

## High-speed Digital Image Sensor CV-2100

### Users Manual

Before starting operation, please read this manual carefully.  
Always keep this manual handy for future reference.



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# Introduction

This manual describes the hardware of the V-2000 high-speed digital image sensor and its basic operation.

Read this manual carefully before using the system in order to ensure optimum performance.

Always keep this manual in a safe place for future reference whenever needed, and ensure that the manual is passed to the end user in case of transfer of the unit.

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## Symbols

The following warning symbols are used to ensure safety and to prevent human injury and/or damage to property when using the CV-2000 series.



### **DANGER**

Indicates that the operator is at risk of death or serious physical injury if the system is improperly operated or this precaution is not followed.



### **WARNING**

Indicates that the operator is at risk of physical injury if the system is improperly operated or this precaution is not followed.



### **CAUTION**

Indicates that property could be damaged (product malfunction, etc.) if the system is improperly operated or this precaution is not followed.

### **Note**

Indicates an important operating procedure that could be easily mistaken.

### **Reference**

Indicates further information to be read or which is useful to know.

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## Trademarks

- Windows 95/Me/98/2000/XP Professional Edition/Home Edition are registered trademarks of Microsoft Corporation, U.S.A.
- CompactFlash is the registered trademark of SanDisk Corporation, U.S.A.
- Other company names and product names are registered trademarks or trademarks of their respective companies. The <sup>TM</sup> mark and ® mark are omitted in this manual.

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# Safety Precautions

## General Cautions

- Before starting work or before starting the system, confirm that all the functions of the system are working properly.
- If any product of our company fails, take full safety measures to prevent damage before using the system again.
- If the system is used exceeding the ranges shown in the specifications or if the system is modified, the functions and performances cannot be guaranteed.
- Please note that when the product is used in combination with other instruments, the functions and performance may be degraded, depending on the conditions and environment.
- Do not use any product for protecting the human body.
- Do not subject this unit or connected device to a sudden change of temperature. Condensation may occur.

## Warning

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### General

- Do not use with any power voltage other than DC 24 V. Doing so could cause fire, electric shock, or product malfunction.
- Do not disassembly or modify this unit. Doing so could cause fire or electric shock.

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### Operating environment and conditions

- To use the CV-2100 properly and safely, avoid installing this unit in the following locations. Otherwise fire, electric shock, or product malfunction could result.
  - Locations where there is moisture or dust, or which are poorly ventilated.
  - Locations where the CV-2100 is exposed to direct sunlight or temperature rises.
  - Locations where there are flammable or corrosive gases.
  - Locations where the unit may be directly subjected to vibration or impact.
  - Locations where water, oil or chemicals may splash onto the unit.
  - Locations where static electricity occurs.
- Keep this unit and cables away from high-tension cables or power lines. Otherwise, noise could cause malfunction or accident.
- This unit and optional devices are precision components. Do not subject them to vibration or impact.

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### Measures to be taken when an abnormality occurs

In the following cases, turn the power OFF immediately. Using the unit in an abnormal condition could cause fire, electric shock, or product malfunction. Contact our office for repair.

- If water or debris enters the unit
- If the unit is dropped or the case is damaged
- If abnormal smoke or odor comes from the controller



### Caution

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### Usage

- Before connecting or disconnecting the cable, be sure to turn off the power of this unit and connected devices. Otherwise, malfunction of this unit and connected devices could result.
- Do not turn the power off while you are setting each item. Otherwise, all or part of the setting data may be lost.
- Do not block the ventilation holes. Otherwise, the inside temperature may rise and malfunction may result.

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### Note

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### Operation

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

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### Cameras

The cameras are dedicated products. Commercially-available cameras cannot be used. (However, commercially-available c-mount lenses can be used.)

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# Cautions about CE Mark

KEYENCE evaluated compliance with the EU Directive for the conditions given below, and confirmed that the CV-2100 meets the requirements.

Therefore, if you use the CV-2100 in EU countries, you must comply with the following conditions. However, these conditions do not guarantee compliance with the EMC Directive and Low Voltage Directive for the whole machine unit which you manufacture.

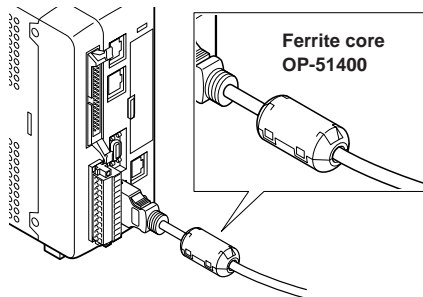
Please evaluate the compliance of the whole machine unit by yourself.

