarding this image loading procedure, refer to "7.1.7.5 RC image operations - loading images".

Loading image data from the RCXiVY2+ unit



Step 4 Specify the number of search-object images, then click [Search].

Setting	Description
Single image	The current (active) image number is target.
Multiple image	All the captured images are target.

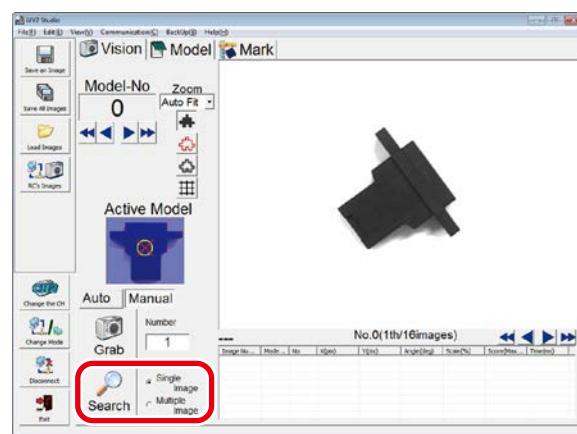
When (Search) is clicked, the search occurs in accordance with the "Single Image" or "Multiple Image" setting.



NOTE

When performing a "Single Image" search, be sure to specify the search-object image number before clicking (Search).

▶ Step 4 Executing a search



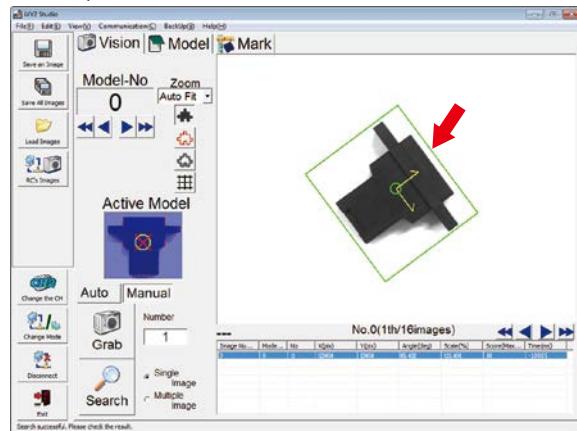
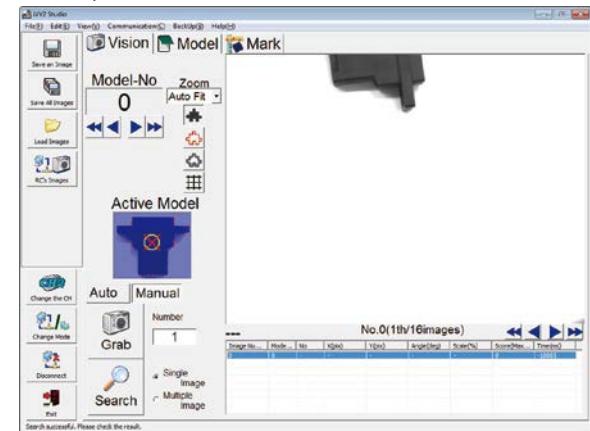
Step 5 Check the search results.

Check the detected results at the search results display area.

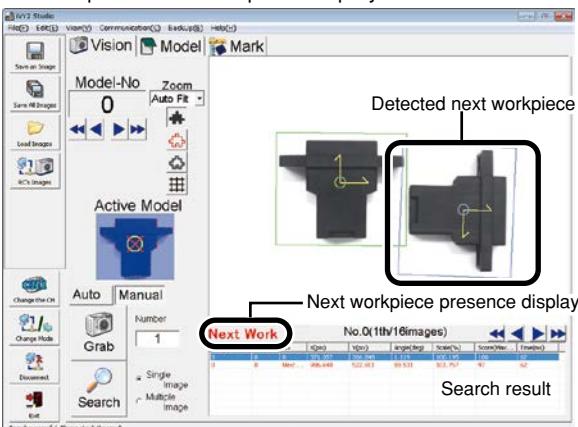
The workpiece is enclosed in a green frame if the search was successful. The green frame does not display if the search was unsuccessful.

If multiple images are detected in a "Single Image" search, click on each line of the search results display area to move the green frame to that workpiece.

The same applies to "Multiple Image" search results. Here too, click on each line of the search results display area to move the green frame to that workpiece. The arrow buttons to the right of the image number can also be used to switch the image number, with the green frame then moving accordingly to that workpiece, permitting scrolling through the search result display.

■ Example of successful search detection**■ Example of failed search detection**

When the next workpiece display function is enabled and the next workpiece is present, the search results become as follows.

■ Example of next workpiece display

For details about how to turn on or off the next workpiece display function, refer to "7.2.3 [View (V)] menu functions".

**NOTE**

- The next workpiece is present when all conditions shown below are satisfied after searching.
The number of detected workpieces is less than the detection workpieces quantity parameter value.
There are workpieces rejected by the score threshold value 2 (priority area threshold value when the priority area is set).
- Even when there are multiple rejected workpieces, the next workpiece to be detected is only one workpiece with the highest score among them.

7.5 Registering fiducial marks

Fiducial marks are required in order to perform camera calibration operations.

When the camera height is changed, this causes deviations in the coordinates (camera coordinates) of the image to be captured, and in the robot coordinates. Therefore, camera calibration settings are required for each camera height.

The RCXiVY2+ system can save 32 sets of camera calibration data. Camera calibration settings are specified from the RCXiVY2+ Studio, based on the fiducial marks which have been registered at RCXiVY2+ Studio. For details, refer to A RCXiVY2+ SYSTEM EXPLANATION SECTION "6. Camera calibration".
2 fiducial marks are required for each camera calibration setting.

TIP

"Camera calibration" refers to the process in which the coordinates (camera coordinates) of the image captured by the camera are aligned with the robot coordinates.

**NOTE**

- No more than 2 fiducial marks (mark numbers 0, 1) can be registered, regardless of the camera channel. Therefore, fiducial mark registration is required at each camera calibration setting operation.
- After registering fiducial marks, be sure to save that fiducial mark data to the personal computer.
- The 2 fiducial marks to be registered must have different shapes.

The fiducial mark registration procedure is given below.

A fiducial mark registration operation consists of capturing the fiducial mark image with the camera, and then registering that image. The following 5 settings are required in order to register fiducial marks.

■ Set Pattern

A mark image is captured, and the range of the image to be registered is specified.

■ Set Parameter

The edge extraction and search parameter settings are specified.

■ Set Contour

The fiducial mark contour is specified.

■ Set Position

Specifies the reference position for the workpiece position information used at searches.

■ Search Test

Verifies that registered marks can be detected successfully.

The settings required for fiducial mark registration must be performed in the following order.

Setting order

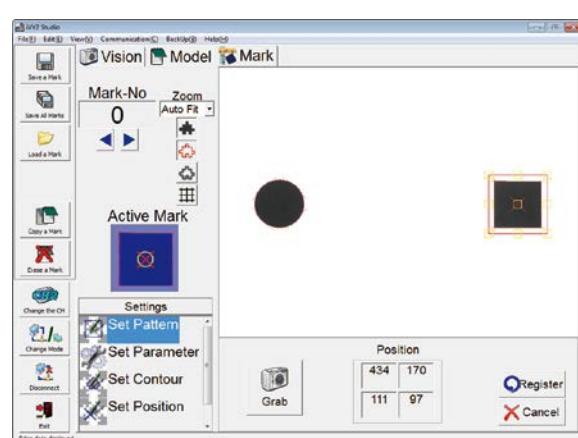
Set Pattern → Set Parameter → Set Contour → Set Position → Search Test

**NOTE**

The above settings must be specified again if specified in the wrong order. Be sure to specify the settings in the order shown above.

In order to register a fiducial mark, RCXiVY2+ Studio must be in Edit mode. For details on how to do this, refer to "7.1.1 Switching modes".

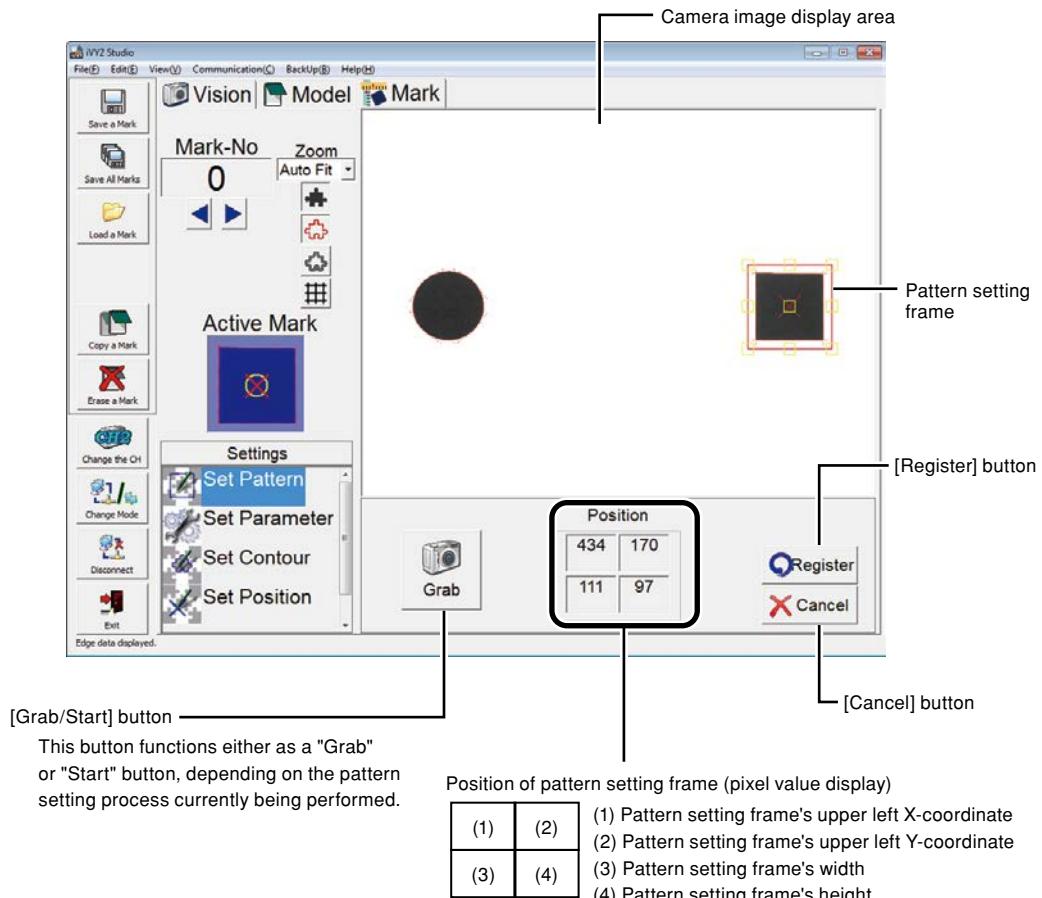
Fiducial mark registration window



7.5.1 Pattern setting

The fiducial mark's pattern setting operation consists of capturing the fiducial mark image, specifying the image range to be registered in that image, and then registering that data at the RCXiViVY2+ unit.

Fiducial mark pattern setting window



The fiducial mark pattern setting procedure is given below.



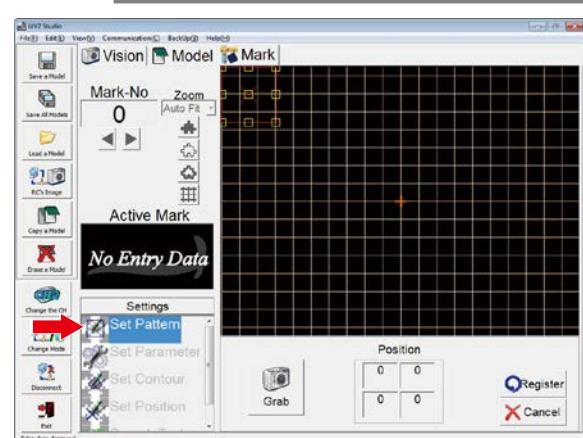
NOTE

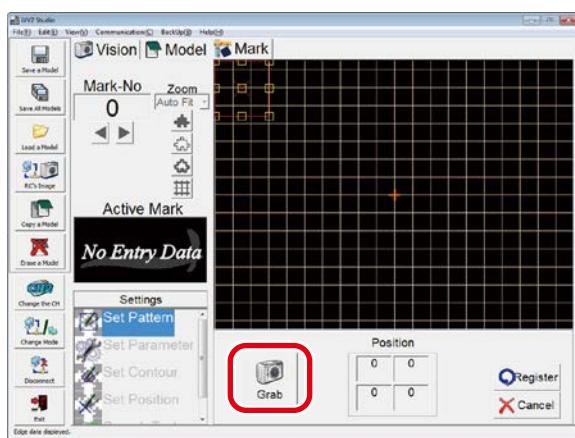
Check the following items before beginning the pattern setting procedure.

- Verify that the mark number to be registered is selected. If it is not selected, select it. For this procedure, refer to "7.1.3 Changing a model number or mark number".
- Verify that the grid display is on at the camera image display area. For this procedure, refer to "7.1.5 Switching the display".

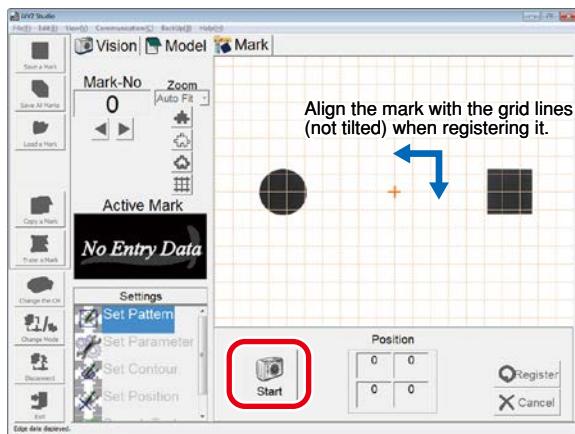
Step 1 In Mark mode, select "Set Pattern" from Setting Items.

► **Step 1 Selecting "Set Pattern"**



step2 Click [Grab].**Step 2** [Grab] button**step3** Place the registration-object mark directly beneath the camera, then click [Start].

With the registration-object mark placed directly beneath the camera, adjust the mark position (while observing the camera image display) so that the mark is perpendicular to the window. Perform this mark position adjustment by aligning the mark's angle with the window's grid lines. To discontinue the mark image capture operation, press the keyboard's (ESC) key before (Start) is clicked.

Step 3 Capturing a fiducial mark image**CAUTION**

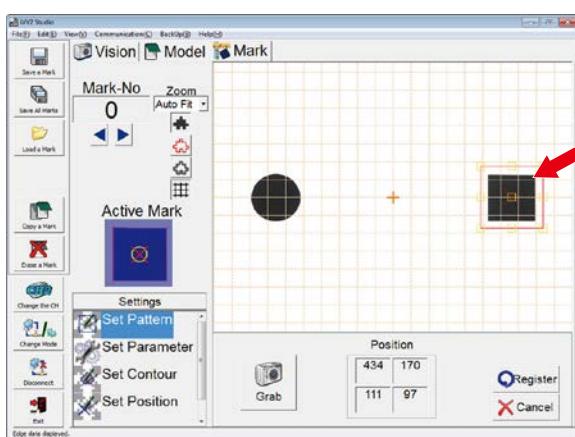
When registering the fiducial mark, do not place the mark at 4 corners of the camera's FOV. If the mark is put at 4 corners of the camera's FOV, the registration-object mark image may become distorted depending on the type of lens to be used. When registering the fiducial mark, place the registration-object mark directly beneath the camera and capture the mark image.

**NOTE**

Registering a mark with its angle aligned with the grid lines enables the camera and robot coordinate angles to be aligned at camera calibration operations.

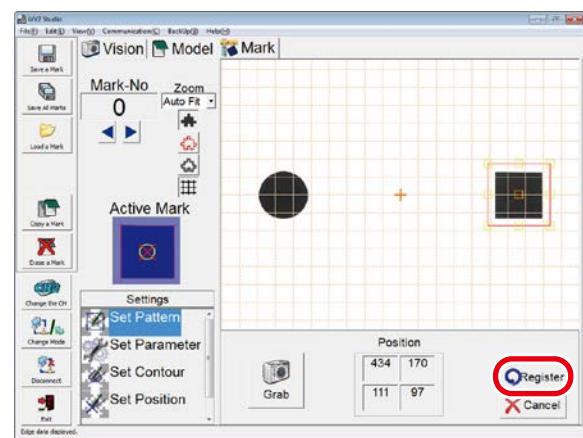
step4 Align the pattern setting frame with the mark to be registered.

To change the size of the pattern setting frame (red frame), use the mouse to drag the yellow boxes which appear on the frame lines.

Step 4 Aligning the pattern setting frame

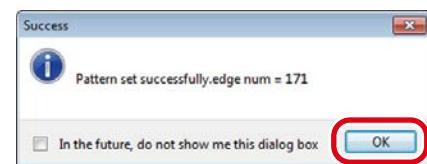
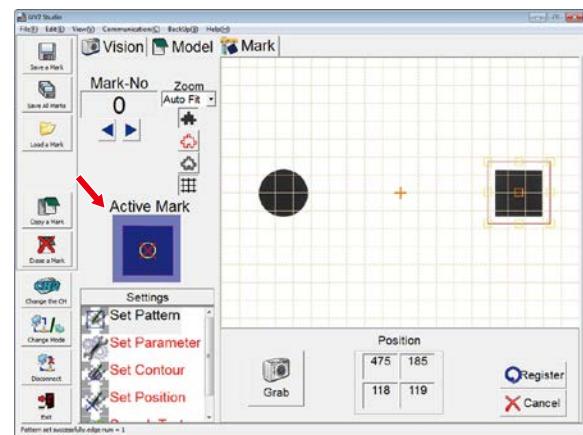
Step 5 Click [Register].

The data is transmitted to the RCXiIVY2+ unit when [Register] is clicked.
To discontinue the registration operation, click [Cancel].

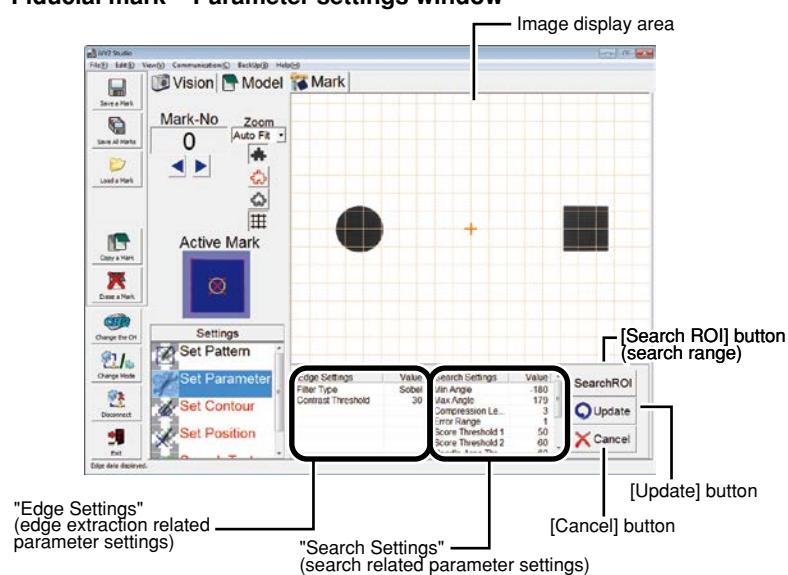
Step 5 Registering a pattern**Step 6 The "Pattern set successfully" message appears.**

The "Pattern set successfully" message appears when the pattern registration is completed. Click [OK] at this time.

The registration is completed when the "Active Mark" workpiece image is displayed in the workpiece view area.

Step 6 Pattern registration completed (1)**Step 6 Pattern registration completed (2)****7.5.2 Parameter settings**

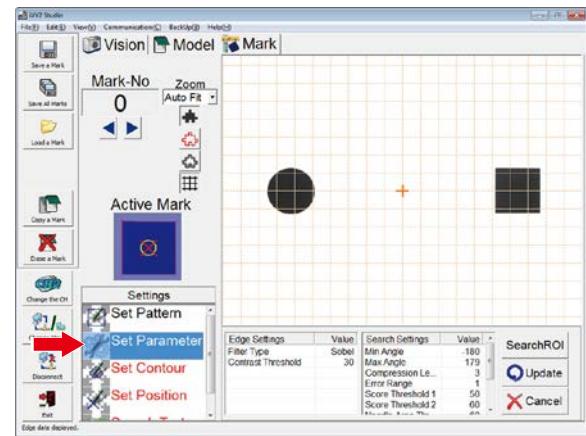
The fiducial mark parameter setting comprises the edge extraction and search parameter settings. The degree of edge extraction changes in accordance with changes made in the edge settings. The search results which are output change in accordance with changes made in the search settings.