## Caution

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### Compliance with EMC Directive (89/336/EEC)

- Compliance standard: EN61326
- Mount the ferrite core specified by KEYENCE (OP-51400) to the camera cable within 200 mm from the controller unit.



- Keep all cables used to connect the controller unit and external devices shorter than 30 m.
- Use a shielded Ethernet cable (OP-42275).



# Chapter 1

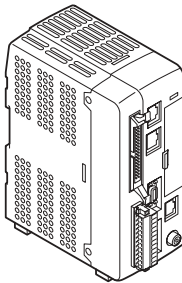
## Introduction

## Checking the Package Contents

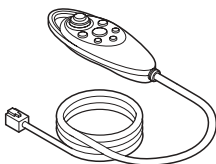
The equipment and accessories listed below are included in the package delivered to you. Upon opening the carton, check that you have received all of the equipment and accessories listed below.

### Standard Package

- Controller unit (CV-2100): 1



- Remote control console (OP-42342): 1

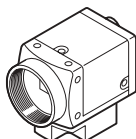


- Monitor cable (RCA - RCA, 2 m): 1
- Instruction Manual (this document): 1

### Options

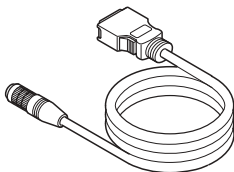
#### CV-020

- Camera (CV-020): 1 (Resin mounting parts (OP-42346) are already mounted)



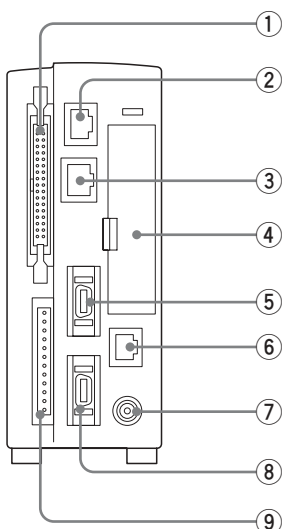
#### Camera connecting cables

- CV-C3: Camera cable (3 m): 1
- CV-C10: Camera cable (10 m): 1
- CV-C17: Camera cable (17 m): 1



# Identifying Controls and Connectors

## Controller Unit



**① Expansion I/O connector**

Connects the parallel input/output signals.

**② Modular connector**

Connects the remote control console.

**③ Ethernet connector**

Connects the Ethernet cable.

**④ Compact flash memory slot**

Insert the compact flash memory into this slot (page 9-2).

**⑤ Camera 2 connector**

Connects camera 2.

**⑥ RS-232C connector**

Connects the RS-232C communication cable.

**⑦ Video output terminal**

Connects external monitor (page 2-7).

**⑧ Camera 1 connector**

Connects camera 1.

**⑨ Standard I/O connector**

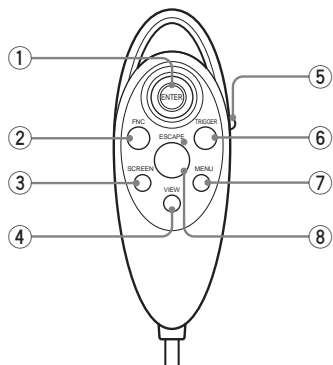
Connects the power supply (DC 24 V) and the input/output signals.



## Remote Control Console

### Reference

The following buttons on the remote control console can perform operations when they are used singularly and when they are used in combination with other buttons. Refer to “List of Remote Control Console Operations” (next page).



#### ① [ENTER] button

Move the [ENTER] button up, down, right or left to move the selected item on the screen. When you press the [ENTER] button, the setting on screen is confirmed.

#### ② [FNC (FUNCTION)] button

When you want to show a submenu on the screen, press the [FNC] button on the selection item.

#### ③ [SCREEN] button

When you want to change the processing screens, press the [SCREEN] button. By pressing the [SCREEN] button, the display will change from the RAW screen to the PROCESS 1 screen and then to the PROCESS 2 screen (page 5-4).

#### ④ [VIEW] button

The [VIEW] button functions differently depending on if you are in [RUN] or [PROGRAM] mode (page 5-2).

- During PROGRAM: Pressing the [VIEW] button will change the transparency of the setting menu.
- During RUN: Pressing the [VIEW] button will toggle the information display on the screen between measured valves, evaluation values, and custom window settings.

#### ⑤ Selector switch

When you want to select either the RUN mode or the PROGRAM mode, press the selector switch. Pressing of the switch toggles between the RUN mode and the PROGRAM mode.

#### ⑥ [TRIGGER] button

Press the [TRIGGER] button to enter a trigger input. This will update the screen.

#### ⑦ [MENU] button

When you want to show the startup screen, press the [MENU] button.

#### ⑧ [ESCAPE] button

When you want to return to the previous screen or to resume the previous operation, press the [ESCAPE] button.

## List of Remote Control Console Operations

Various operations can be performed by simultaneously pressing two or more buttons of the remote control console. Please note that the same combination of buttons can have the different functions depending on the mode of operation that the system is in.

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### Operation when the power is turned on

#### Initializing all settings of the CV-2100

While pressing the [ESCAPE] button, turn on the power. All of the registered images are also cleared.

#### ► Note

Never turn off the power while initialization of the system is in progress. It can cause error of the internal data.

#### Forcibly starting the system in Program Edit mode

Hold the [ENTER] button in the upper position, then turn on the power while pressing the [FNC] button.

#### Clearing the password and disabling the password setting

While pressing the [FNC] button and the [ESCAPE] button simultaneously, turn on the power.

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### Operation in the Program Edit mode

#### Saving the current image on the screen to the CF memory card (Screen capture)

While pressing the [FNC] button, press the [VIEW] button.

#### Adding/Deleting a vertex to/from the polygon area during scanning

- While pressing [FNC] button, press the [ENTER] button. A vertex is then added to the polygon.
- While pressing [FNC] button, press the [ESCAPE] button. A vertex is then deleted from the polygon.

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### Operation in the RUN mode or in the Trial Run mode

#### Saving the current image on the screen to the CF memory card (Screen capture)

While pressing the [FNC] button, press the [VIEW] button.

#### Re-testing an image

While pressing the [FNC] button, press the [TRIGGER] button.

#### Opening limit setting menu in the RUN mode (when setup in program options)

While pressing the [FNC] button, press the [MENU] button (page 6-14).

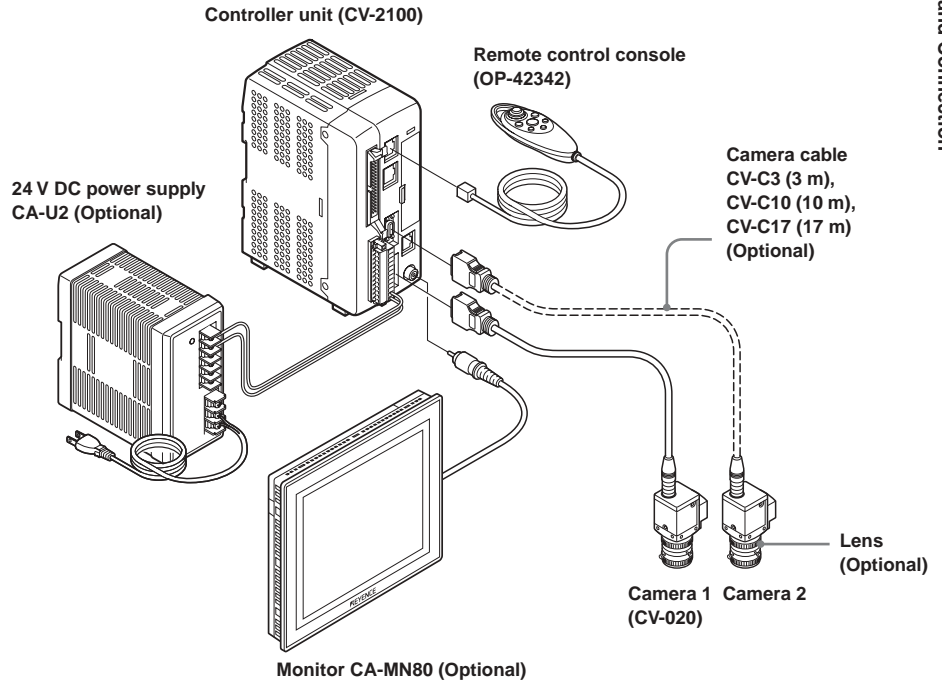
#### Switching between camera 1 and camera 2 in the RUN mode

While pressing the [FNC] button, push the [ENTER] button up or down. (pages 6-20 and 6-22)

#### Inputting a reset signal to the CV-2100 (resets measured/evaluation values)

While pressing the [FNC] button, press the [ESCAPE] button.

### Example of a standard system setup with two cameras

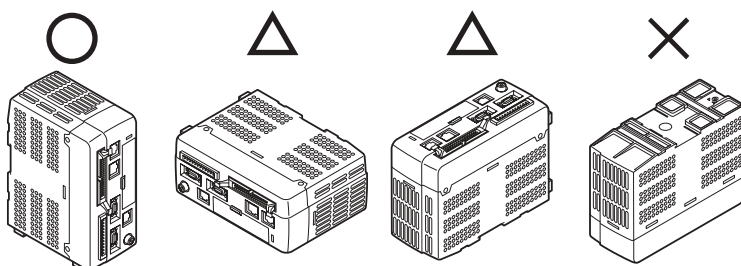


# Installing the Controller Unit

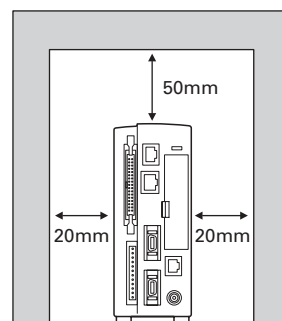
Install the controller unit either by mounting it on a DIN rail or by fixing it on floor with screws..