Fiducial mark – Parameter settings window

The fiducial mark parameter setting procedure is given below.

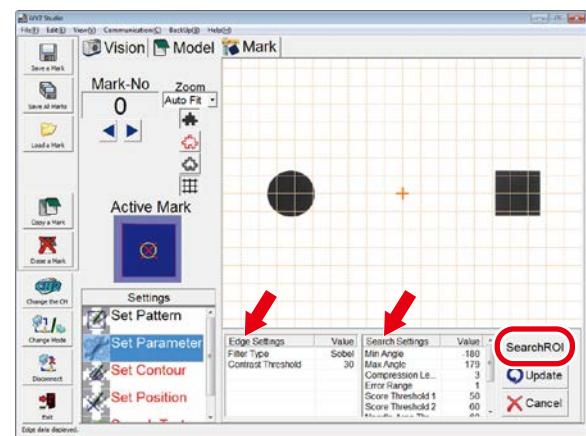
Step 1 In Mark mode, select "Set Parameter" from Setting Items.

Step 1 Selecting "Set Parameter"



Step 2 Specify the parameter settings.
Specify the following 3 parameter settings.

Step 2 Setting the parameters



■ Edge Settings

The edge extraction related parameter settings are specified here.

Click on the item for which a setting is to be specified. That item then is displayed in red, and Edit mode is established.

Settings for parameters requiring numeric inputs can be specified by entering the numeric values from the keyboard, or by using the slide bar or spin button. Other parameter settings are specified by selections made from pull-down menus.

The descriptions of each setting item, refer to A RCXiVY2+ SYSTEM EXPLANATION SECTION "5.5.1 Edge settings".

■ Search Setting

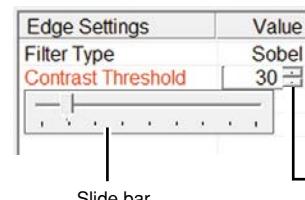
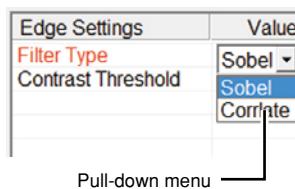
The search related parameter settings are specified here.

Click on the item for which a setting is to be specified. That item then is displayed in red, and Edit mode is established.

Settings for parameters requiring numeric inputs can be specified by entering the numeric values from the keyboard, or by using the slide bar or spin button. Other parameter settings are specified by selections made from pull-down menus.

The descriptions of each setting item, refer to A RCXiVY2+ SYSTEM EXPLANATION SECTION "5.5.2 Search settings".

Pull-down menu, Slide bar, Spin button



■ Search range settings

This setting specifies the search range.

A search for the specified fiducial mark occurs within the range specified here. The default search range setting is the camera's full FOV.

1. Click (Search ROI).

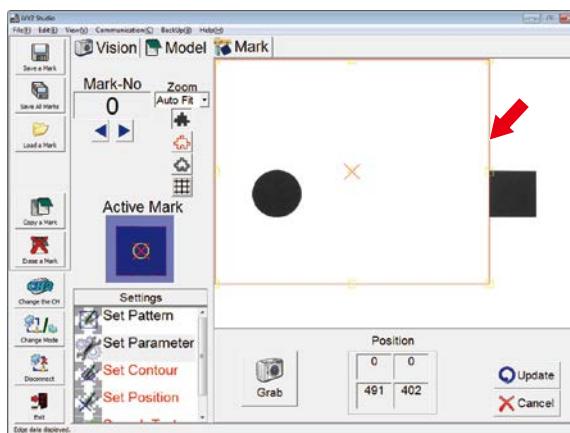
2. Specify the desired search range (red frame area).

To change the size of the range setting frame (red frame), use the mouse to drag the yellow boxes which appear on the frame lines. To move the range setting frame, use the mouse to drag the yellow box which appears in the center.

TIP

The search range (red frame) setting operation is easier if performed while changing the zoom setting.

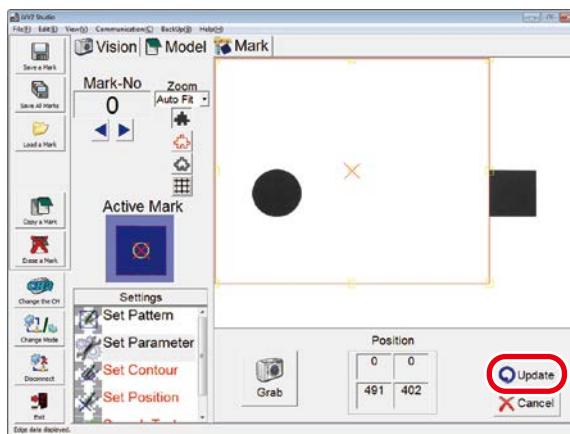
Setting the search range (1)



3. Click (Update) to register the setting changes which have been made.

To discontinue the setting operation, click (Cancel). The original (before change) settings are then reestablished.

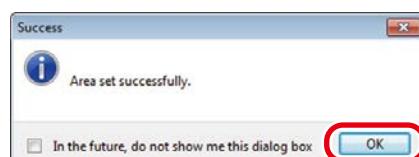
Setting the search range (2)



4. The "Area set successfully" message appears.

The "Area set successfully" message appears when the search range setting is completed. Click (OK) at this time.

Search range setting completed



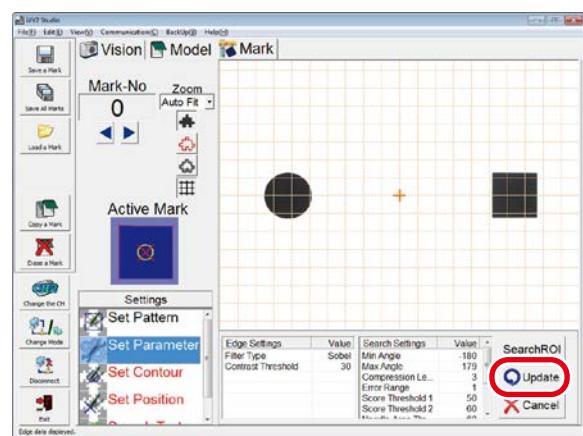
Step 3 Click [Update].

Click (Update) to register the setting changes which have been made. To discontinue the setting operation, click (Cancel). The original (before change) settings are then reestablished.

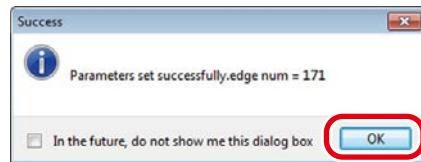


NOTE

Once the search range has been changed at Step 2 above, the original settings will not be reestablished even if (Cancel) is clicked at the parameter settings window shown above. To restore the original settings, the search range must be set again.

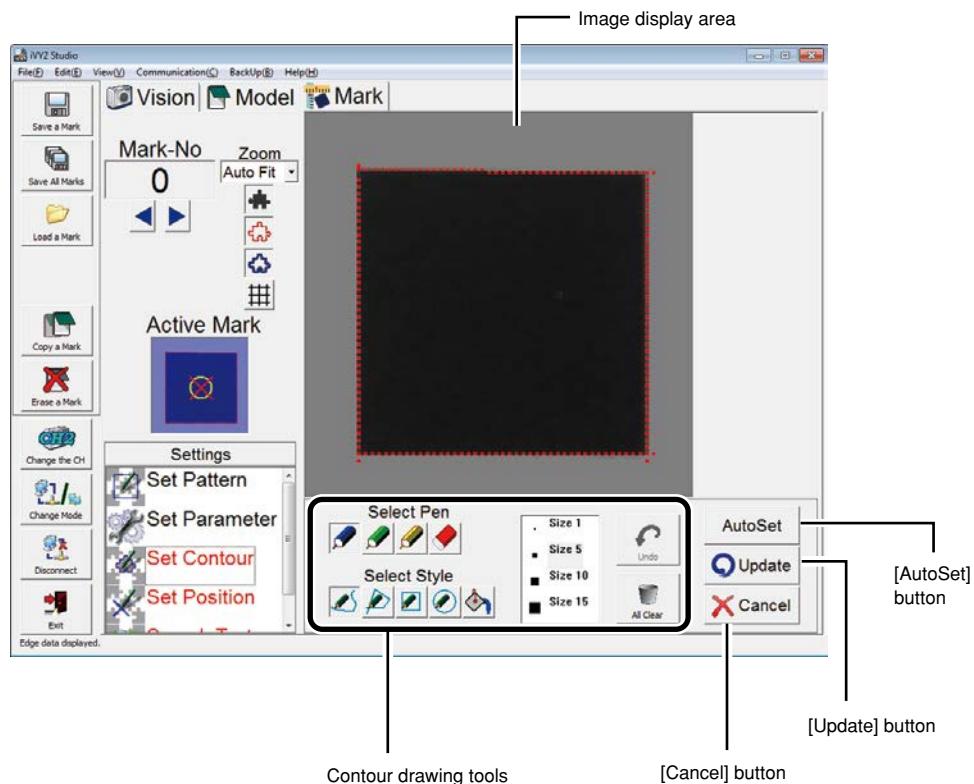
Step 3 Registering the parameter settings**Step 4 The "Parameters set successfully" message appears.**

The "Parameters set successfully" message appears when the parameter settings are completed. Click (OK) at this time.

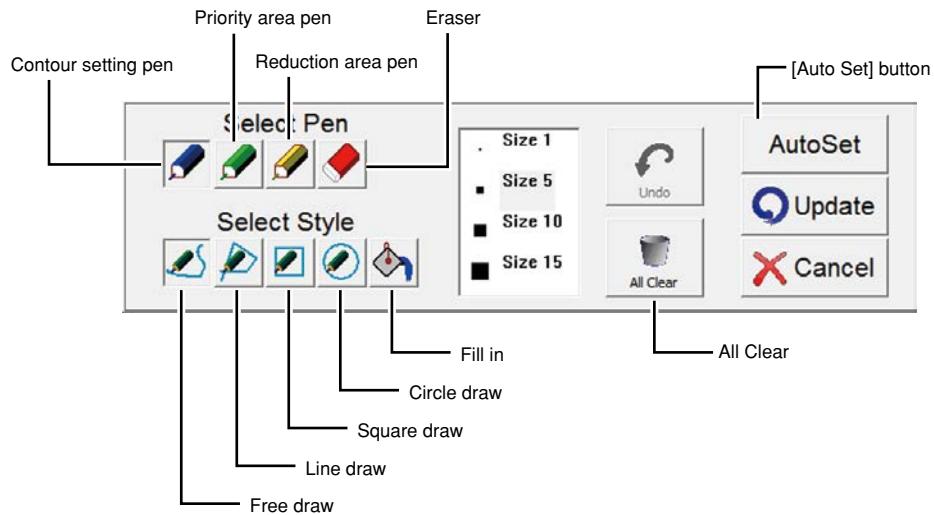
Step 4 Parameter settings completed**7.5.3 Contour setting**

This setting specifies the fiducial mark contour which is used in searches. Automatically detected edges appear in red. Search operations use the edge (red area) located within the contour specified by this contour setting.

The default contour setting specifies the use of all edges.

Fiducial mark – Contour setting window

Contour drawing tools



The fiducial mark contour setting procedure is given below.

Step 1 In Mark mode, select "Set Contour" ▶ **Step 1** Selecting "Set Contour"

Step 2 Verify that the [Background], [Edge], and [Contour] displays are on (buttons are clicked).

Click (Background), (Edge), and (Contour) to display the image, extracted edge, and the contour to be specified. For this procedure, refer to "7.1.5 Switching the display".

Step 3 Use the contour draw tools to select a contour.

Instructions for using the draw tools are given below.

■ Select Pen

- Contour setting pen: Paints (in blue) the area to be used from among the automatically detected edges.
- Priority area pen: Paints (in green) the area to be used from among the automatically detected edges. The areas painted in green are used as priority areas at search operations. In other words, these areas are viewed as important edge areas during search. In cases where multiple similar-shaped workpieces exist, use this pen to accurately identify the separate models.
- Reduction area pen: Paints (in yellow) the area to be used from among the automatically detected edges. The areas painted in yellow are used as unnecessary areas during search. In other words, no edges should be found in these areas. Use this pen when not searching for model workpieces having scratches or when reducing the score.

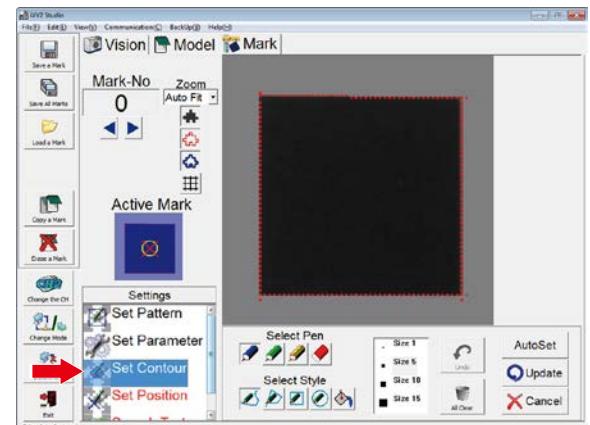
(The score reduction can be adjusted by the "reduction weight" parameter.)



NOTE

If the areas drawn by the contour setting pen, priority area pen and reduction area pen overlap, then the area last drawn has priority.

- Eraser: Erases the color painted by the pen. (Automatically detected edges are not erased.)

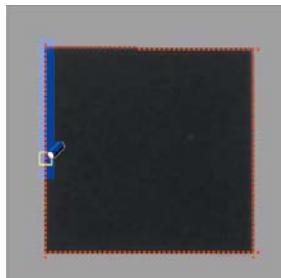


■ Select Style

Selects the styles (shapes) which are drawn by the pen (contour setting pen, priority area pen and reduction area pen), and which are erased by the eraser.

- Free draw: Use to draw free shapes with the pen of the selected size. Draw by dragging the mouse. The eraser can be used in the same manner.

Free drawing



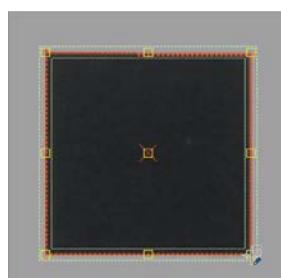
- Line draw: Use to draw a straight line between start and end points. Draw by dragging the mouse. The eraser can be used in the same manner.
The red line indicates the straight line's drawing destination, and the green box indicates the straight line thickness. The yellow boxes at both ends of the straight line can be used to change the direction or length of the straight line. The box at the center can be used to move the straight line.
To register the straight line, click at any point away from the line, or press the keyboard's [Enter] key.
To cancel a drawn straight line (before it is registered), press the keyboard's [ESC] key.

Line drawing



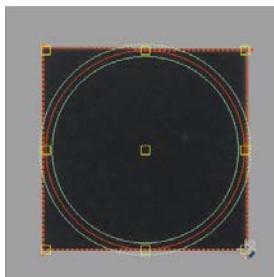
- Square draw: Use to draw a square by dragging the mouse diagonally away from the start point. The eraser can be used in the same manner.
The red line indicates the square's drawing destination, and the green box indicates the square line thickness. The outer perimeter yellow boxes can be used to change the size of the square, and the center box can be used to move the square.
To register the square, click at any point away from the square, or press the keyboard's [Enter] key.
To cancel a drawn square (before it is registered), press the keyboard's [ESC] key.

Square drawing



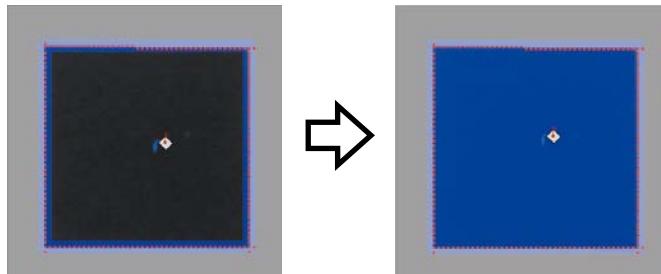
- Circle draw: Use to draw a circle by dragging the mouse diagonally away from the start point. The eraser can be used in the same manner. The red line indicates the circle's drawing destination, and the green box indicates the circle line thickness. The outer perimeter yellow boxes can be used to change the size of the circle, and the center box can be used to move the circle. To register the circle, click at any point away from the circle, or press the keyboard's [Enter] key. To cancel a drawn circle (before it is registered), press the keyboard's [ESC] key.

Circle drawing



- Fill in: Use to fill in (paint) an enclosed area by clicking inside that area. Erasing occurs in the same manner when the eraser is selected.

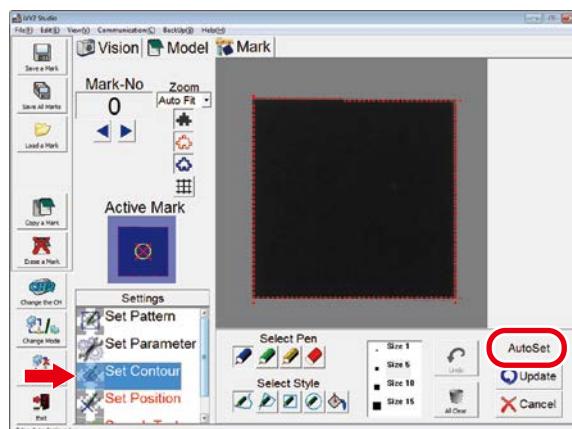
Filling in



- Size selection
Specifies the pen's line thickness and the eraser size.
- Undo
Restores the status which existed prior to the operation which was just performed. The most recent operations (up to 5 operations) can be undone.
- All Clear
Clears (deletes) all drawn objects.
- Auto contour setting
If the workpiece contour has a shape that is defined to some extent, it can easily be drawn by the auto contour setting.
(This function works well when the contour shape resembles a circle, square or cross.)
To use the auto contour setting, proceed as follows:

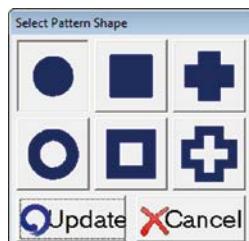
1. Click (Auto Set).

Selecting "Auto Set"



2. The "Select Pattern Shape" window appears. Select the button that is closest to the shape for auto contour setting.

"Select Pattern Shape" window



3. Click (Update).
Clicking (Update) executes auto contour setting.
To stop the auto contour setting, click (Cancel).
Clicking (Update) also changes the search settings "START angle" and "END angle" parameters.
4. A message appears indicating the setting is completed.
When the auto contour setting is completed, the message "Contour set successfully" appears.
Click (OK).

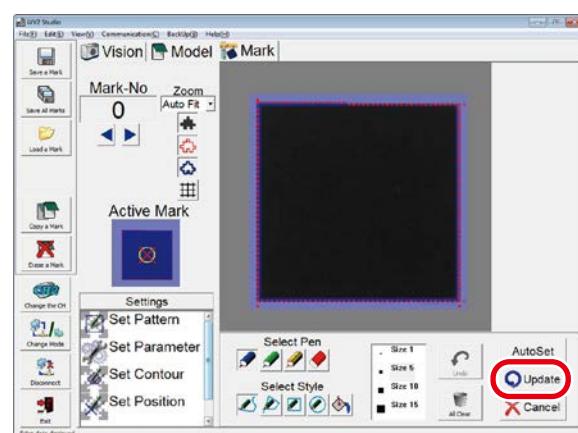
Auto contour setting completed



step4 Click [Update].

*Click (Update) to register setting changes which have been made.
To discontinue the setting operation, click (Cancel).*

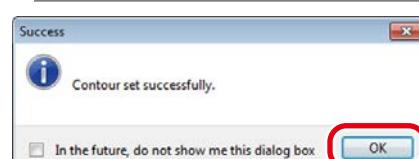
▶ Step 4 Registering the contour setting



step5 The "Contour set successfully" message appears.