## Caution on Direction of Controller Mounting

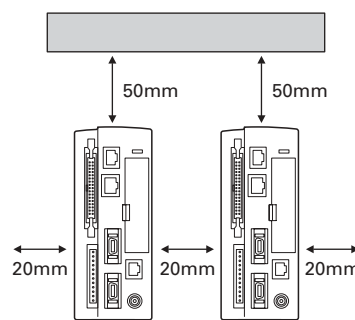
- We recommend that the controller be installed in the direction indicated by the round ○ mark as shown below. If you install the controller in the direction indicated by the triangle Δ mark, accumulated heat must be exhausted by forced air-cooling or the controller must be installed with surrounding free space of 150mm or more.



- For ventilation, secure free space of 50 mm or more on top of the controller, and 20 mm or more on both sides of the controller. Also secure free space of 90 mm or more in front of the connector panel to enable easy and safe connection of cables.



- When two or more controllers are installed side by side, secure free space of 20 mm or more between controllers, and 50 mm or more on top of both controllers.

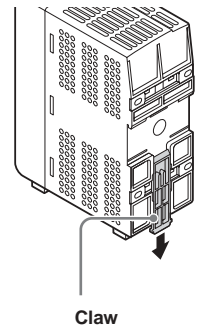


### Note

- Do not block the ventilation opening on the top and bottom of the controller. If blocked, heat is accumulated inside the machine and can cause system failure.
- If the temperature inside the control panel (temperature at the bottom of the controller) exceeds 40°C, use forced air-cooling or increase the free space around the system to improve ventilation until the operating ambient temperature drops below 40°C.

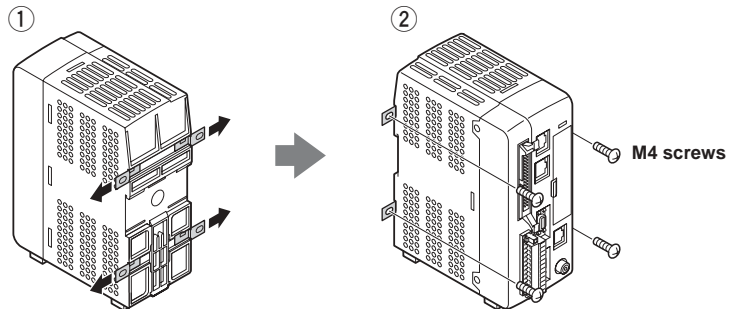
## Installing the Controller on a DIN Rail

The controller unit is designed to be mounted on a DIN rail. Pull out the claw on the bottom in the direction of the arrow to mount or dismount the controller.



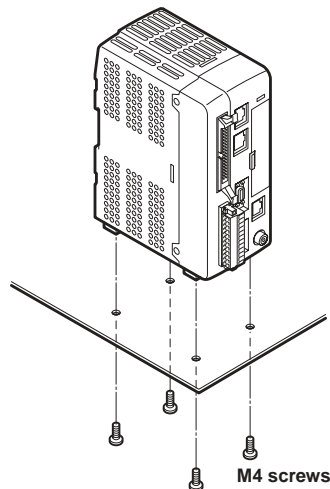
## Mounting to the Back of the Controller

Pull out the tabs on the back of the controller and mount the unit with the four M4 screws.



Pull out the tabs to mount the controller with screws

## Mounting to the Bottom of the Controller



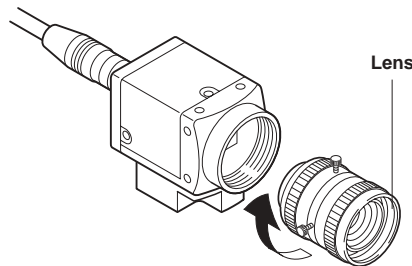
# Installing Camera

## Caution on insulation

- The outside case of the camera is used as the ground potential of the camera circuit. If the installation bracket or mount has any electric potential or noise, it can cause internal damage or malfunction. For secure insulation, be sure to use the resin mounting parts that are supplied with the system when installing the camera.
- If the supplied resin mounting parts are not used for installation, insulate the camera case by any other means.

## 1 Install the lens in the camera.

Select an appropriate lens in accordance with the size of the object or distance between the object and the camera. (See next page.)



### ► Note

- Do not touch the inside of the camera when installing the lens.
- Be careful that any dust and/or foreign material do not enter into the inside of the camera.

## 2 Install the camera using the given screw holes on the resin mount.

Three different types of screw-holes are provided. (m3: 2, m4: 2, 1/4-2 unc: 1)

### ► Note

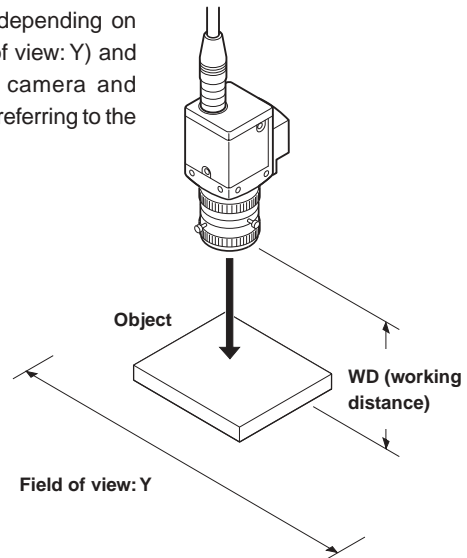
- The focus and aperture adjustment (page 2-11) are necessary upon completion of installation. Leave enough space around the lens to ensure easy adjustment of the focus and aperture.
- If the installation location vibrates, the lens mount can be loosened. Use of the locking paint such as Lock-right is recommended in such a case.

### Reference

Creating a mount that leaves room to adjust the position of the camera is recommended; this will make slight adjustment easier.

## Selecting the Lens

Select an appropriate lens depending on the size of the object (field of view: Y) and the distance between the camera and object (working distance), by referring to the chart below.



**Confirm the working distance from the field-of-view chart.**

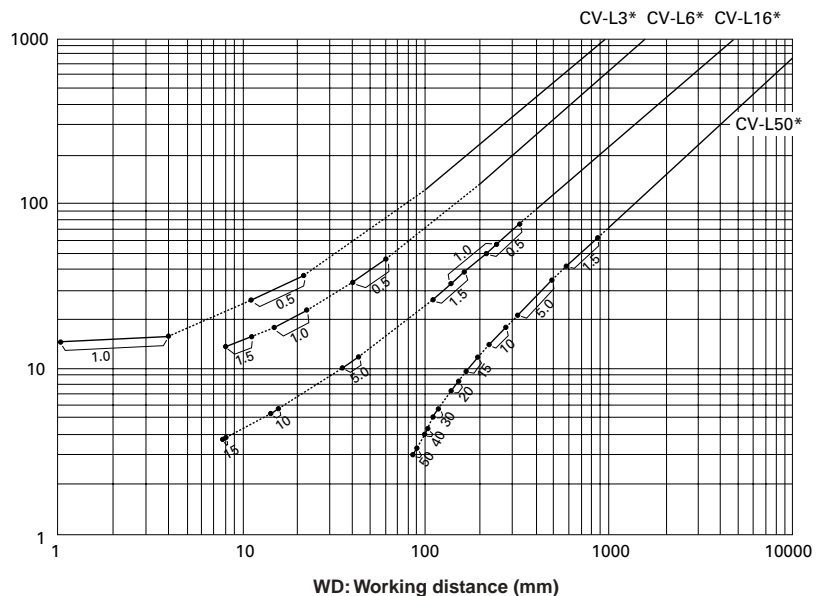
- Symbols such as ●→ in the chart indicate the thickness of the close-up ring required. Install the close-up ring between the lens and the camera when required.
- An asterisk (\*) in the chart indicates the type of lens.

**► Note**

The numerical numbers shown in the chart are typical values. Adjust the values when installing the camera.

**Example: When the required field of view is 70 mm**

When using the CV-L16, the chart shows that the working distance should be set to 300 mm and the close-up ring of 0.5 mm should be used.



## Selecting the Lens

### Optional lenses

#### Standard lens

If you need a lens other than those listed in the following table, contact your nearest KEYENCE office.