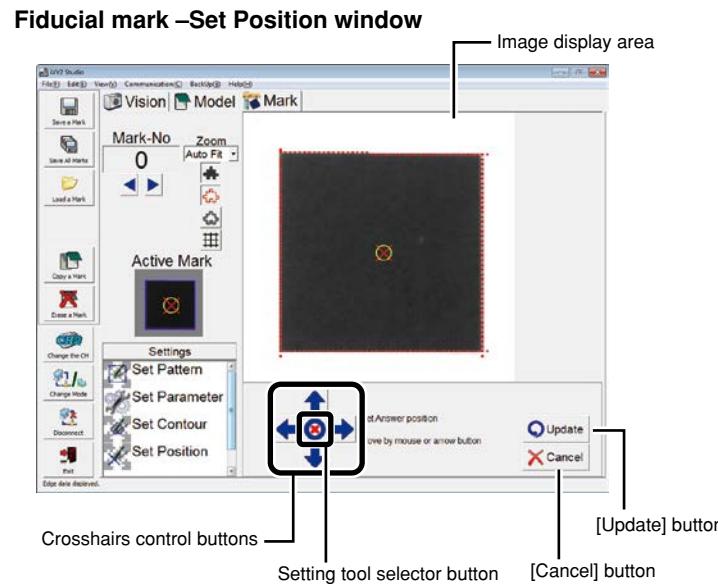
The "Contour set successfully" message appears when the contour setting is completed. Click (OK) at this time.

▶ Step 5 Contour setting completed



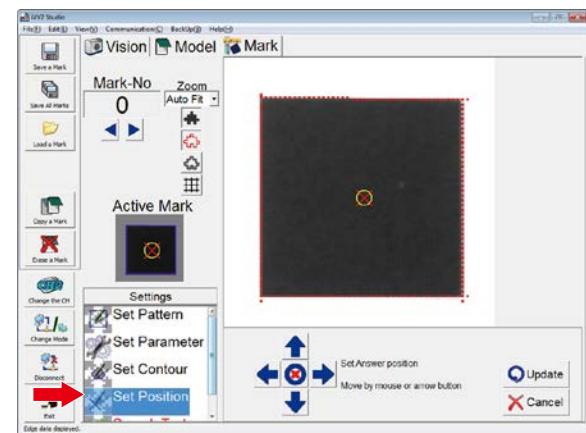
7.5.4 Detection position setting

This setting specifies the reference position for the fiducial mark position information used at searches. The position registered here is recognized as the fiducial mark center point.



The fiducial mark detection position setting procedure is given below.

Step 1 In Mark mode, select "Set Position" ▶ **Step 1 Selecting "Set Position"**

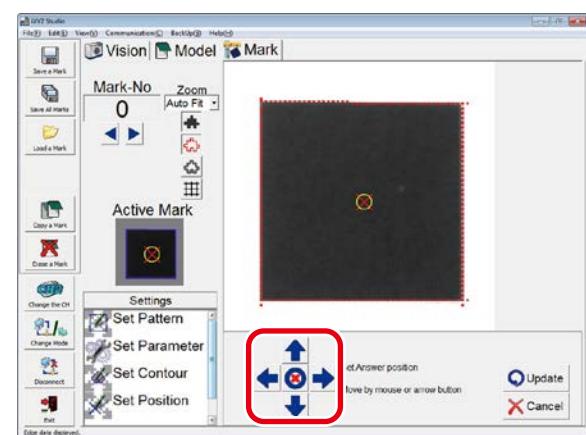


Step 2 Set the detection position.

Use the crosshairs control buttons (arrow buttons) at bottom of window to move the detection position.

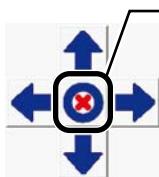
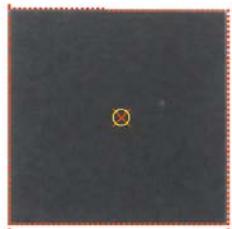
The detection position can be specified by a point or rectangle designation. Each time the setting tool selector button at the center of the crosshairs control buttons is pressed, the designation method toggles between the point and rectangle method. The procedures for moving the detection position with each designation method (point/rectangle) are shown below.

▶ **Step 2 Setting the detection position**



- Point designation method: Use the crosshairs control buttons (↑↓←→) at the bottom of the window to move the detection position. The detection position can also be moved by dragging the mark (detection position mark) with the mouse.

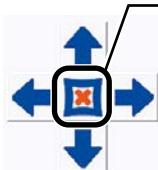
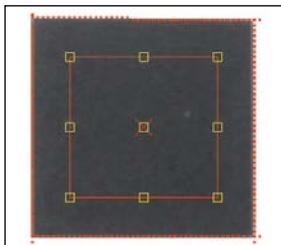
Setting the detection position by point designation



Appearance when the point designation method is selected.

- Rectangle designation method: With the rectangle designation method, the detection position is at the center of the rectangular frame. The size of the rectangular frame (red) can be changed by dragging the yellow squares at its perimeters. The rectangular designation frame can be moved by using the crosshairs control buttons (↑↓←→) at the bottom of the window, or by dragging the yellow square at the center of the rectangular frame.

Setting the detection position by rectangle designation

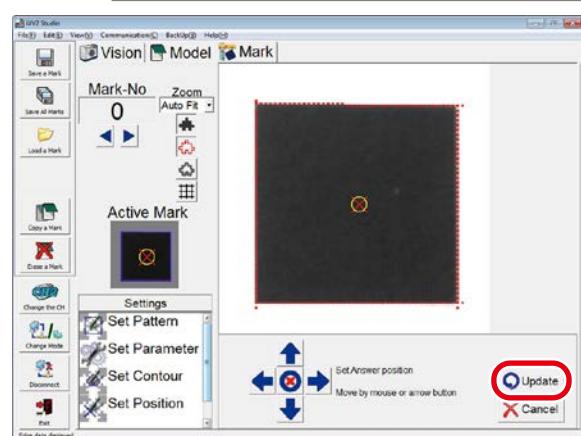


Appearance when the rectangle designation method is selected.

step3 Click [Update].

Click (Update) to set the detection position. To discontinue the setting operation, click (Cancel).

▶ Step 3 Registering the detection position setting



step4 The "Output origin position set successfully" message appears.

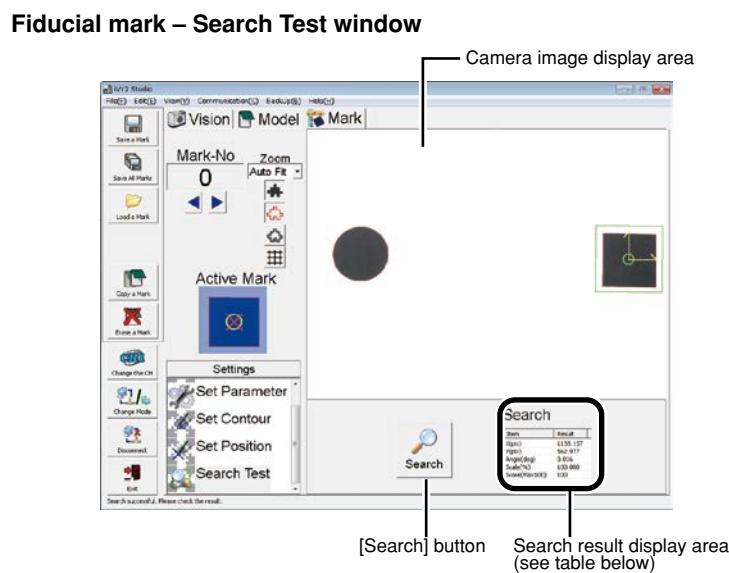
The "Output origin position set successfully" message appears when the detection position setting operation is completed. Click (OK) at this time.

▶ Step 4 Detection position setting completed



7.5.5 Detection check

The fiducial mark registration process is completed when the pattern setting, parameter setting, contour setting, and detection position setting have all been specified. A fiducial mark detection check (search) is then performed to verify that the registered fiducial marks can be detected.

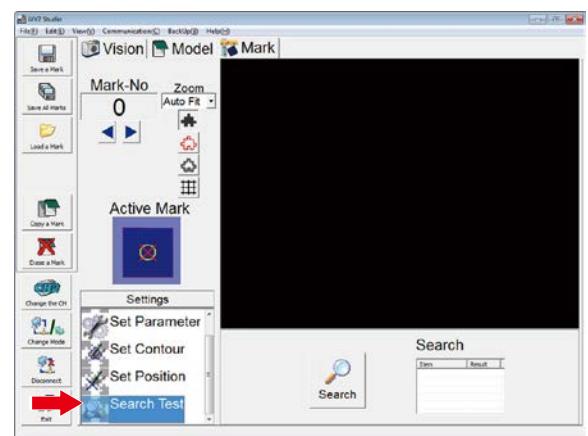


Search result display details

Item	Description
X (pix)	Indicates the detected workpiece's X-position in the camera coordinate system.
Y (pix)	Indicates the detected workpiece's Y-position in the camera coordinate system.
Angle (deg)	Indicates the detected mark's angle (within a -180.000° to 179.999° range).
Scale (%)	Indicates the proportional size relative to the specified fiducial mark.
Score (Max100)	Indicates the degree of correlation with the specified fiducial mark.

The fiducial mark detection check (search test) procedure is given below.

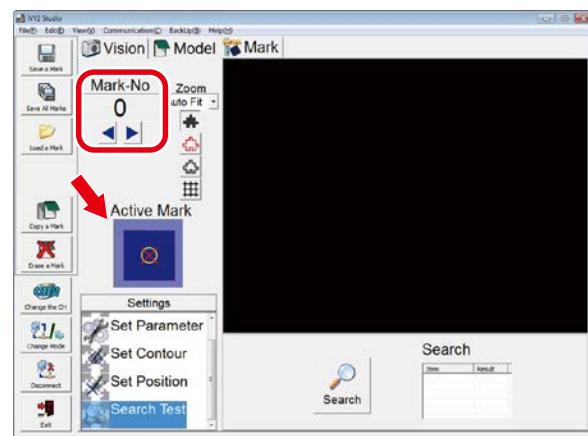
Step 1 In Mark mode, select "Search Test" ▶ Step 1 Selecting "Search Test" from Setting Items.



Step 2 Select the mark number to be searched for.

The search-object mark number's image is displayed at the "Active Mark" item. Verify that the correct search-object mark is indicated. If the correct mark number is not indicated, select the mark number to be searched for. For this procedure, refer to "7.1.3 Changing a model number or mark number".

Step 2 Selecting the mark number



Step 3 Place the mark within the camera's FOV, then click [Search].

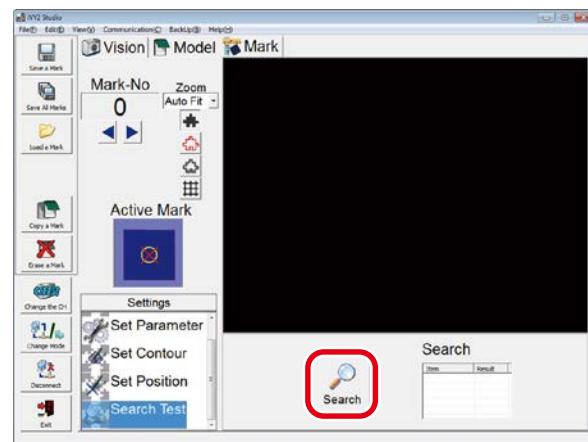
When [Search] is clicked, images are captured at the camera image display area, and the search occurs.



CAUTION

When performing the search operation, do not place the mark at 4 corners of the camera's FOV. If the mark is put at 4 corners of the camera's FOV, the mark image may become distorted depending on the type of lens to be used.

Step 3 Executing the search



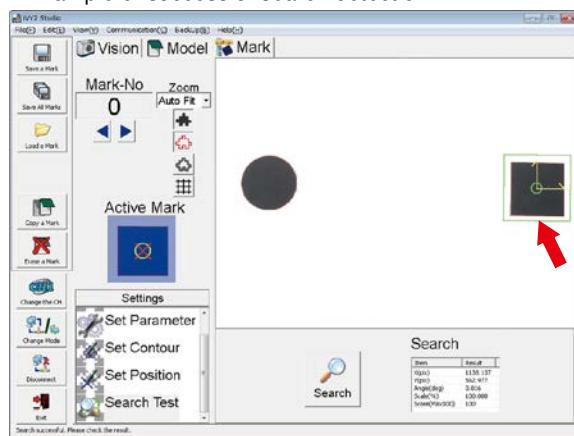
Step 4 Check the search results.

Check the search results at the search results display area. Verify that the "score" and "scale" values are close to 100.

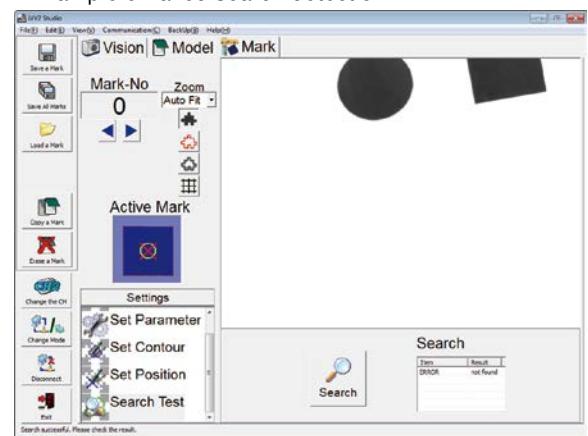
The workpiece is enclosed in a green frame if the search was successful. The green frame does not display if the search was unsuccessful.

If the search was unsuccessful or if the search results are poor, register the fiducial marks again.

■ Example of successful search detection



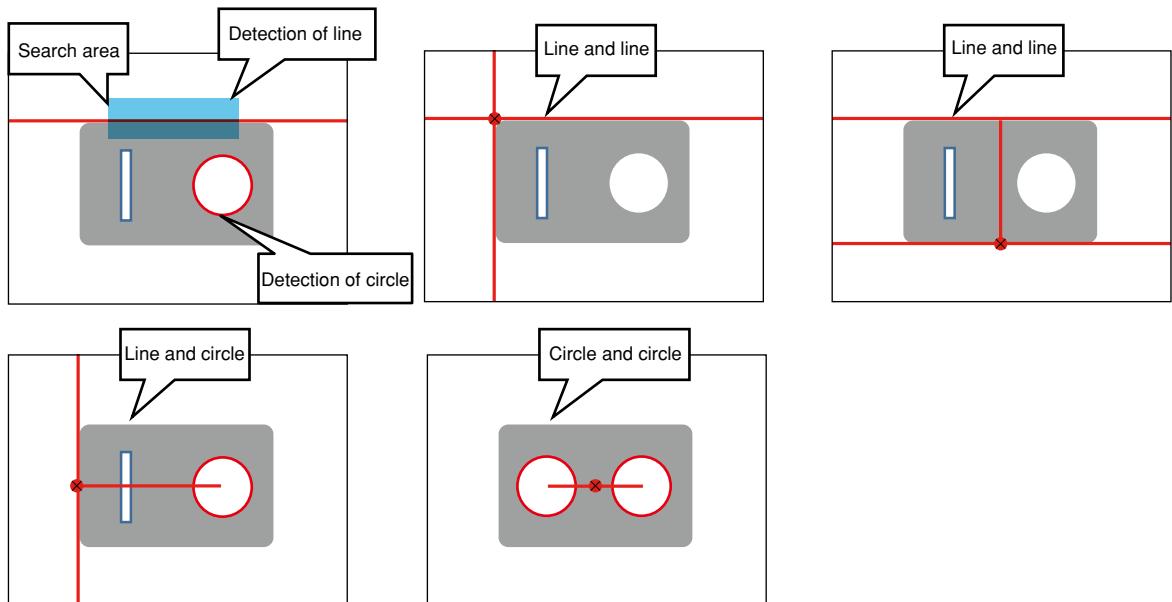
■ Example of failed search detection



7.6 Using the measure function

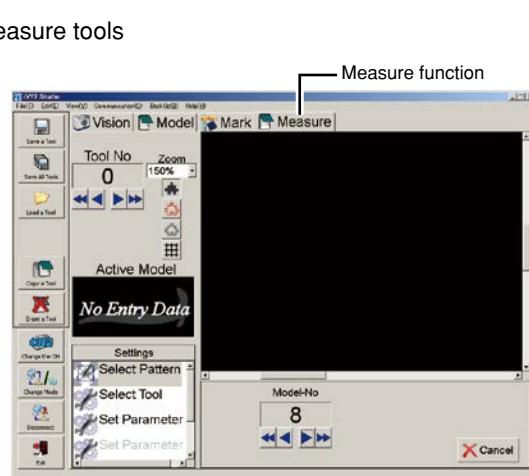
The measure function is detecting lines and circles to calculate the length or angle of a line and central position of a circle. The intersection of a perpendicular and line or two lines can be calculated by this function. A standard detection position is obtained for each measure tool. The offset position from the standard detection position can be obtained as a search result.

The specified measure tools are executed by the dedicated robot language. For details, refer to A RCXiVY2+ SYSTEM EXPLANATION SECTION "7.2.5 Image processing (Measurement function)".



7.6.1 Registering measure tools

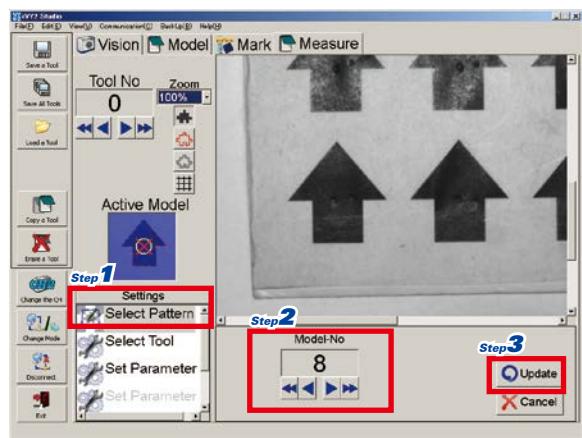
Connect the controller to the RCXiVY2+ Studio and double-click "Measure" to register measure tools.



7.6.2 Setting model pattern

- step1** Click "Select Pattern" from Settings.
step2 Select the target model number.
step3 Click [Update].

Pattern setting



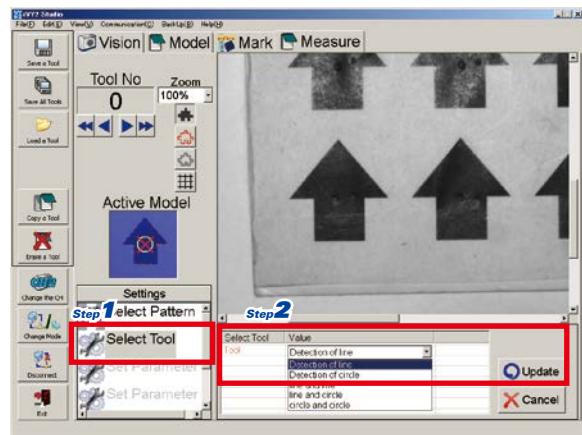
7.6.3 Selecting measure tool

- step1** Click "Select Tool" from Settings.
step2 Select the target model number and click [Update].

Selectable tools

- Line
- Circle
- Line and line
- Line and circle
- Circle and circle

Selecting measure tools

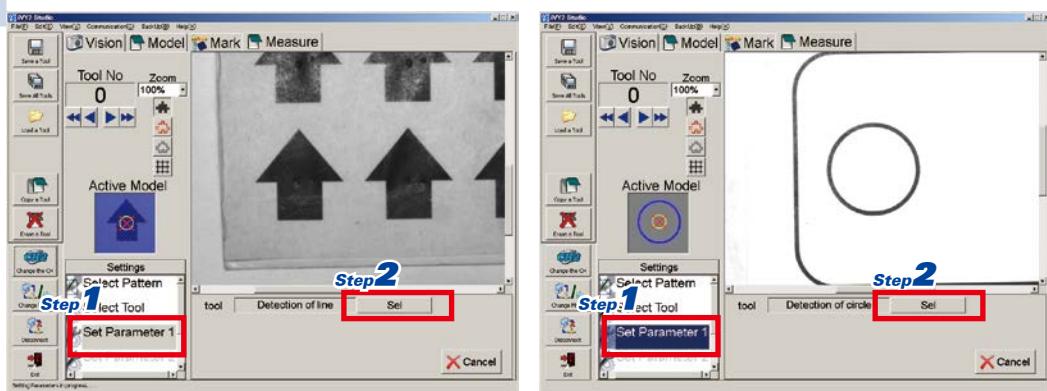


7.6.4 Setting measure tool parameters

Select the target measure tools.

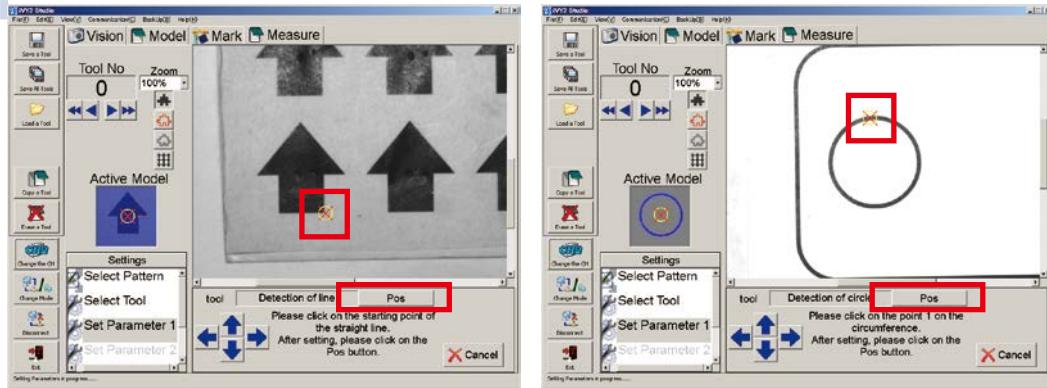
- step1** Click "Set Parameter 1" from Settings.
step2 Click [Sel].

Measure tool parameter



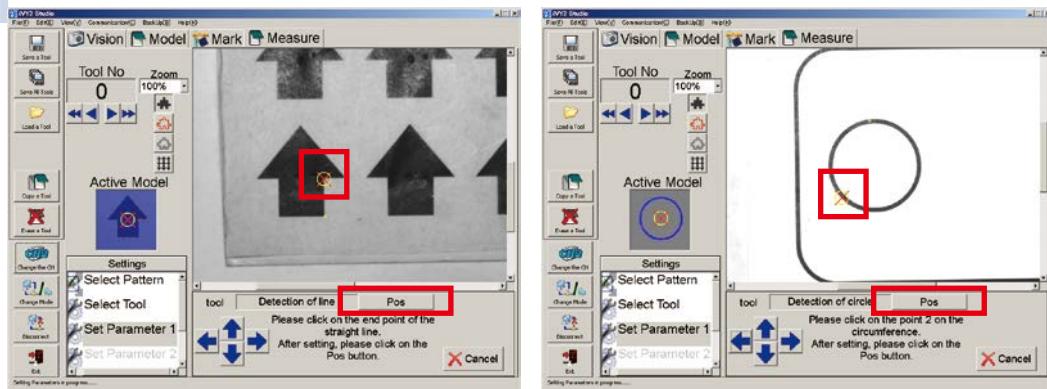
- Step3** Line...Click the start point of the line in the image and [Pos].
 Circle...Click the Point 1 on the circumference in the image and [Pos].
 * Arrow buttons can be used to specify the points instead of clicking.

Clicking point 1



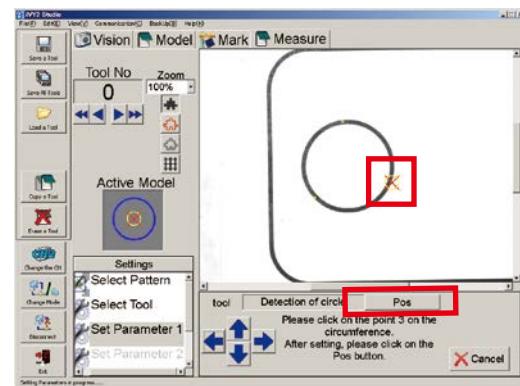
- Step4** Line...Click the end point of the line in the image and [Pos].
 Circle...Click the Point 2 on the circumference in the image and the [Pos].
 * Arrow buttons can be used to specify the points instead of clicking.

Clicking point 2



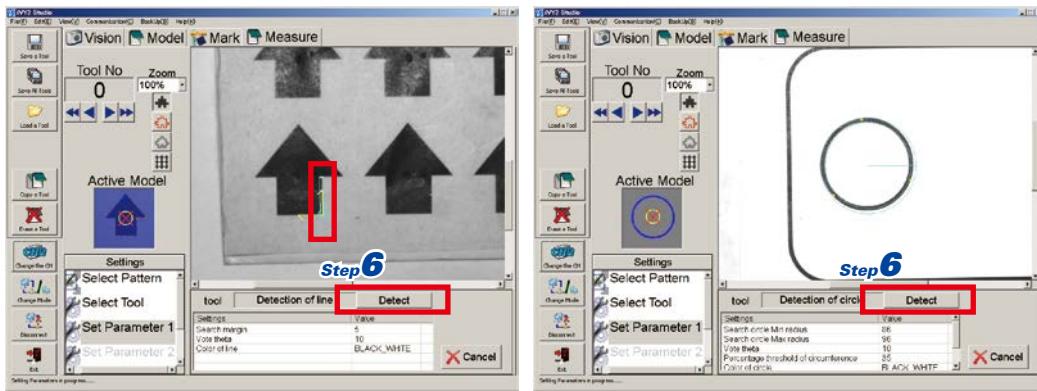
- Step5** Line...None.
 Circle...Click the Point 3 on the circumference in the image and [Pos].
 * Arrow buttons can be used to specify the points instead of clicking.

Clicking point 3



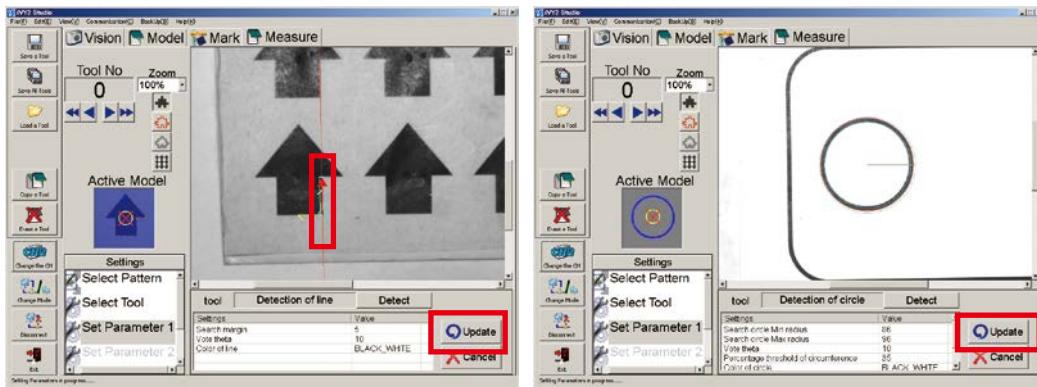
step 6 Confirm the specified line/circle is detected by clicking [Detect]. When they are not detected, adjust the parameters.

Detection



step 7 When the result in which the displayed red line and specified line are corresponded satisfies, click [Update].

Detection result - Update



step 8 When selecting line and line, line and circle or circle and circle on "Select Tool", repeat **Step 1** to **Step 7** on "Set Parameter 2".

7.6.5 Setting detection position

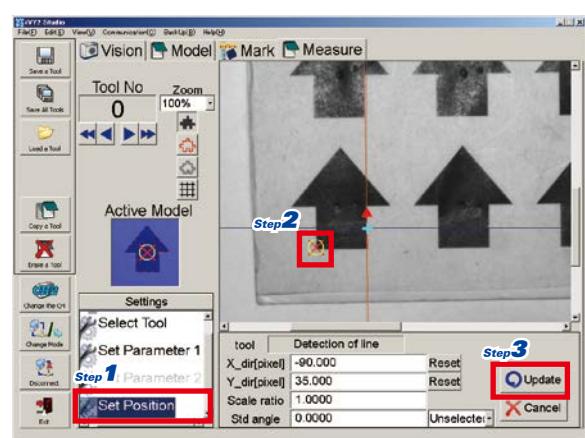
The position to be obtained as a search result is specified. The offset value from the detected standard position is specified. The standard position depends on the selected measure tool.

step 1 Click "Set Position" from Settings.

Set Position

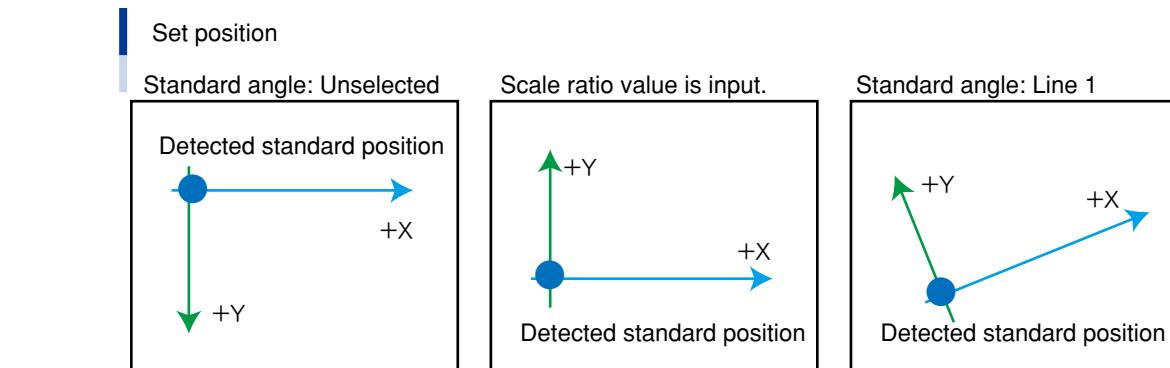
step 2 Click the point on the coordinate to obtain in the image.

step 3 Click [Update].



Inputting numeric value of the position to specify and confirming is available instead of clicking point on the coordinate. The initial XY coordinate is camera coordinate [pixel]. Inputting the scale ratio changes the camera coordinate to the robot coordinate [mm]. Selecting the detected line as the standard angle converts to the robot coordinate on which the detected line is X-direction.

■ Coordinate definition for setting "Set Position"



NOTE

The angle information which is obtained at measure search command execution depending on the standard angle settings.
Unselected...The difference angle from the standard model registration is obtained as the angle information.

Line 1, 2, or Detect line...The angle of selected line is obtained.

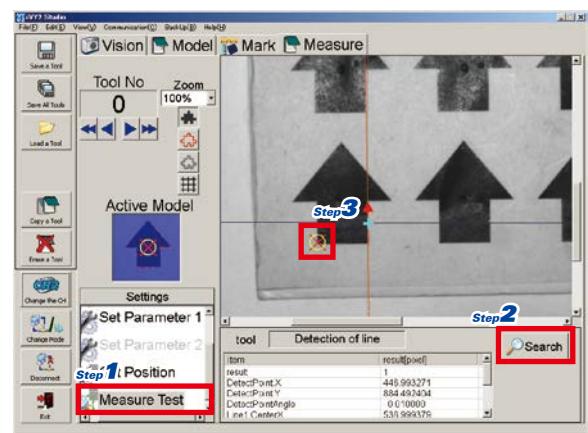
7.6.6 Measure test

Step 1 Click "Measure Test" from Settings.

Step 2 Click [Search].

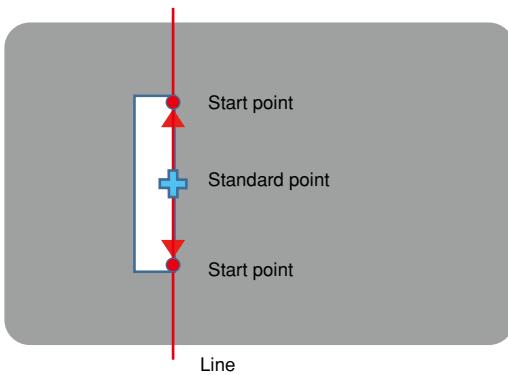
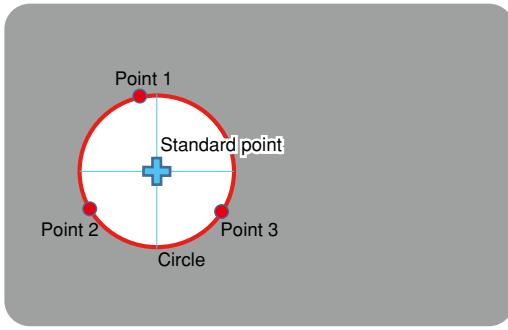
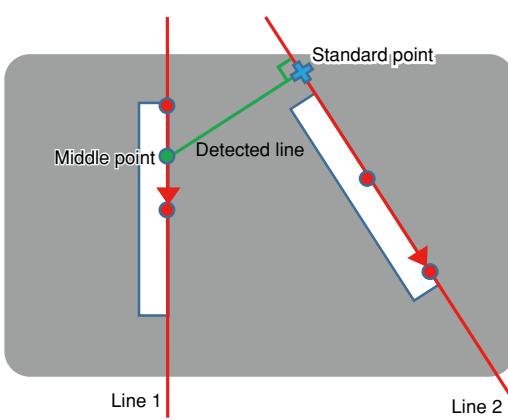
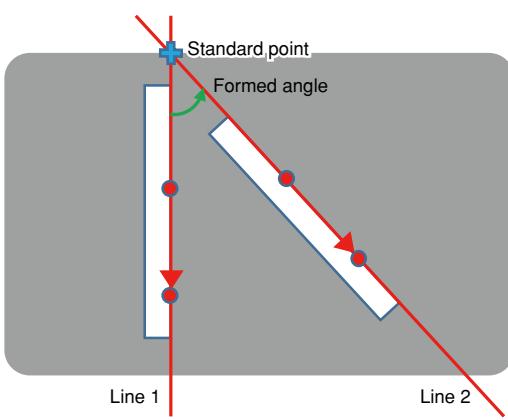
Step 3 Confirm the position corresponds to that was specified at "Set Position".

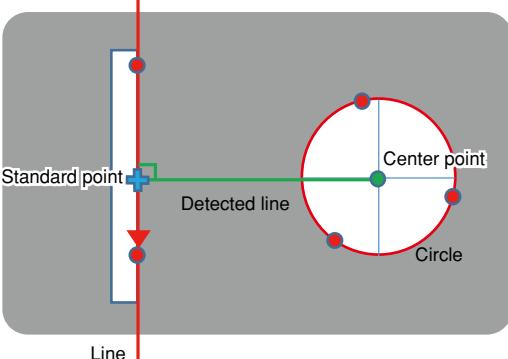
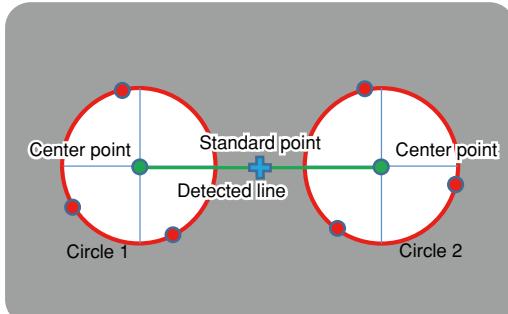
Measure Test



7.6.7 Measure tool details

The search result depends on the measure tool as described below. The additional information is that is obtained from VGETOBJC or VGETOBJR command.

Line	
Camera's FOV	Standard point Middle point of the line
	Additional information The distance between the start and end point
Circle	
Camera's FOV	Standard point Center of the circle
	Additional information The circle radius
Line and line...Line 1 and 2 do not intersect in the camera's FOV	
Camera's FOV	Standard point Intersection of the perpendicular from the line 1 middle point to the line 2 and line 2
	Additional information The distance of detected line between line 1 middle point and the standard point
Line and line...Line 1 and 2 intersect in the camera's FOV	
Camera's FOV	Standard point The intersection of the two lines
	Additional information The angle formed with the two lines

Line and circle	
Camera's FOV	Standard point Intersection of line and the perpendicular from the center of circle to the line and Additional information The distance of detected line between the center of circle and the standard point
	
Circle and circle	
Camera's FOV	Standard point Middle point of the detected line connecting the centers of circle 1 and 2 Additional information The distance of detected line between the centers of circle 1 and 2
	

7.7 Using the blob function

The blob tool is a function that binarizes the captured images and detects the workpiece as a blob. The blobs extracted from the images are selected by the area, main axis length after oval fitting, angle, and roundness to detect the target workpiece. This function is used to detect an irregular shape object, check the presence status, and count the workpiece.

With the blob tool settings, the detection target workpiece is enclosed and only the automatic adjustment is performed to easily set the parameters.

7.7.1 Blob tool processing

Step 1 Capture images with the camera.

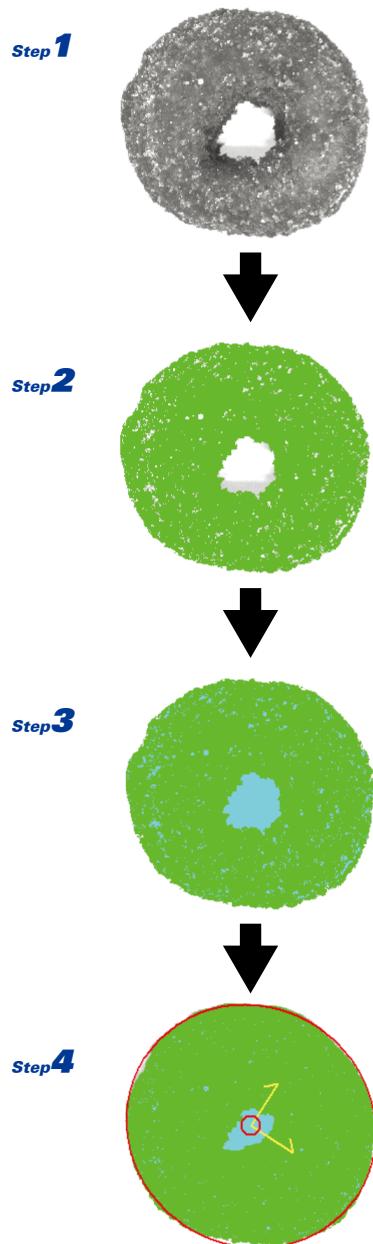
▶ **Step 1-4** Blob tool processing

Step 2 The binarization process of the captured images is performed.
(Perform the filter process as required.)

Step 3 Perform the hole filling process.

Step 4 Perform the oval fitting for the extracted blob.

Blobs are selected by the area and main axis length to detect the target workpiece.
The center of gravity position of the blob is output as the detection position.
The main axis angle of the oval is output as the angle.



7.7.2 Registering blob tools

To register blob tools, perform 4 settings shown below.

■ Pattern settings

Capture the workpiece images and specify the range of the images to be registered.

■ Automatic adjustment

The upper and lower limit values of the binarization, and the area range are automatically calculated from the registered images.

■ Parameter settings

Set the detailed parameters for the blob search.

■ Detection check

Check whether the workpiece can be detected using the registered blob tools.

To register blob tools, connect RCXiVY2+Studio to the controller, and click the [Blob] tab.

Blob tools



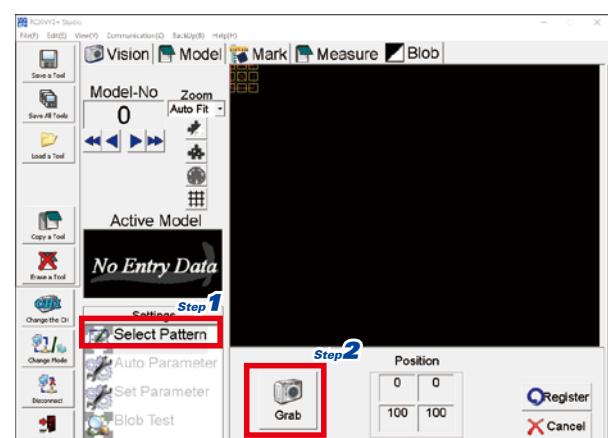
7.7.3 Blob tool pattern setting

The blob tool pattern setting operation consists of capturing the target workpiece image, specifying the image range to be registered in that image, and then registering this data to the RCXiVY2+ unit.

Step 1 Select "Set Pattern" in the Blob tool mode.

Step 2 Click the [Grab] button.

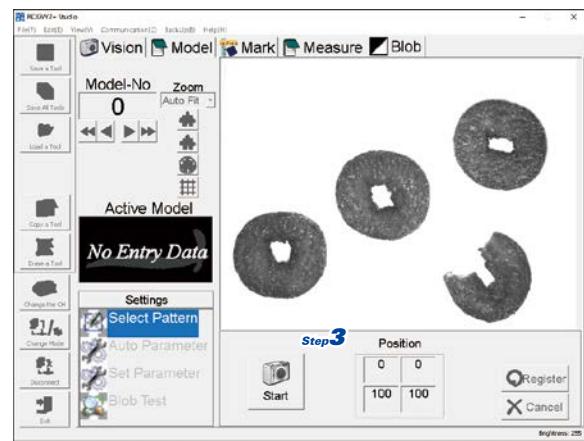
Selecting "Set Pattern"



step3 Place the workpiece to be registered directly beneath the camera, and then click [Start].

To discontinue the workpiece image capture operation, press the (ESC) key on the keyboard before clicking (Start).

[Start] button



step4 Align the pattern setting frame with the workpiece to be registered.