Model	Focal distance	F-value	Filter size
CV-L3	3.5 mm	F 1.6	43.0 mm P 0.75
CV-L6	6 mm	F 1.4	30.5 mm P 0.5
CV-L16	16 mm	F 1.6	27.0 mm P 0.5
CV-L50	50 mm	F 1.8	30.5 mm P 0.5

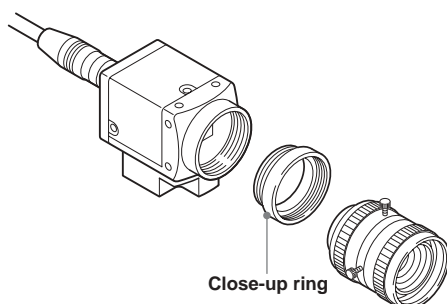
#### Macro lens

Model	Shape	Optical magnification	WD (When standard magnification is used)
CA-LM2	Straight	×2	66.9 mm
CA-LM4	Straight	×4	70.3 mm
CA-LM6	Straight	×6	64.6 mm
CA-LM8	Straight	×8	65.5 mm
CA-LMA2	Coaxial	×2	66.9 mm
CA-LMA4	Coaxial	×4	70.3 mm

### When using the close-up ring

You can install the close-up ring between the camera unit and the lens.

The close-up rings are sold in sets of 0.5 mm, 1.0 mm, 5 mm, 10 mm, and 22 mm (OP-35406, optional). If a single ring does not achieve sufficient thickness, combine multiple rings.



#### ► Note

If you use the 0.5 mm or 1.0 mm close-up lens with other close-up lenses, looseness may be caused by vibration due to insufficient tightening strength. Use a locking paint such as Neji-Lock in such a case.



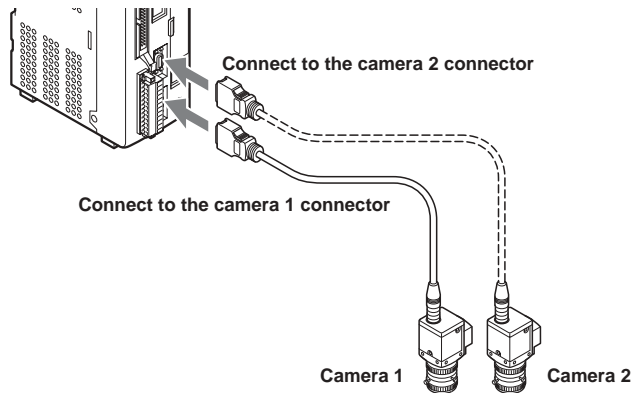
# Connecting Cables

## ► Note

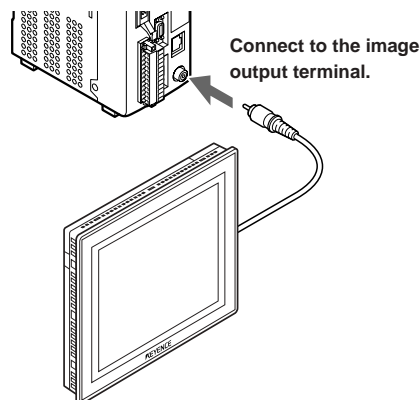
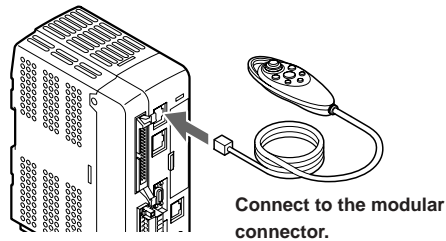
Do not supply power to the controller before connecting the cable or the terminal block.  
If you connect the cable or the terminal block while the power is being supplied, it may damage the camera or peripheral devices.

### 1 Connect the camera to the camera connector of the controller unit with a camera cable.

If connecting only a single camera, connect it to the camera 1 connector.



### 2 Connect the remote control console to the modular connector of the controller unit.

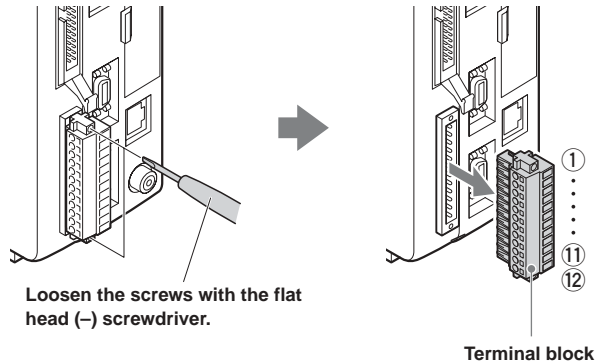


**3** Connect the monitor to the image output terminal of the controller unit.

**4** Connect the DC 24 V power supply to terminals No. 11 and 12 on the terminal block.

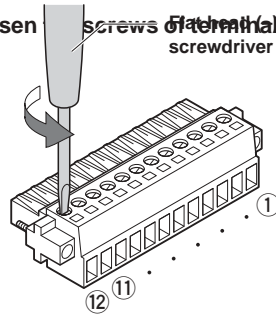
► **Note**

- Use a flat head (–) screwdriver to connect the power supply to the terminals.
- Use AWG14 to AWG22 electric wire to connect the DC 24 V power supply.
- Do not supply power until installation is completed.