NOTE

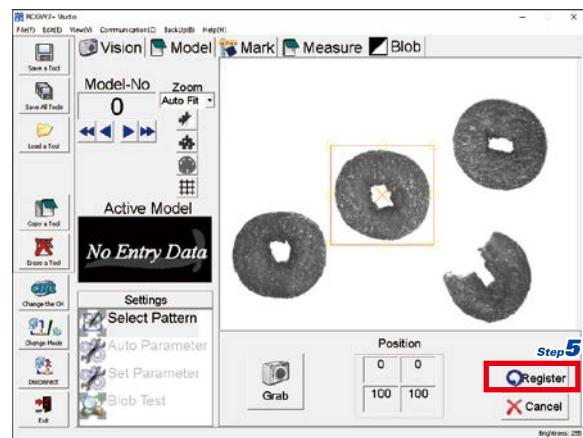
To discontinue the workpiece image capture operation, press the (ESC) key on the keyboard before clicking (Start).

step5 Click [Register].

When (Register) is clicked, the data is transmitted to the RCXiVY2+ unit.

To discontinue the registration operation, click (Cancel).

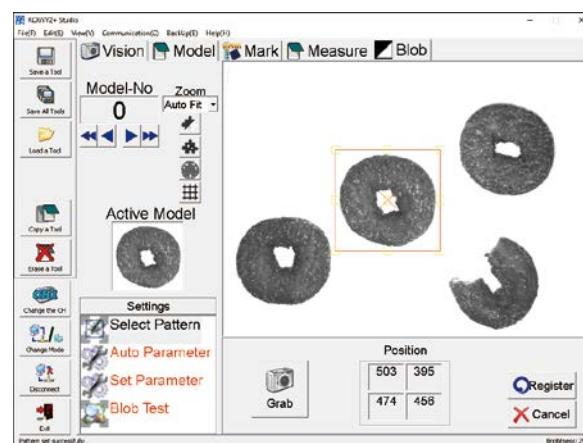
Executing the registration operation



step6 The pattern setting is completed.

When the pattern setting is completed, the appearance of the workpiece is displayed in the Active Model.

Active Model



7.7.4 Blob tool automatic adjustment

The automatic adjustment automatically calculates the upper or lower limit of the binarization from the registered pattern images.

In addition, the area of the workpiece is calculated, and the upper and lower limits of the area are calculated automatically.

Step 1 Select "Auto Adjust" in the Blob mode.

Step 2 Set the automatic adjustment parameters.

■ Target color

Set the workpiece color is black or white corresponding to the background.

■ Hole filling ratio

Set a value of 0 to 100% in accordance with the size of the hole to be filled.

When the hole filling is not needed, set 0. When all holes need to be filled, set 100.

For details about the meaning of each item, refer to A RCXiVY2+ SYSTEM EXPLANATION "5.8.2 Blob setting parameter details".

Step 3 Click [Auto Adjust].

The automatic adjustment is executed.

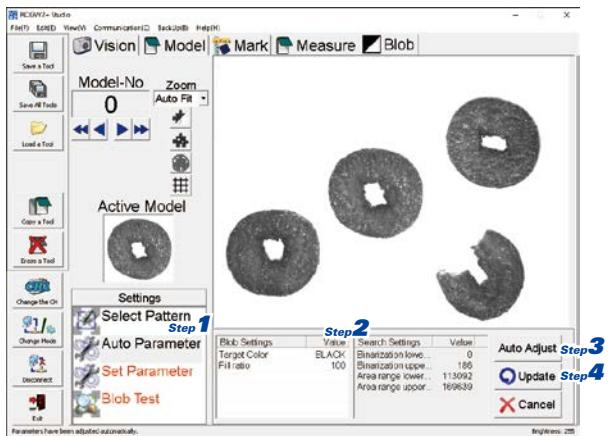


NOTE

If the target color setting is incorrect, the images may include many noises or the contrast between the workpiece and background is small, the automatic adjustment may be failed.

In this case, review the setting and environment.

Automatic adjustment



Step 4 Click [Apply].

When the automatic adjustment is succeeded, the automatically calculated value is displayed in each item of the search setting.

Click (Apply) to register the setting.



NOTE

To discontinue the setting operation, click (Cancel).

When (Cancel) is clicked, the setting is returned to that before change.

7.7.5 Blob tool parameter setting

step1 Select "Set Parameter" in the Blob mode.

step2 Set each parameter.

■ Blob setting

Set parameters necessary to extract blobs.

For details about the meaning of each item, refer to A RCXiVY2+ SYSTEM EXPLANATION "5.8.2 Blob setting parameter details".

■ Search setting

Set the parameters necessary to select the extracted blobs.

For details about the meaning of each item, refer to A RCXiVY2+ SYSTEM EXPLANATION "5.8.3 Search setting parameter details".

■ Search range setting

Change the range where the search is executed.

The search range setting is that all view fields of the camera are the search range in the initial status.

step3 Click [Apply].

When (Apply) is clicked, the settings are registered.

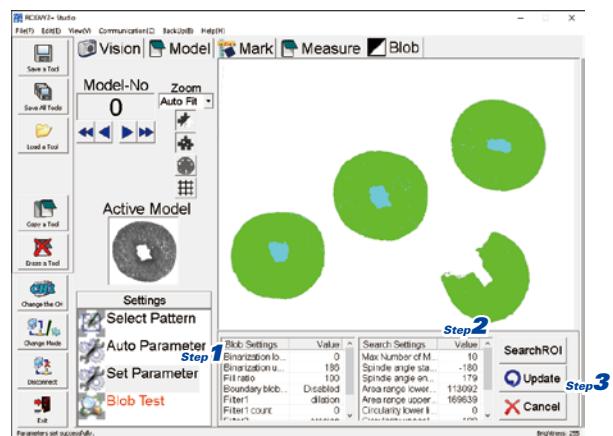


NOTE

To discontinue the setting operation, click (Cancel).

When (Cancel) is clicked, the setting is returned to that before change.

Parameter setting



7.7.6 Blob tool detection check

Using the set blob tools, whether the workpiece can be searched for is checked.

step1 Select "Blob Test" in the Blob mode.

step2 Place the workpiece within the view field of the camera, and then click [Search].

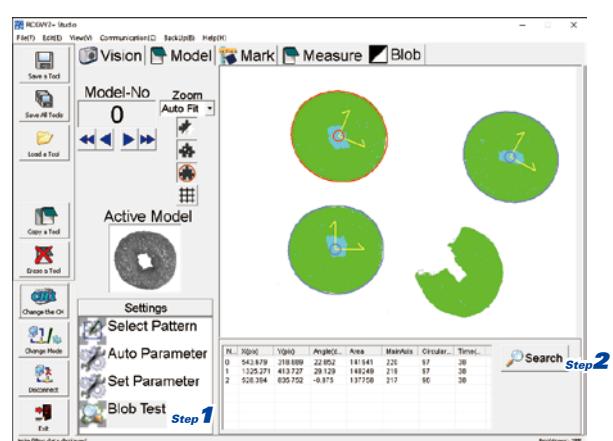
step3 Check the detection result.

Check the detection result in the search result display area.

Check that the target workpiece is detected.

If not, set the parameters again or review the environment.

Parameter setting



7.7.7 Points for blob tool setting

The points to correctly detect the workpiece using the blob tools is described.

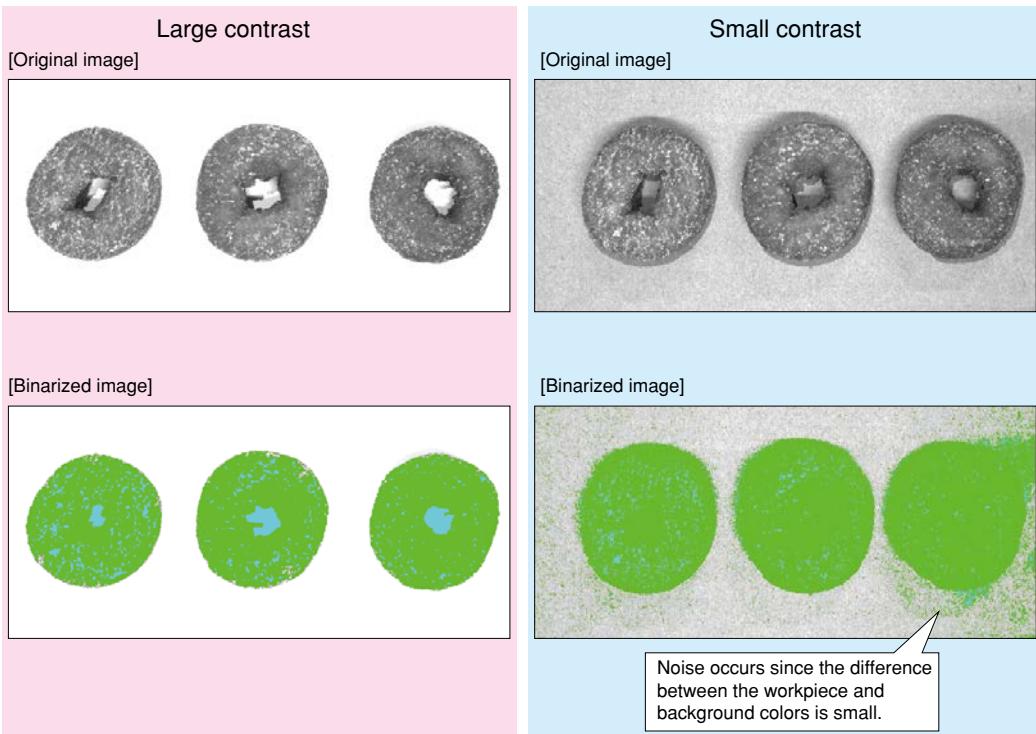
■ The contrast between the workpiece and background is made larger.

The blob tool performs the binarization based on the brightness in the images.

When the brightness of the workpiece differs from that of the background largely, the binarization can be performed more accurately.

Select the background and lighting colors in accordance with the workpiece.

Contrast between workpiece and background



* Binarization threshold value: 20 to 190 Hole filling ratio: 100

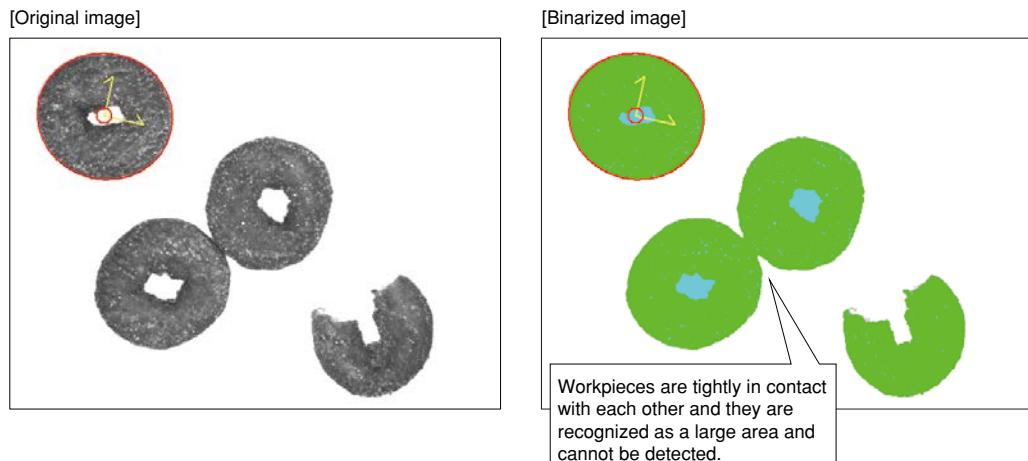
■ Workpieces shall not be tightly in contact with each other.

When workpieces are tightly in contact with each other, the following detection result may be obtained.

- Workpieces are tightly in contact with each other and they are detected as a large blob.
- Workpieces are tightly in contact with each other and the area is outside the blob area range. As a result, they are not detected.
- Even when the workpiece within the range is detected, it is detected with the detection position shifted from the center of gravity position.

In any case, it is necessary that workpieces are not in contact with each other.

Workpieces are tightly in contact with each other.



■ Blob shall not be cracked.

The blob may be cracked or chipped by the reflection of the film.

- When the blob is cracked, blobs are extracted as individual blobs.
- When the blob is chipped, the correct hole filling may not be performed.

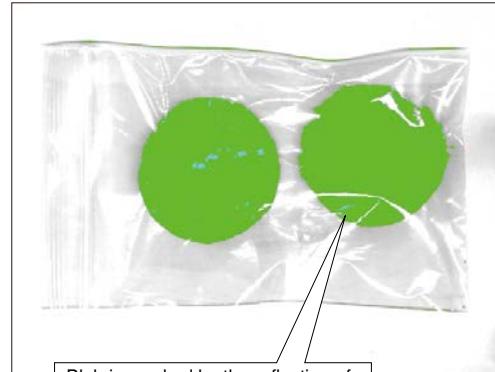
The cause of the detection failure or incorrect detection position output is reduced by improving the environment or adding the filter process.

Workpiece cracking

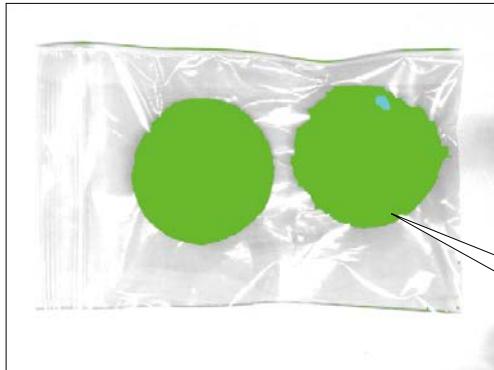
[Original image]



[Binarized image]



[Closing filter is applied 9 times.]



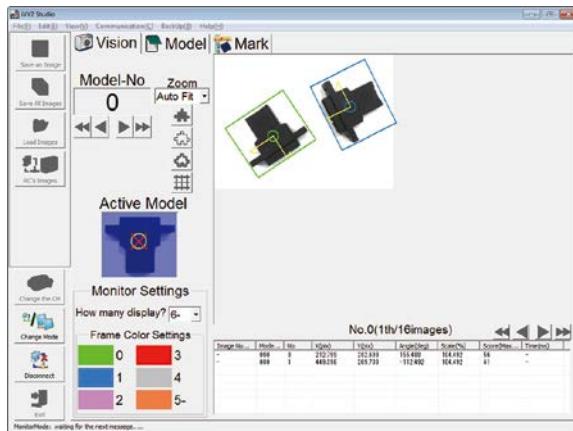
Blob is cracked by the reflection of the light and they are recognized as individual blobs.

The blob cracking is removed by the closing (expansion) filter.

7.8 Using the monitor function

RCXiVY2+ Studio permits monitoring of workpiece search results during automatic robot operation, and monitoring of fiducial mark search conditions during calibration setting operations.

The monitoring function is only enabled when in Monitor mode.



7.8.1 To use monitor function

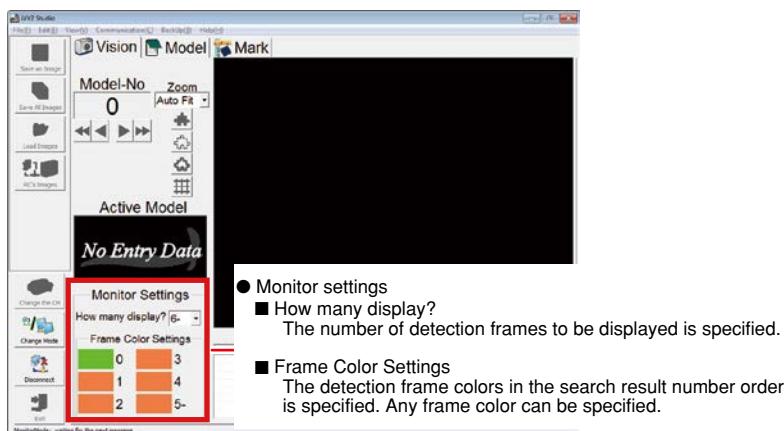
In order to use the Monitor function, RCXiVY2+ Studio must be in Monitor mode. If RCXiVY2+ Studio is in Edit mode, click [Change Mode] to switch to Monitor mode.

TIP

When switched to Monitor Mode, the "Monitor Mode: started successfully" message appears at the lower left portion of the RCXiVY2+ Studio window.

7.8.2 Monitor settings

At monitor function searches, a detection frame encloses the detected workpieces in the search result number order. The monitor settings specify how many detection frames are to be displayed, and the detection frame color.

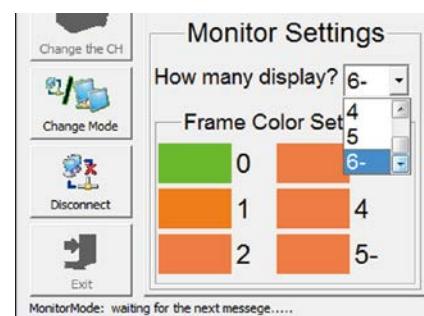


The "monitor settings" setting procedure is given below.

Step 1 Set RCXiVY2+ Studio to Monitor mode.

Step 2 Specify the number of detection frames ("How many display?" setting).

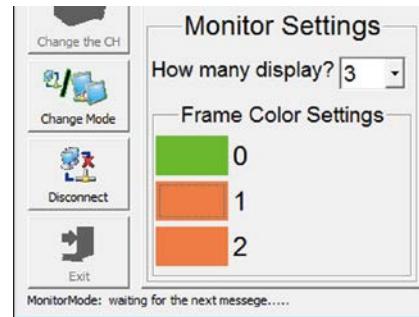
► **Step 2 Specifying "How many display?" setting**



Step 3 Click on the detection frame color to be changed.

The numerals to the right of the detection frame colors indicate the search result numbers. Detection frame color settings can be specified for each search result number. If "How many display?" is set as "6 ~", the colors of all search result number 5 and higher frames will be the color specified at "5 ~".

▶ **Step 3 Detection frame color setting (1)**



Step 4 Select the detection frame color, then click [OK].

The detection frame color is then established.

To discontinue the detection frame color setting operation, click (Cancel).

▶ **Step 4 Detection frame color setting (2)**



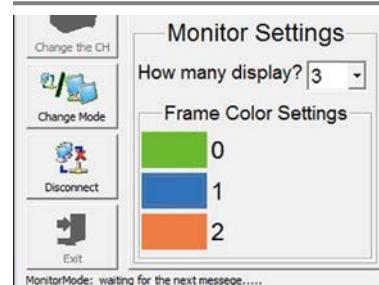
Step 5 The detection frame colors are set.

▶ **Step 5 Detection frame color setting completed**



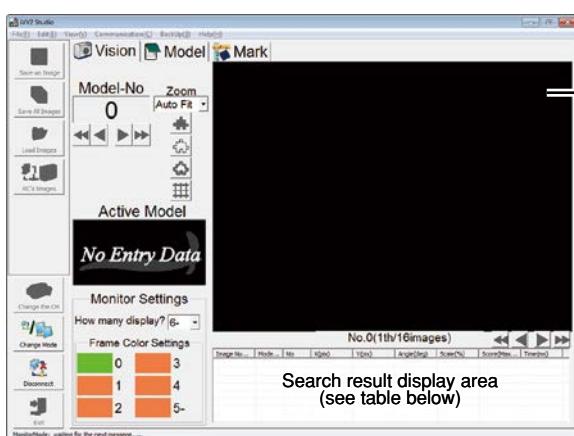
NOTE

To continue the operation in order to change the color of another detection frame, repeat the above procedure from [Step 3](#).



7.8.3 Using the monitor function

The monitor function is explained here using "search result check during automatic robot operation" as an example.



Search result display details

Item	Description
Image Number	Indicates the searched image number.
Model / Mark No. ¹⁾	Indicates the searched model or fiducial mark.
No.	Indicates the detected workpiece's ranking (in descending score order) within the searched images.
X (pix) / X (mm) ²⁾	Indicates the detected workpiece's X-position in the camera coordinate system.
Y (pix) / Y (mm) ²⁾	Indicates the detected workpiece's Y-position in the camera coordinate system.
Angle (deg)	Indicates the detected workpiece's angle (within a -180.000° to 179.999° range).
Scale (%)	Indicates the proportional size relative to the specified model workpiece number.
Score (Max100)	Indicates the degree of correlation with the specified model workpiece number.
Time (ms)	Indicates the time required to perform the search.

*1: "Model" is displayed at model number searches, and "Mark No." is displayed at fiducial mark number searches.

*2: If a search is performed by specifying a camera calibration number, the position will be indicated by the robot coordinate position (X (mm), Y (mm)), not by the camera coordinate pixel values (X (pix), Y (pix)).

The procedure for using the monitor function during automatic robot operation is given below.

Step 1 Set RCXiVY2+ Studio to Monitor mode.

Step 2 Execute a robot program.

Run the robot program which contains dedicated robot language commands.

Execute the desired robot program from the programming box or from RCX-Studio.

(Example) Program which uses camera 1 to search for model number 0:

*LOOP:

VSEARCH 1. 0 ← The model number 0 workpiece is searched for in the images captured by the Ch.1 camera.
GOTO *LOOP

TIP

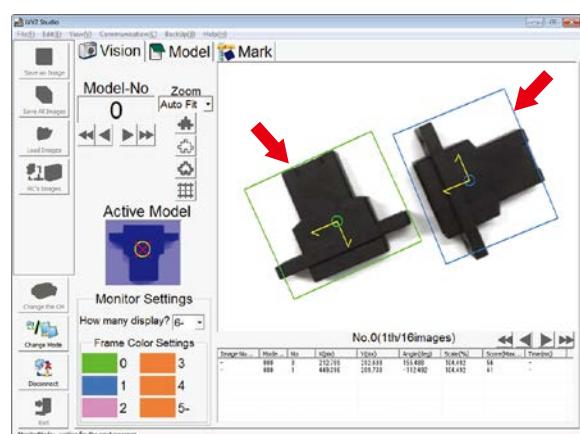
Robot programs cannot be run with RCXiVY2+ Studio.

Step 3 The search results display at RCXiVY2+ Studio.

The search results display at the search results display area. The number of displayed search-detected items depends on the "detection quantity" (search settings) specified in Model mode.

If the search was successful, the detected workpiece is enclosed in a detection frame of the specified color.

Step 3 VSEARCH 1, 0 execution result screen



CAUTION

When performing the search operation, do not place the workpiece and mark at 4 corners of the camera's FOV. If the workpiece and mark are put at 4 corners of the camera's FOV, the workpiece and mark images may become distorted depending on the type of lens to be used.

TIP

To use the monitor function to check the fiducial mark search status during a calibration setting operation, specify a calibration setting at [Step 2](#). In this case, searches are performed for one mark at a time, resulting in alternating searches for 2 marks.

C. TROUBLESHOOTING AND SPECIFICATIONS SECTION

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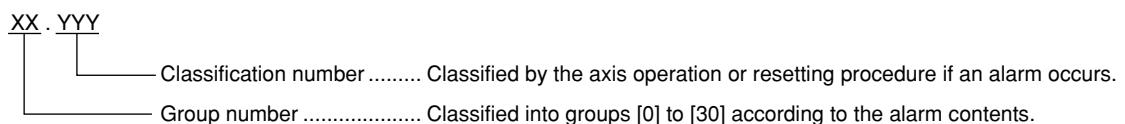
1. Troubleshooting

1.1 Alarm messages

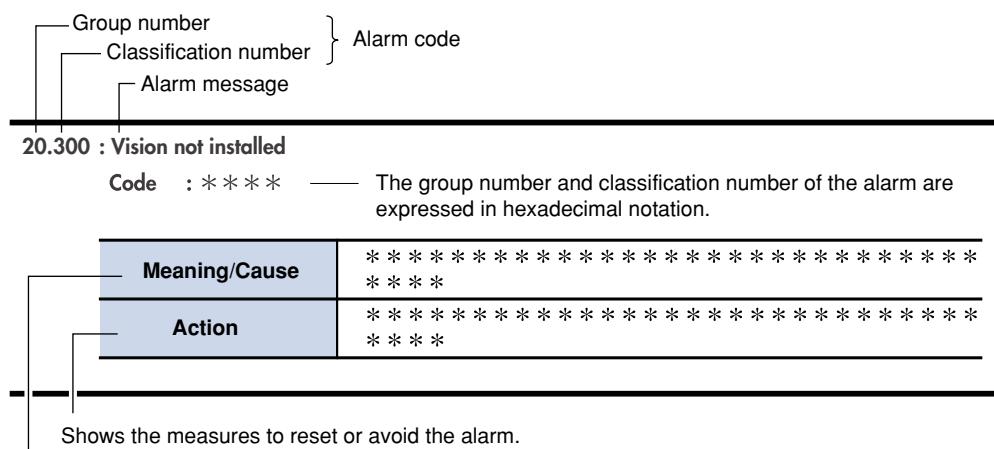
This section explains the RCXiVY2+ system alarm messages. For details concerning other alarms, refer to the user's manual for the robot controller being used.

If an alarm occurs, relevant alarm message appears on the screen of the programming box. For details about contents of each alarm message, see the list.

The alarm code consists of 2 elements, "group" and "classification". Each code is classified as follows.



■ [Error message display format]



NOTE

If the alarm cannot be solved even after taking the corrective action, contact your distributor.

* The alarm occurrence status and alarm history can be checked from the programming box. For details on how to check the conditions that caused the alarm and the alarm history, refer to the RCX3 series Operator's Manual. Information on the alarm occurrence location (axis or option board, etc.) may be added next to the alarm code.

■ Checking the alarm occurrence status

CHECK		S:-- RBT:1 H:-- SPD:50	ALM
Alarm code	No.	RESULT	
	1	22.511:01	
	2		
	3		
	4		
	5		
	6		
	7		
	8		

■ Alarm occurrence location list

T*	Task * ... Task number
SYS	Startup, memory check, generation
ONL	Online command
RMT	Remote command
SEQ	Sequence program
SIN	Standard input
C*	Controller * ... Controller number
C*O*	Option board * ... Controller number, option slot number
R*/R*A*	Robot, axis * ... Robot number, axis number
M*/C*M*	Physical motor * ... Controller number, motor number

For example, when “17.403:M1” is displayed, this shows that the position reset position error occurs in motor 1. In the same manner, when “14.400:T02” is displayed, this shows that the communication shutdown error occurs in task 2.

[20] Alarm related to the RCXiVY2+ system

20.100: Vision Camera channel out of range

Code : &H0014 &H0064

Meaning/Cause	The specified camera channel number is out of range.
Action	Change to a correct camera channel number.

20.101: Vision Target number out of range

Code : &H0014 &H0065

Meaning/Cause	The specified model number is out of range.
Action	Change to a correct model number.

20.102: Vision Calibration number out of range

Code : &H0014 &H0066

Meaning/Cause	The specified camera calibration number is out of range.
Action	Change to a correct camera calibration number.

20.103: Vision Memory number out of range

Code : &H0014 &H0067

Meaning/Cause	The specified memory number is out of range.
Action	Change to a correct memory number.

20.104: Vision File name number of characters error

Code : &H0014 &H0068

Meaning/Cause	The number of characters in the file name is out of range.
Action	Change to a correct file name.

20.105: Vision array number out of range

Code : &H0014 &H0069

Meaning/Cause	The specified array number is out of range.
Action	Change to a correct array number.

20.106: Vision task number out of range

Code : &H0014 &H006A

Meaning/Cause	The specified task number is out of range.
Action	Change to a correct task number.

20.107: Vision Light channel out of range

Code : &H0014 &H006B

Meaning/Cause	The specified light channel number is out of range.
Action	Change to a correct light channel number.

20.108: Vision data out of range

Code : &H0014 &H006C

Meaning/Cause	The specified data value is out of range.
Action	Change to a correct data value.

20.120: Vision calibration error

Code : &H0014 &H0078

Meaning/Cause	An error occurred during camera calibration. a. The fiducial mark was not detected. b. The fiducial mark is outside the camera's field of view.
Action	<ul style="list-style-type: none"> • Make sure that the fiducial mark is registered. • Make sure that the fiducial mark is correctly recognized. • Check the camera calibration settings.

20.121: Vision Calibration Robot type error

Code : &H0014 &H0079

Meaning/Cause	The camera calibration setting is not corresponded to the robot type.
Action	Change the camera calibration setting.

20.122: Vision Calibration Calculate error

Code : &H0014 &H007A

Meaning/Cause	The camera calibration calculation was failed.
Action	<ul style="list-style-type: none"> • Change the camera calibration movement range. • Confirm the point data for creating the camera calibration data.

20.123: Vision Calibration Setting error

Code : &H0014 &H007B

Meaning/Cause	The specified camera calibration setting is not suitable for the specification.
Action	Change the camera calibration.

20.300: Vision not installed

Code : &H0014 &H012C

Meaning/Cause	The RCXiVY2+ unit is not connected. a. The RCXiVY2+ unit is not connected. b. The RCXiVY2+ unit is disabled. c. The RCXiVY2+ unit has malfunctioned.
Action	a. Verify that the RCXiVY2+ unit is connected correctly. b. Enable the RCXiVY2+ unit's enable/ disable parameter. c. Replace the RCXiVY2+ unit.

20.301: Vision edit mode error

Code : &H0014 &H012D

Meaning/Cause	The RCXiVY2+ unit is in Edit mode. • RCX-Studio is connected in Edit mode. • RCXiVY2+ Studio is connected in Edit mode.
Action	• Disconnect RCX-Studio or RCXiVY2+ Studio. • Change the RCX-Studio or RCXiVY2+ Studio connection to Monitor mode.

20.302: Vision not ready

Code : &H0014 &H012E

Meaning/Cause	The RCXiVY2+ unit is starting up.
Action	Verify that the RCXiVY2+ unit's status LED (green) has changed from flashing to lit before you perform operations.

20.303: Vision camera disconnected

Code : &H0014 &H012F

Meaning/Cause	The camera cannot be detected correctly. a. The camera cable may be broken or disconnected. b. The camera channel is not assigned. c. The camera has malfunctioned.
Action	a. Check the camera cable connection. b. Check the camera channel. c. Replace the camera and cable.

20.304: Vision no pattern data

Code : &H0014 &H0130

Meaning/Cause	A model is not registered for the specified model number. a. Model registration has not been performed. b. There is a mistake in the specified model number.
Action	a. Perform model registration. b. Change the specified model number.

20.305: Vision mismatch between image and pattern

Code : &H0014 &H0131

Meaning/Cause	The specified camera does not match the model image size.
Action	• Check the specified model. • Check the number of screen pixels for the specified camera.

20.306: Vision calibration not set

Code : &H0014 &H0132

Meaning/Cause	There is a mistake in the specified camera calibration number.
Action	• Specify a different camera calibration number. • Perform camera calibration settings.

20.307: Vision memory image doesn't exist

Code : &H0014 &H0133

Meaning/Cause	There is no image in the specified memory number.
Action	<ul style="list-style-type: none"> • Register an image in the memory number that you specify. • Execute the "VCAPTURE" command and "VSEARCH" command.

20.308: Vision no result data

Code : &H0014 &H0134

Meaning/Cause	<ul style="list-style-type: none"> a. The specified result array number is incorrect. b. Search has not been executed. c. No workpiece was detected.
Action	<ul style="list-style-type: none"> a. Specify a different result array number. b. Execute search. c. Check the model setting so that the workpiece is detected.

20.309: Vision search timeout

Code : &H0014 &H0135

Meaning/Cause	<ul style="list-style-type: none"> The search ended in a timeout. a. The fiducial mark was not detected. b. The fiducial mark is outside the camera's field of view.
Action	<ul style="list-style-type: none"> a. Change the timeout setting parameter of the specified model. b. Change the model setting of the specified model. (Refer to the RCXiVY2+ manual for details.)

20.310: Vision memory full

Code : &H0014 &H0136

Meaning/Cause	The RCXiVY2+ unit has no free memory capacity.
Action	Read the image data, and delete unneeded data from the RCXiVY2+ unit.

20.311: Vision not execute search

Code : &H0014 &H0137

Meaning/Cause	Search was not executed.
Action	Execute a search command ("VSEARCH", "VSEARCHS", "VSEARCHR", "VSEARCHM").

20.312: Vision command running

Code : &H0014 &H0138

Meaning/Cause	A vision command is currently running.
Action	Wait for the vision command to finish before executing.

20.313: Vision camera FOV mismatch

Code : &H0014 &H0139

Meaning/Cause	The number of screen pixels of the specified camera and the camera calibration data do not match.
Action	<ul style="list-style-type: none"> • Specify a different camera number. • Specify a different camera calibration number. • Correct the camera calibration data.

20.314: Vision trigger timeout

Code : &H0014 &H013A

Meaning/Cause	a. The trigger timeout setting is too short. b. There is a problem with the wiring of the camera H/W trigger input cable. c. The camera H/W trigger input cable is broken.
Action	a. Check the setting of the "trigger timeout" camera parameter. b. Check the wiring and connection of the camera H/W trigger input cable. c. Check whether the camera H/W trigger input cable might be broken.

20.315: Vision camera parameter set error

Code : &H0014 &H013B

Meaning/Cause	Setting the camera parameters failed.
Action	• Specify a different parameter value. • Check the state of the RCXiVY2+ unit.

20.316: Vision light parameter set error

Code : &H0014 &H013C

Meaning/Cause	Setting the light parameters failed.
Action	• Specify a different parameter value. • Check the state of the RCXiVY2+ unit.

20.317: Vision unit version mismatch

Code : &H0014 &H013D

Meaning/Cause	The RCXiVY2+ unit version is not corresponded.
Action	Update the RCXiVY2+ unit.

20.380: Vision system error

Code : &H0014 &H017C

Meaning/Cause	A problem has occurred with the RCXiVY2+ unit.
Action	Contact your distributor.

20.381: Vision capture timeout

Code : &H0014 &H017D

Meaning/Cause	Capturing the image failed.
Action	Check the wiring and connection of the camera cable.

20.382: Vision system error

Code : &H0014 &H017E

Meaning/Cause	A problem has occurred with the RCXiVY2+ unit.
Action	Contact your distributor.

20.383: Vision system error

Code : &H0014 &H017F

Meaning/Cause	A problem has occurred with the RCXiVY2+ unit.
Action	Contact your distributor.

20.384: Vision system error

Code : &H0014 &H0180

Meaning/Cause	A problem has occurred with the RCXiVY2+ unit.
Action	Contact your distributor.

20.385: Vision system error

Code : &H0014 &H0181

Meaning/Cause	A problem has occurred with the RCXiVY2+ unit.
Action	Contact your distributor.

20.386: Vision system error

Code : &H0014 &H0182

Meaning/Cause	A problem has occurred with the RCXiVY2+ unit.
Action	Contact your distributor.

20.387: Vision system error

Code : &H0014 &H0183

Meaning/Cause	A problem has occurred with the RCXiVY2+ unit.
Action	Contact your distributor.

20.399: Vision system software error

Code : &H0014 &H018F

Meaning/Cause	A problem has occurred with the RCXiVY2+ unit.
Action	Contact your distributor.

20.400: Vision EtherNet link error

Code : &H0014 &H0190

Meaning/Cause	a. The cable is broken, or the connector is disconnected. b. 24 VDC power is not being supplied to the RCXiVY2+ unit, or it has stopped operating.
Action	a. Replace the cable or connect the connector correctly. b. Restart the RCXiVY2+ unit.

20.401: Vision EtherNet connection timeout

Code : &H0014 &H0191

Meaning/Cause	RCXiVY2+ Ethernet communication has timed-out.
Action	Contact your distributor.

20.402: Vision EtherNet system error

Code : &H0014 &H0192

Meaning/Cause	A problem has occurred with RCXiVY2+ Ethernet communication.
Action	Contact your distributor.

20.500: Vision DC24V disconnected

Code : &H0014 &H01F4

Meaning/Cause	24 VDC is not being supplied. a. 24 VDC is not being supplied. b. There is a problem with the 24 VDC wiring. c. The 24 VDC cable is broken.
Action	a. Check the 24 VDC status. b. Check the 24 VDC wiring. c. Check whether the 24 VDC cable might be broken. * Use alarm reset to restart the RCXiVY2+ unit.

20.700: Vision initialize error

Code : &H0014 &H02BC

Meaning/Cause	An error occurred while initializing the RCXiVY2+ unit.
Action	<ul style="list-style-type: none"> • Check the wiring of the camera and lighting. • Restart the RCXiVY2+ unit. * Use alarm reset to restart the RCXiVY2+ unit.

20.701: Vision renew parameter error

Code : &H0014 &H02BD

Meaning/Cause	Synchronization with the RCXiVY2+ unit's parameters failed.
Action	<ul style="list-style-type: none"> • Check the status of the RCXiVY2+ unit. • Re-synchronize with the RCXiVY2+ unit. * Use alarm reset to re-synchronize with the RCXiVY2+ unit.

20.702: Vision camera parameter init error

Code : &H0014 &H02BE

Meaning/Cause	Camera parameter initialization failed. a. The structure of the connected camera was changed. b. The camera cable is broken or the connector is disconnected. c. The camera has malfunctioned.
Action	<ul style="list-style-type: none"> a. Check the camera parameter settings. b. Connect the cable and connector. c. Replace the camera.

20.703: Vision light parameter init error

Code : &H0014 &H02BF

Meaning/Cause	Lighting parameter initialization failed.
Action	Check the lighting parameter settings.

20.704: Vision abnormal temperature error

Code : &H0014 &H02C0

Meaning/Cause	The RCXiVY2+ unit's temperature has risen beyond approximately 90 °C.
Action	<ul style="list-style-type: none"> • Improve the installation conditions. • Check that the cooling fan is working correctly. • Replace the RCXiVY2+ unit. * Use alarm reset to restart the RCXiVY2+ unit.

20.705: Vision system thermal shutdown

Code : &H0014 &H02C1

Meaning/Cause	The RCXiVY2+ unit shut down automatically because of high temperature.
Action	<ul style="list-style-type: none"> • Improve the installation conditions. • Check that the cooling fan is working correctly. • Replace the RCXiVY2+ unit. * Use alarm reset to restart the RCXiVY2+ unit.

20.706: Vision file error

Code : &H0014 &H02C2

Meaning/Cause	The RCXiVY2+ unit's memory is damaged.
Action	<ul style="list-style-type: none"> • Connect with the RCXiVY2+ Studio and execute Recovery mode. • Replace the RCXiVY2+ unit.

20.707: Vision internal 5V down

Code : &H0014 &H02C3

Meaning/Cause	<ul style="list-style-type: none"> • 5V power supply inside the RCXiVY2+ unit has been stopped. • USB port may be short-circuited.
Action	<ul style="list-style-type: none"> • Check that a device connected to the USB port operates correctly. • Replace the RCXiVY2+ unit. * Reset the alarm, and then restart the RCXiVY2+ unit.

20.750: Vision system status error

Code : &H0014 &H02EE

Meaning/Cause	A problem has occurred with the RCXiVY2+ unit.
Action	Contact your distributor.

20.751: Vision system status error

Code : &H0014 &H02EF

Meaning/Cause	A problem has occurred with the RCXiVY2+ unit.
Action	Contact your distributor.

20.752: Vision system status error

Code : &H0014 &H0F0

Meaning/Cause	A problem has occurred with the RCXiVY2+ unit.
Action	Contact your distributor.

20.753: Vision system status error

Code : &H0014 &H02F1

Meaning/Cause	A problem has occurred with the RCXiVY2+ unit.
Action	Contact your distributor.

20.754: Vision system status error

Code : &H0014 &H02F2

Meaning/Cause	A problem has occurred with the RCXiVY2+ unit.
Action	Contact your distributor.

20.755: Vision system status error

Code : &H0014 &H02F3

Meaning/Cause	A problem has occurred with the RCXiVY2+ unit.
Action	Contact your distributor.

20.756: Vision system status error

Code : &H0014 &H02F4

Meaning/Cause	A problem has occurred with the RCXiVY2+ unit.
Action	Contact your distributor.

20.900: Vision CFastcard doesn't exist

Code : &H0014 &H0384

Meaning/Cause	The CFast card is not connected.
Action	Contact your distributor.

[C] Warning**c40 : Vision abnormal temperature**

Meaning/Cause	The RCXiVY2+ unit temperature rose over 80 °C.
Action	<ul style="list-style-type: none">• Improve the installation environment.• Check if the cooling fan works normally.• Replace the RCXiVY2+ unit.

c41 : Vision fan error

Meaning/Cause	The number of fan rotation of the RCXiVY2+ unit dropped 4700 rpm or less.
Action	<ul style="list-style-type: none">• Check if the cooling fan is stuck with dust, etc.• Check the cooling fan connector.• Replace the cooling fan.

c42 : Vision memory life warning

Meaning/Cause	The RCXiVY2+ unit CFast card is reaching the end of its lifespan.
Action	Backup RCXiVY2+ unit data and then replace the CFast card. Restore the backup data after replacing the CFAST card.

1.2 Troubleshooting

1.2.1 When trouble occurs

Please contact your distributor with details of the problem that occurs. Report the following items in as much detail as possible.