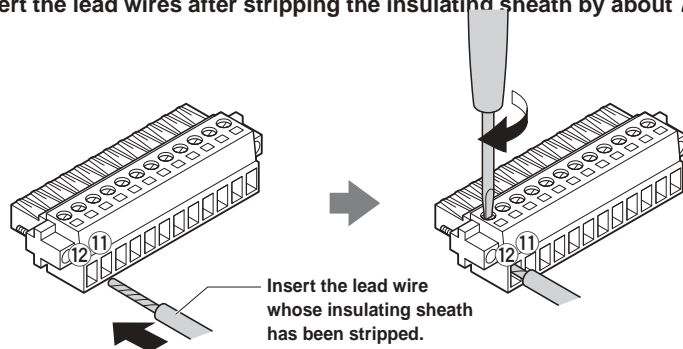
① Remove the terminal block from the controller unit.

② Loosen the screws of terminal Nos. 11 and 12 with the flat head (–) screwdriver.



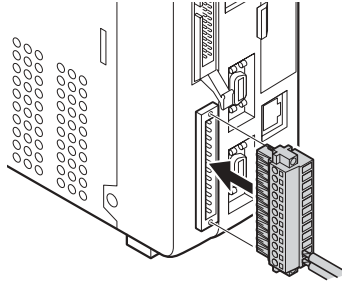
driver.

③ Insert the lead wires after stripping the insulating sheath by about 7 mm,



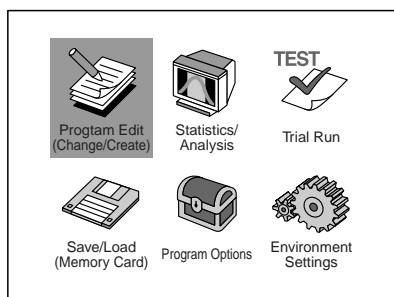
to terminal No. 11 (DC 24 V) and No. 12 (0 V), and then tighten the screws.

- ④ After connecting all the necessary cables/wires, insert the I/O terminal



# Adjustment

block to the I/O connector securely as far as it can go, and then fix it with the screws.



## 1 Confirm that the cables are connected correctly, and then turn on the power.

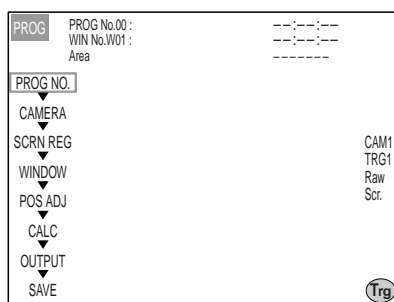
The startup screen is displayed.

**If the monitor displays nothing, check the following:**

Check the following:

- Is the power supply connected correctly?
  - Is DC 24 V (1 A) used for power supply?
  - Are the power input terminals connected correctly? (Are they connected in reverse polarity by mistake?)
- Are the remote control console and the monitor cable connected correctly?
- Is the power of the monitor turned on?

## 2 Move the [ENTER] button of the remote control console left and right or up and down to select the “Program Edit” and then press the [ENTER]



**button.**

The initial setup screen is displayed.

## 3 Press the TRIGGER button to confirm that the Raw screen is displayed on the background of the screen.

The Raw screen displays the view seen through the camera as it is.

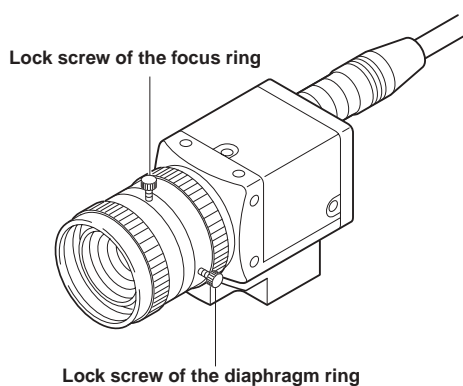
- If you use two cameras, the view through camera 1 is displayed.

- If you want to display the view through camera 2, refer to page 4-17.

**If the Raw screen is not displayed**

Check the following:

- Are the cameras connected correctly?
- Are the caps of the cameras removed?
- Is the aperture iris diaphragm of the lens closed too narrowly?



# Selection and Installation of the Lighting System

## 4 While monitoring the screen, turn the diaphragm ring and the focus ring to adjust the iris diaphragm and focus.

- **Measuring the iris diaphragm adjustment** : Make the target and the surroundings distinguishable.
- **Measuring the focus adjustment** : Make the outline of the target displayed clearly. When the iris and focus adjustments are complete, tighten the locking screws so that the iris ring and the focus ring should not move.

### Use a lighting system to ensure stable examination.

If you use the CV-2000 in the following locations, detection may be unstable. Change the installation location or use a dedicated lighting system.