Item	Description
What happened	<ul style="list-style-type: none"> Controller model name and serial No. example: RCX340 Robot model name and serial No. example: YK400XR Controller version No. example: V1.05 R0018 RCXiVY2+ Studio version No. example: V1.00 RCXiVY2+ unit version No. example: V1.00
When	<ul style="list-style-type: none"> Date of purchase example: April 2020 How long used example: Since delivery, about 1 year
Under what conditions	<ul style="list-style-type: none"> Usage conditions example:when power is turned on when creating program during manual movement when robot is moved to particular location during program operation. during model registration in RCXiVY2+ Studio
Current status	<ul style="list-style-type: none"> Status on programming box screen example:Nothing is displayed on screen Error message appears on screen Robot servo status example:Servo won't turn on Abnormal sound when robot is moved Sets to origin incomplete. Programming box operating status example:Keys won't function Response after pressing key is slow Only the emergency stop button functions etc.
How often it happens	<ul style="list-style-type: none"> How often above problem occurs example:Always occurs when power is turned on. Occurs at particular line during program operation. Only occurs once, then does not occur again.

If the following trouble occurs, confirm each condition and take the countermeasures.

■ Lighting fails to switch on.

- * Check the power LED on/off status.

If the LED is off

- Check the power supply voltage.
- The lighting control board may have malfunctioned. Please contact your distributor.

If the LED is on

- Check to see if the lighting parameter values of the lighting control parameters are correct.
- Verify that the lighting specifications and power supply specifications are compatible, and that the lighting is operational (normal).
- Check to see if the "20.704: Vision abnormal temperature error" error occurred. If this error occurred, turn the lighting output off.

Check the status of the RCXiVY2+ unit's side fan, and turn the power on again.

■ Flicker on monitor screen

monitor may be interfered with noise, etc.

- Rearrange the wiring; keep the monitor cable from the robot cable.
- Attaching a ferrite core on the monitor cable may improve the flicker.

1.3 Recovery mode

1.3.1 About Recovery mode

The system data, model data, mark data for calibration, and RCXiVY2+ unit parameters that are used for the RCXiVY2+ system are saved into the CFast card installed on the RCXiVY2+ unit. If an unexpected trouble occurs to this CFast card and the RCXiVY2+ unit does not function, "20.706: Vision file error" appears and the operation automatically enters Recovery mode.

If an unexpected problem occurs with the CFast card, the status LEDs (green/red) flash alternately.

Example of recovery mode screen



All the vision functions cannot be used in Recovery mode. To recover from the error, it is necessary to connect the RCXiVY2+ Studio and perform the recovery operation. The following processes can be performed from the RCXiVY2+ Studio in Recovery mode.

- Initialization of CFast card

After the CFast card has been formatted, the data necessary for startup is loaded to make the system ready for operation. At this time, the RCXiVY2+ unit parameters are returned to their factory default settings. Additionally, all of the data (model data and image data, etc.) saved in the CFast card are cleared.

- Data recovery from backup data

The backup data is loaded to recover the data. This allows you to return the CFast card to the data status you have backed up.



CAUTION

To recover from Recovery mode, it is absolutely required to initialize the CFast card. So, it is strongly recommended that you back up the data periodically.

1.3.2 Recovery mode operation

1.3.2.1 Before starting Recovery mode operation

To perform Recovery mode operation, it is necessary to connect the RCXiVY2+ Studio. At this time, the RCXiVY2+ Studio connections are the same as those for normal operation. For details, refer to B RCXiVY2+Studio OPERATION SECTION "Connecting RCXiVY2+ Studio to RCXiVY2+ unit".

Please note that Vision control mode cannot be altered. Vision control mode setting, therefore, is not needed.



NOTE

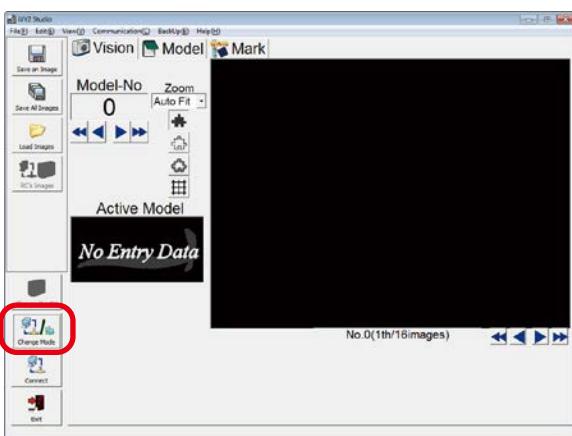
When connecting to the RCXiVY2+ Studio in Recovery mode, the communication settings before Recovery mode is activated are retained. If it is necessary to set up or check the communication settings, refer to B RCXiVY2+ Studio OPERATION SECTION "3.2 Setting the RCXiVY2+ unit's communication" and "5.1 Communication settings".

1.3.2.2 Recovery mode operation procedure

Step 1 Click [Connect].

Click (Connect) at the toolbar in the left portion.

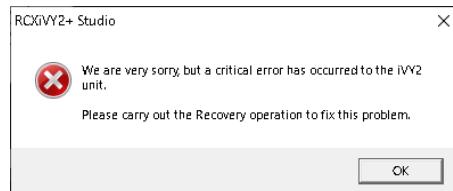
► **Step 1 RCXiVY2+ Studio and RCXiVY2+ unit connection**



Step 2 The error message appears.

The error message indicating that an error has occurred in the RCXiVY2+ unit appears.
Click (OK).

► **Step 2 Error message**



Step 3 Click [Recovery start].

The recovery operation window appears.
Click (Recovery start).

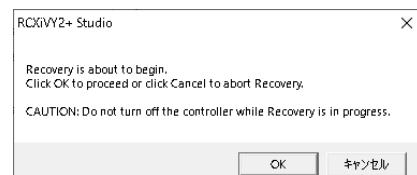
► **Step 3 Recovery operation window**



Step 4 Follow the recovery start confirmation message and click [OK].

To cancel the recovery operation, click (Cancel).

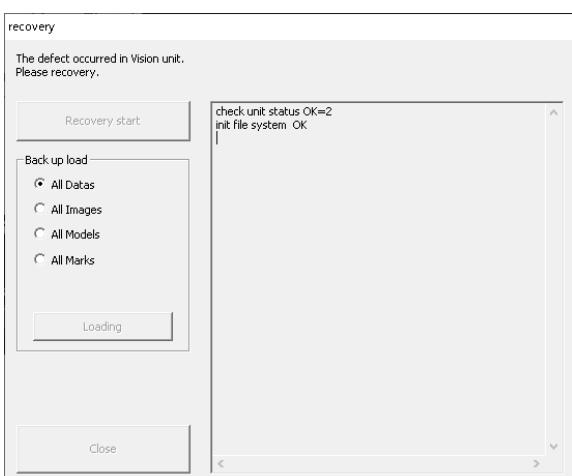
► **Step 4 Recovery start confirmation message**



Step 5 The recovery operation is then started.

When the recovery operation is started, all other operations are disabled. Wait until the recovery operation is completed.

► **Step 5 Recovery operation running state**



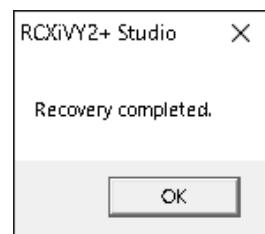
CAUTION

If the robot controller or personal computer is powered off or any cable or connector is disconnected during recovery operation, this may cause the data to corrupt. To prevent such trouble, do not shut down the power or disconnect any cable during recovery operation.

Step 6 *The recovery completion message appears.*

When the recovery operation is completed, the recovery completion message appears. Click (OK). If the recovery operation fails (error occurs during recovery operation), try it again.

► **Step 6** Completion message

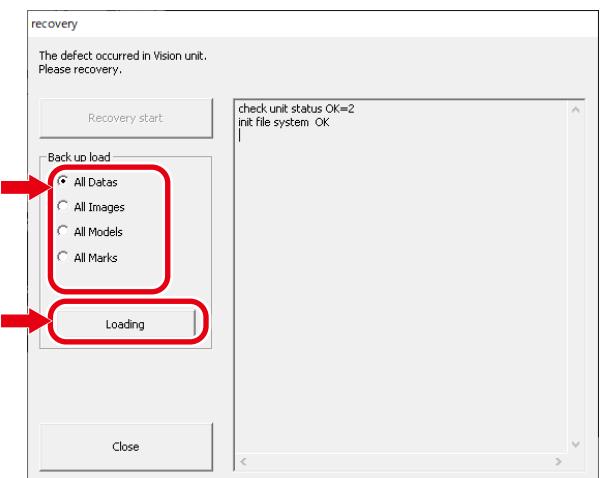


Step 7 *Select data to load and click [Loading].*

Check on radio buttons corresponding to the data you want to load into the RCXiVY2+ unit and click (Loading).

To exit the recovery operation without loading of backup data, go to [step 13](#).

► **Step 7** Data selection

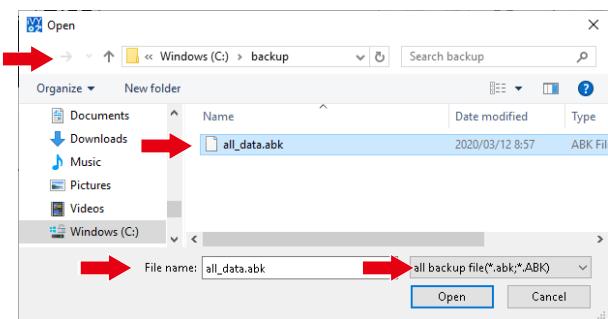


Step 8 *Select a data file to load.*

The "Open" window appears. Select a data file to load. Files corresponding to the data type to be loaded are displayed in the window.

Data Type	File type
All Data	all backup file (*.abk, *.ABK)
All Images	all images backup file (*.ibk, *.IBK)
All Models	all models backup file (*.fbk, *.FBK)
All Marks	all marks backup file (*.mbk, *.MBK)

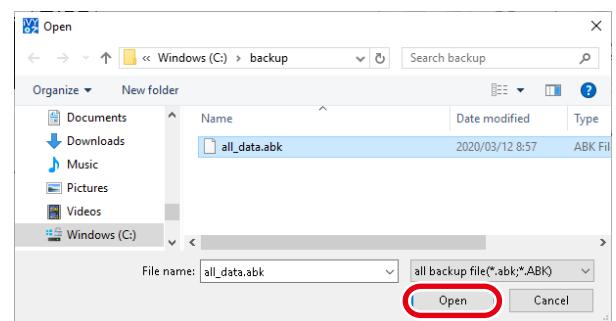
► **Step 8** Selecting the data file to be loaded (1)



Step 9 *Click [Open].*

To cancel the data loading, click (Cancel).

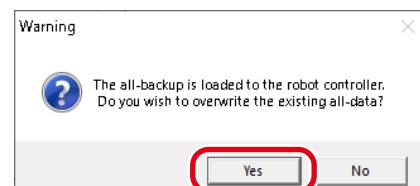
► **Step 9** Selecting the data file to be loaded (2)



Step 10 *Follow the overwrite confirmation message and click [Yes].*

To cancel the data loading, click (No).

► **Step 10** Overwrite confirmation message



Step 11 Load the data.

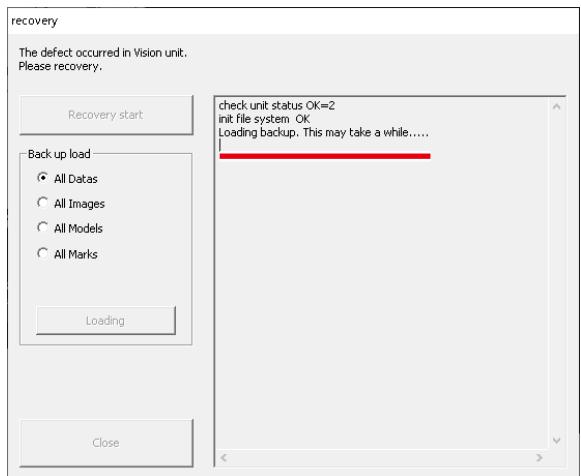
The message, "Loading backup.", appears while the data is being loaded. Wait until the data loading is completed.

**CAUTION**

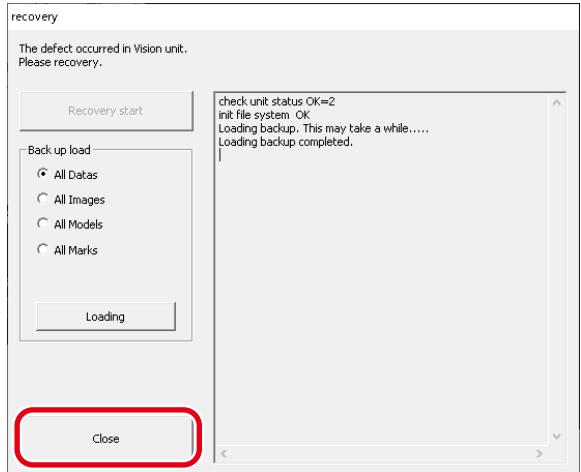
If the robot controller or personal computer is powered off or any cable or connector is disconnected during data loading, this may cause the data to corrupt. To prevent such trouble, do not shut down the power or disconnect any cable during data loading.

Step 12 The loading completion message appears.

When the data loading is completed successfully, the loading completion message appears. Click (OK).

Step 11 Data loading**Step 13 Click [Close].**

To exit the recovery operation, click (Close).

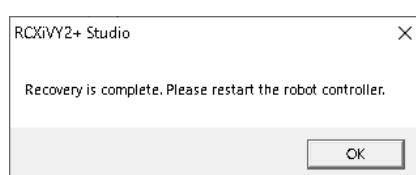
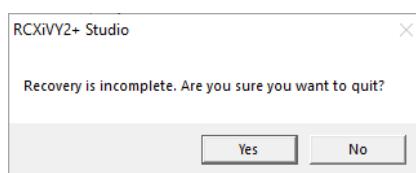
Step 12 Loading backup data completion**Step 13 Recovery operation completion****Step 14 The recovery operation completion message appears.**

When the recovery operation is completed successfully, the message appears, prompting you to restart the robot controller. Click (OK) and restart the robot controller.

When the message, "Recovery is incomplete", appears, you need to retry the recovery operation. To retry the recovery operation, click (No). Conversely, to exit the recovery operation, click (Yes).

**NOTE**

After the recovery operation has been completed successfully and the robot controller has been restarted correctly, the operation then returns to the normal operation.

Step 14 Recovery is complete**Step 14 Recovery is not complete**

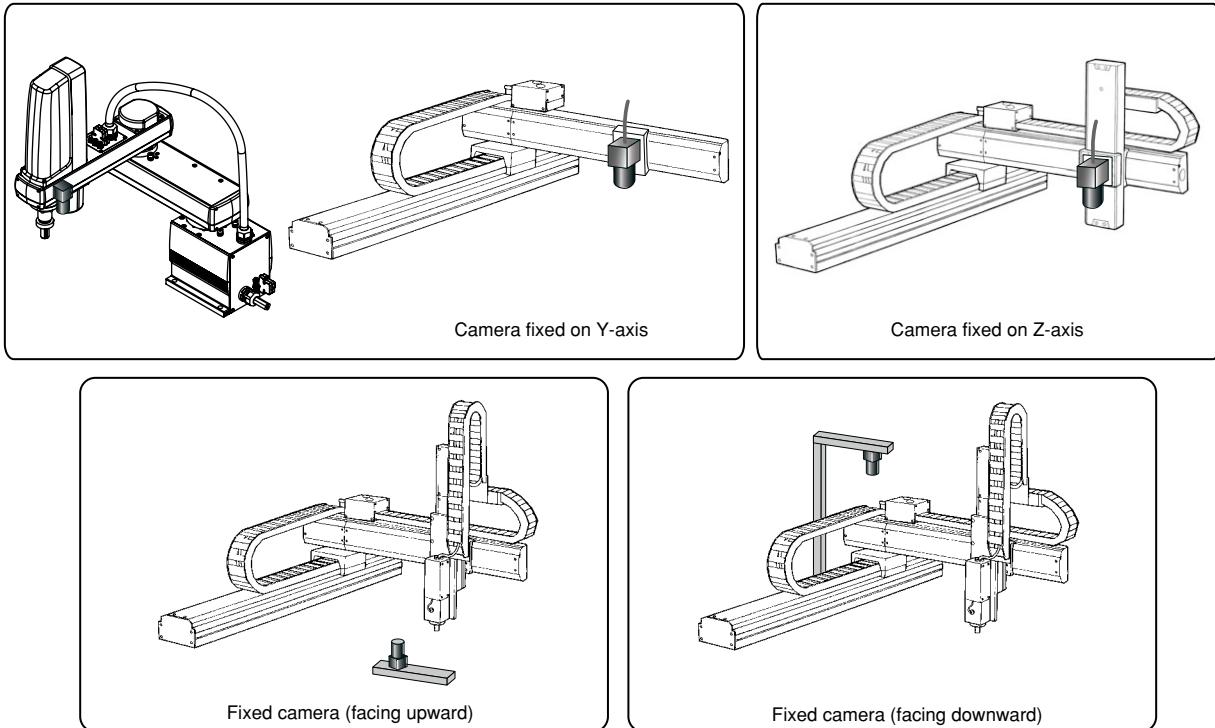
2. Specifications list

C

TROUBLESHOOTING AND SPECIFICATIONS SECTION

Specification Item		RCXiVY2+ unit
Basic specifications	Supported controllers	RCX340 / RCX320
	Number of screen pixels	728(H) × 544(V) (400,000 pixels, VGA) 1456(H) × 1088(V) (1,600,000 pixels, SXGA) 2048(H) × 1536(V) (3,200,000 pixels, UXGA) 2592(H) × 1944(V) (5,000,000 pixels, QSXGA)
	Model setting capacity	254 models
	Number of connectable cameras	2 cameras
	Connectable camera	GigE camera PoE: IEEE802.3af 1 ch up to 7W
	External interface	Ethernet (1000BASE-T) * For setting and monitor operations USB 2.0 2Ch (up to 5V 2.5 W/ch) * It is planned to support this USB later.
	External monitor output	DVI-I * Also usable with an analog monitor by using a conversion adaptor. Monitor resolution: 1024 × 768 Vertical periodic frequency: 60 Hz Horizontal periodic frequency: 48.4 kHz
	Power supply	24 VDC ±10%, Maximum 1.5 A
	Dimensions	W45 × H195 × D130 (RCXiVY2+ unit only)
	Weight	0.8 kg (RCXiVY2+ unit only, when the lighting control board option is selected)
Image capturing	Operating environment	Compliant with the RCX340/RCX320 controller.
	Storage environment	Compliant with the RCX340/RCX320 controller.
	Search method	Edge search (Correlated edge filter, Sobel filter), Measurement function, Blob search
	Trigger mode	S/W trigger, H/W trigger
	External trigger input	2 points
	Function	Position detection, coordinate conversion, automatic point data generation, distortion and inclination correction
	Camera installation position	Fixed to the fixed camera (up and down) or robot (Y-axis and Z-axis). Perpendicular to the workpiece to be captured.
	Setting support function	Calibration, image save function, model registration*, fiducial mark registration*, measurement function registration*, blob registration*, monitor function*
	Number of connectable lighting units	Maximum 2
	Modulated light format	PWM modulated light control (0 to 100%), PWM frequency switchable 62.5 kHz/ 125 kHz Continuous light, strobe light (follows camera exposure)
Lighting control options	Lighting power input	12 VDC or 24 VDC (external supply shared by both channels)
	Lighting output	For 12 VDC supply: Total of less than 40 W for both channels. For 24 VDC supply: Total of less than 80 W for both channels.

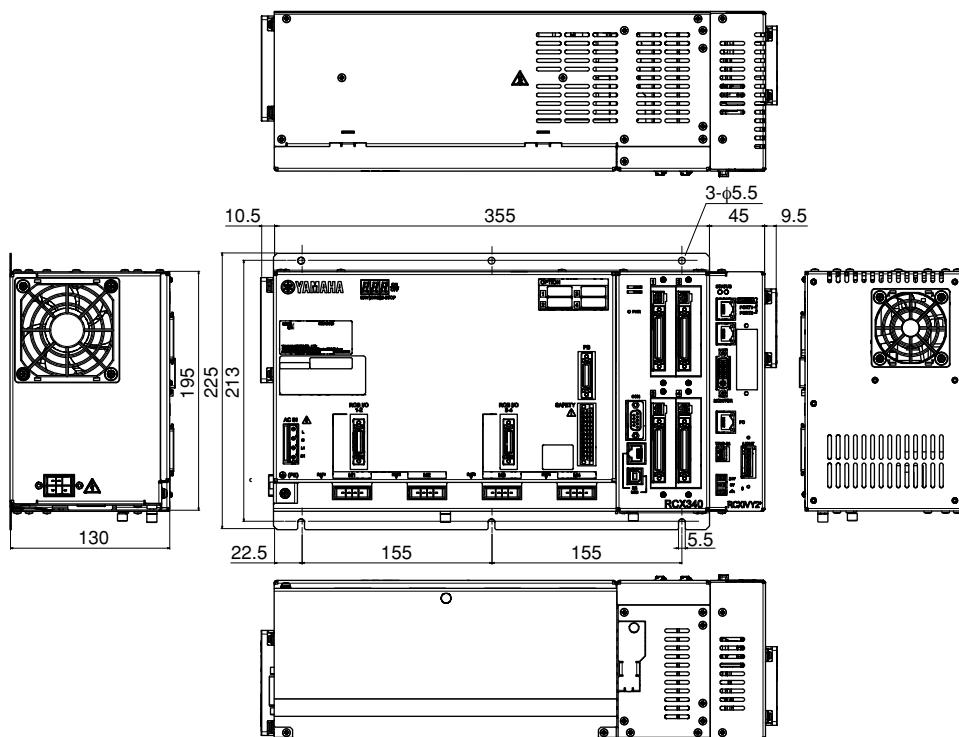
Note: Due to ongoing improvements, the specifications may be changed at any time without prior notice.

■ Camera mounting examples

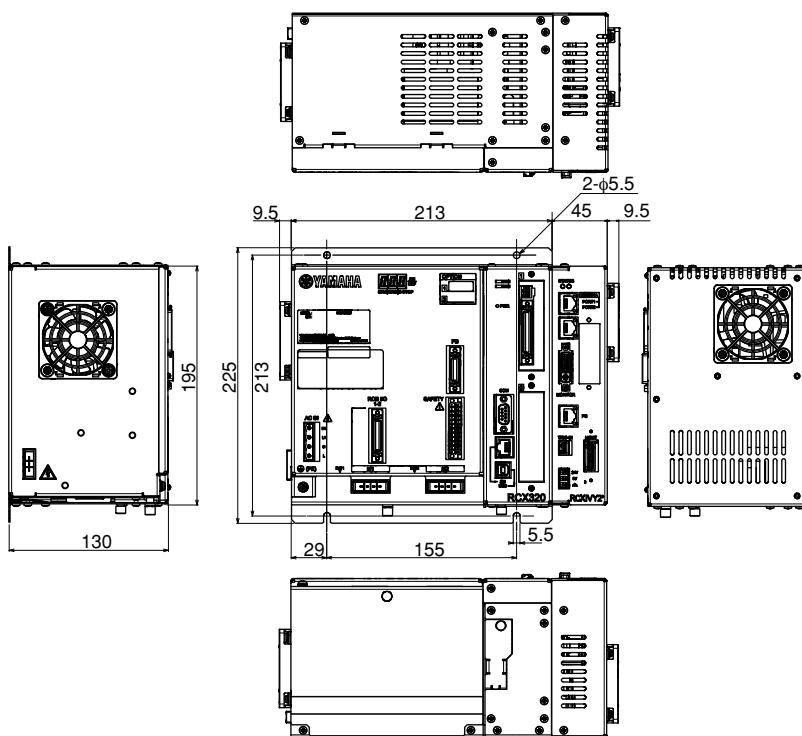
3. Dimensional outlines

3.1 Controller

RCX340 Controller (when RCXiVY2+ unit is installed)

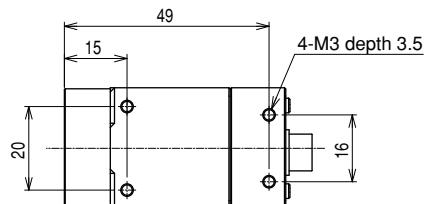
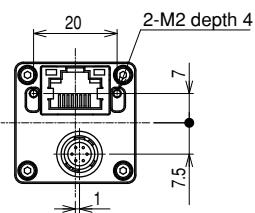
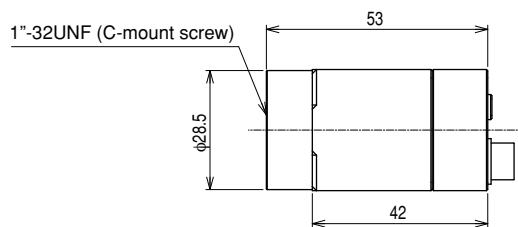
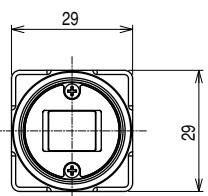
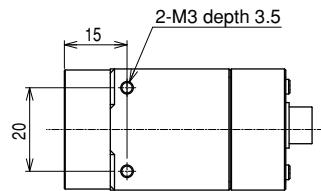


RCX320 Controller (when RCXiVY2+ unit is installed)



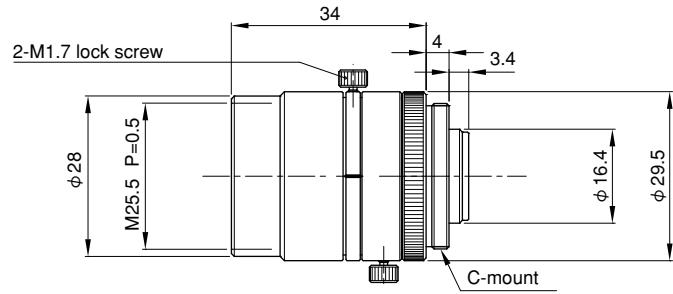
3.2 Camera

- 400,000 pixel camera (Type : KFR-M6541-00)
- 1,600,000 pixel camera (Type : KFR-M6541-10)
- 3,200,000 pixel camera (Type : KFR-M6541-20)
- 5,000,000 pixel camera (Type : KFR-M6541-30)

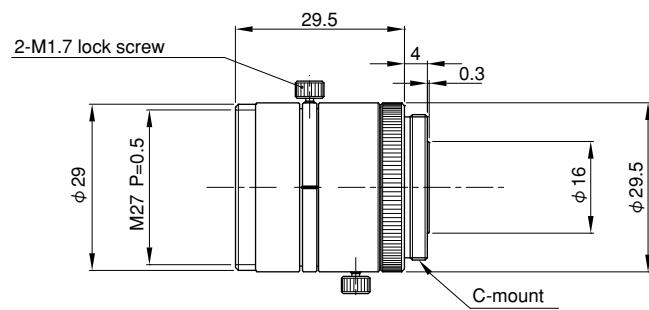


3.3 Lens

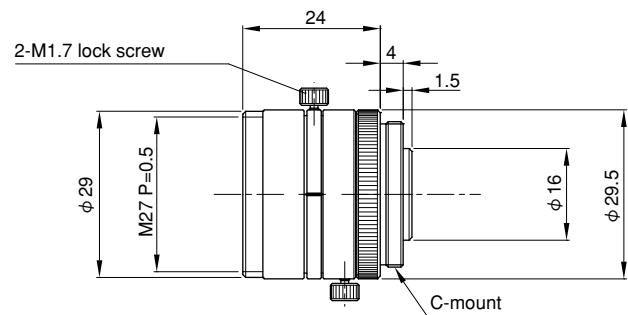
8mm lens dimensions (Type: KCX-M7214-00)



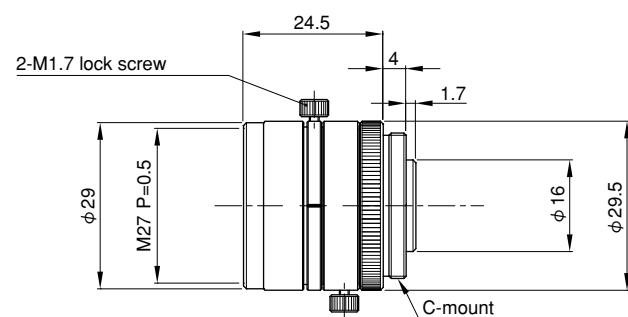
12mm lens dimensions (Type: KCX-M7214-10)

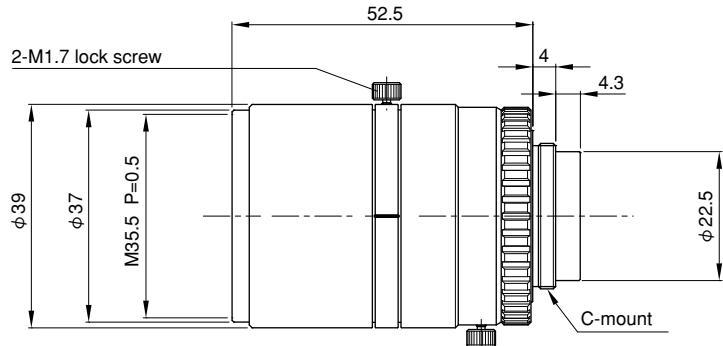
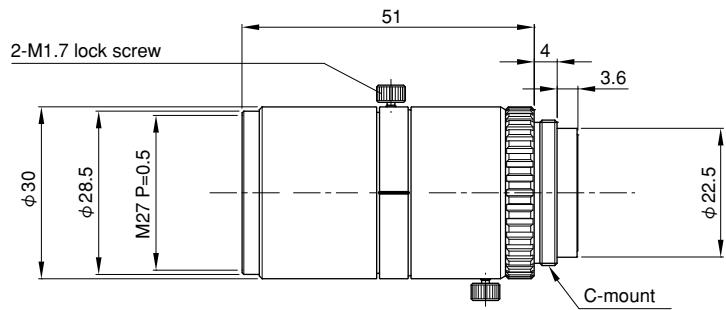
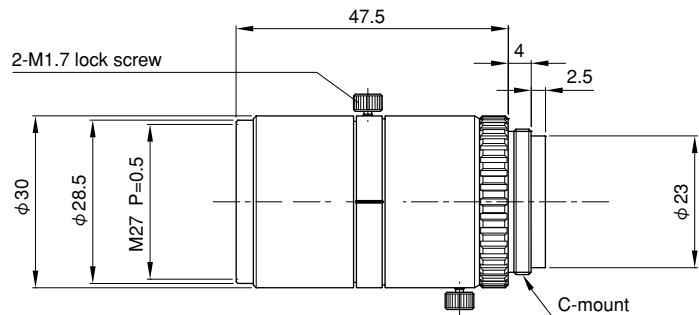
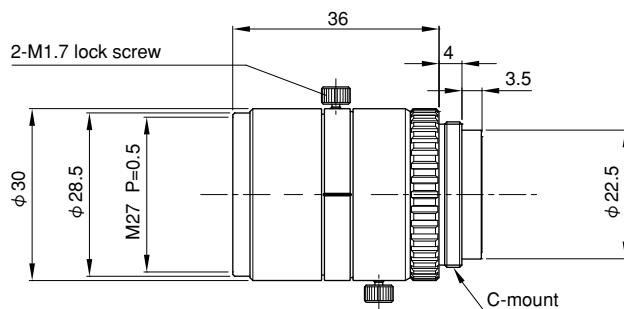


16mm lens dimensions (Type: KCX-M7214-20)



25mm lens dimensions (Type: KCX-M7214-30)



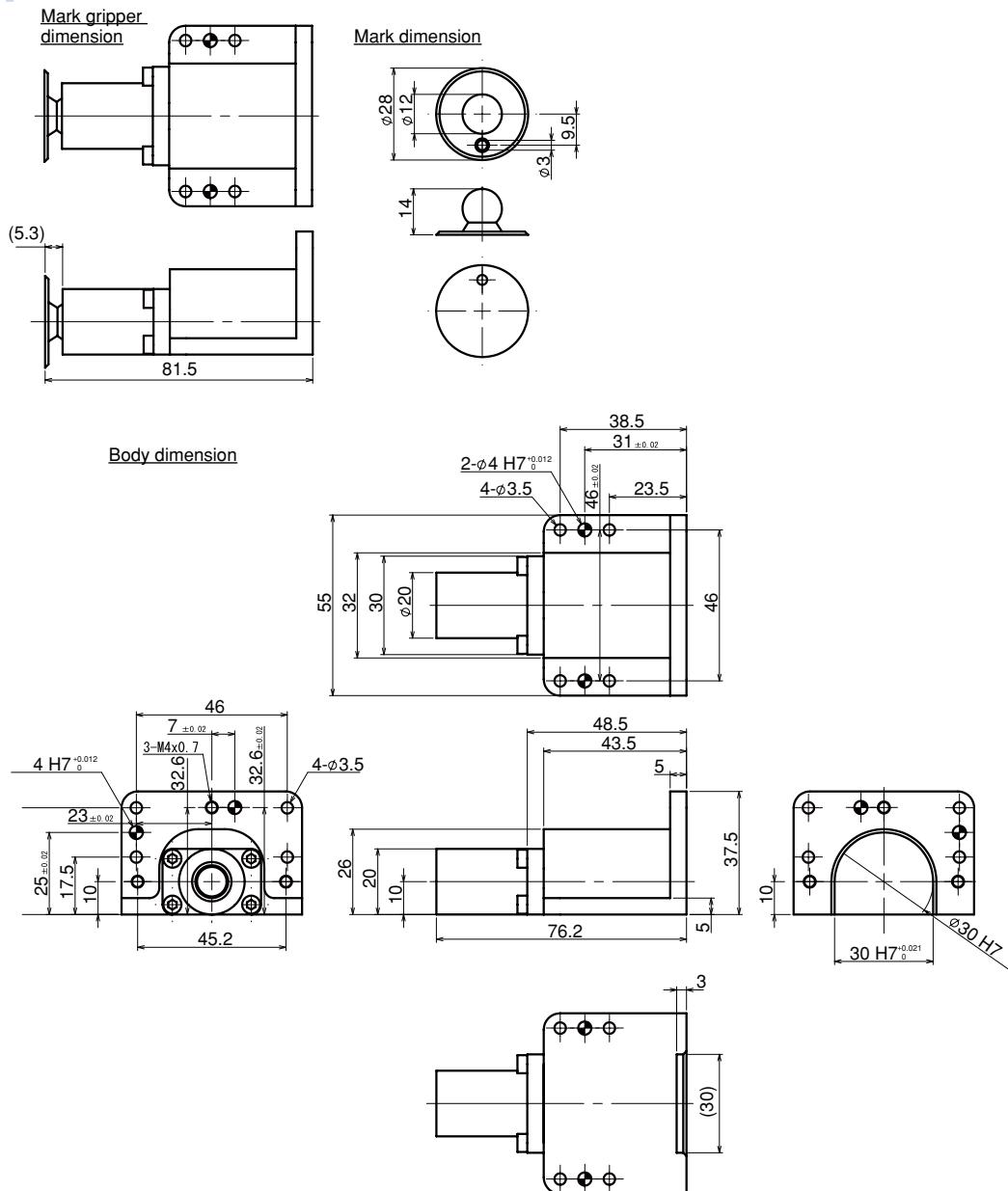
8mm lens for megapixel (Type: KCX-M7214-40)**12mm lens for megapixel (Type: KCX-M7214-50)****16mm lens for megapixel (Type: KCX-M7214-60)****25mm lens for megapixel (Type: KCX-M7214-70)**

3.4 Calibration jig

C

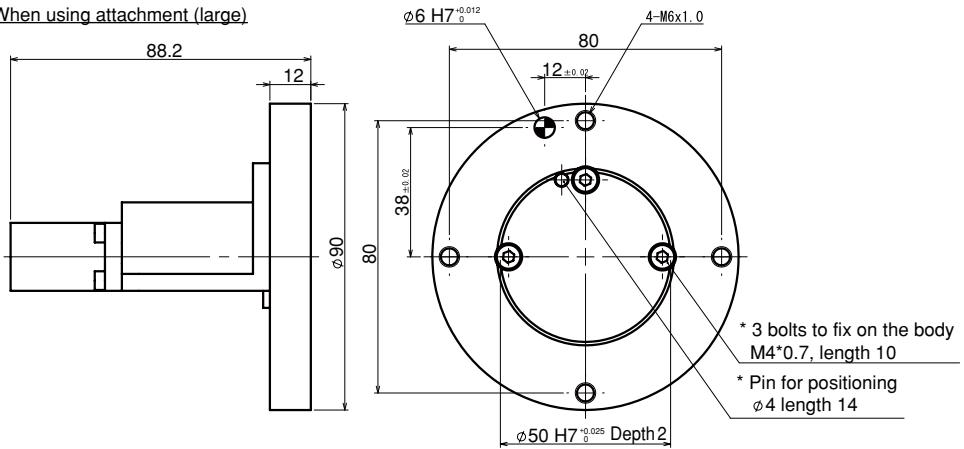
TROUBLESHOOTING AND SPECIFICATIONS SECTION

Calibration jig(Type: KCX-M7200-00)



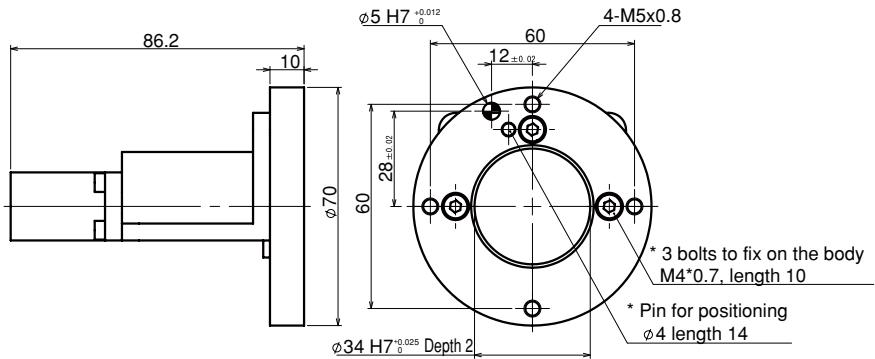
Calibration jig

When using attachment (large)



Calibration jig

When using attachment (small)



4. Appendix

4.1 Explanation of search function

RCXiVY2+ provides the following search methods to detect the workpiece position.

- Edge search
- Measurement function
- Blob search

The following explains each search method.

4.1.1 Edge search

■ Overview of search method

The edge search performs the search using the information on the workpiece contour shape. When there is a difference in brightness that is the specified concentration difference or more between the pixels that are adjacent to each other in the images, the workpiece is extracted as an edge. This edge information is registered as a pattern. The edge is extracted from the images during searching and the registered edge pattern is searched for.

■ Features

The edge search has features that are difficult to be affected by changes in lighting conditions, or workpiece chipping or contamination.

The edge search of RCXiVY2+ establishes both the detection accuracy and high speed using the original process.

A function to set the necessary area or unnecessary area of the edge pattern is held to judge similar workpiece or detect overlapped workpieces.

The edge search is a search method with the detection accuracy, environment robustness, and high speed balanced well, and can be applicable to most applications.

4.1.2 Measurement function

■ Overview of search method

The measurement function performs the search based on the contour shape in the same manner as the edge search.

The line section or circular of the extracted contour shape is detected.

The intersection between the line sections, the position of the workpiece edge, or the center of the circle can be detected.

■ Features

Since the edge of the workpiece or the center of the circle can be detected, this function can support the highly accurate positioning or laminating application of the workpiece whose size or shape is changed easily. The normal edge search is affected by changes in target workpiece size, and the detection position may vary. However, the effect may become small using the measurement function.

In addition, since the absolute angle on the robot coordinate can be output, combining the measurement function with the workpiece coordinate function of the RCX340/320 makes it possible to easily create the position correction application.

4.1.3 Blob search

■ Overview of search method

The blob search binarizes the image to black and white. Neighboring black or white pixels are connected and it is extracted as a blob.

The oval fitting is performed for the extracted blobs to select the target blob by the elements such as the area of the blob or the main axis length of the oval.

■ Features

The blob search detects the workpiece using the blob area, not the shape. Therefore, the blob search can detect an irregular shape object.

This search method is suitable for foods or clothes that often have irregular shapes. In addition, as the binarization process is performed, the search can be performed at a very high speed. The blob search is suitable for the workpiece count, workpiece presence check, or application that does not need the accuracy.

4.1.4 Function comparison of search method

The function comparison of each search is shown in the following list.

■ Support capability by item of each search

Item	Edge search	Measurement function	Blob search
Accuracy	A	AA	B
Speed	A	B	AA
Irregular shape object	B	B	AA
Environment robustness	AA	A	B

AA...Excellent/A...Good/B...Unsuitable

■ Support capability by application of each search

Application	Edge search	Measurement function	Blob search
High-speed positioning	A	B	A
Accurate positioning	A	A	B
Workpiece laminating	A	A	B
Conveyor tracking	A	B	A
Detection of irregular shape object	B	B	A
Random picking	A	B	B
Workpiece count	A	B	A
Workpiece presence check	A	B	A

A...Good / B...Unsuitable

C-25

Revision record

Manual version	Issue date	Description
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User's Manual

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RCXiVY2+

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Ver. 1.00

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