- Locations where the CA-R20 is exposed to direct sunlight
- Locations where the outside light varies greatly depending on the time of day
- Locations where the amount of light changes due to the movement of machines and people

Ask your KEYENCE sales rep. for details.

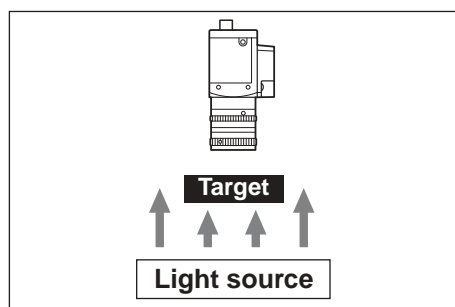
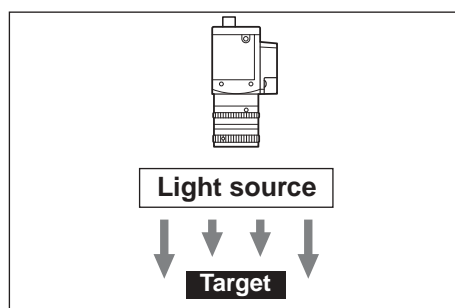
## Typical Lighting Systems

### Reflected illumination

Illuminates broadly and evenly by a lighting system such as a ring light. This type of lighting is suitable for general examination with illuminated systems.

#### LED illumination system

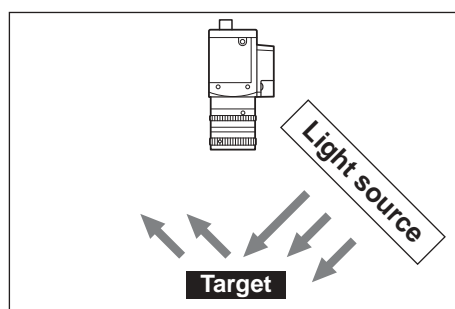
Direct-ring type (CA-DR)



### Backlight-type illumination

Illuminates from behind the target. This type of lighting is suitable for measuring the shape, size and position of a thin target.

#### LED illumination system



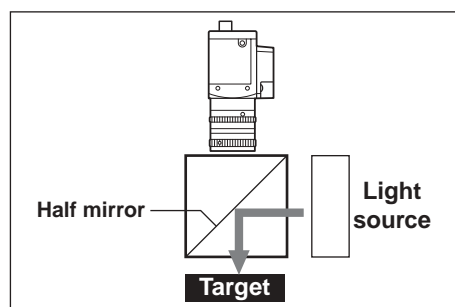
Backlight-type (CA-DS)

### Oblique illumination

Illuminates a target from an angle. This type of lighting is suitable for surface examination when you want to reduce the glare of the target.

#### LED illumination system

Bar-type (CA-DB)

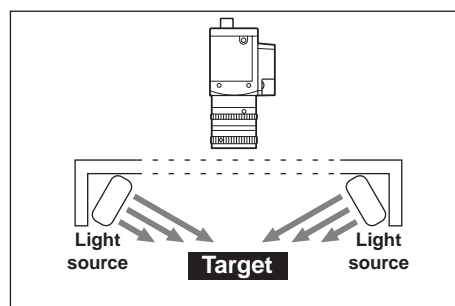


### Coaxial incident-light illumination

Illuminates from the same position as the axis of the lens. This type of lighting makes the target's glossy surface brighter, and so is suitable for surface examination or position and size measurement of a glossy surface.

#### LED illumination system

Coaxial incident-light type (CA-DX)

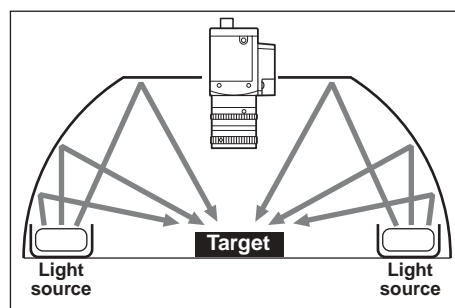


### Low-angle illumination

Illuminates a target from a very low angle. This type of lighting is suitable for detecting flaws or dirt on a glossy surface, imprint detection, or crack inspection for bottle mouths.

#### LED illumination system

Low-angle type (CA-DL)



### Dome illumination

Illuminates evenly from all round a target. It is more effective to illuminate from as close as possible to the target. This type of lighting reduces shadows because it evenly illuminates the target with a glossy and wavy/curved surface.

#### LED illumination system

Dome-type (CA-DD)





# Chapter 3

## Basic Operation

## Operation Mechanism of the CV-2100

The CV-2100 is mainly operated by selecting from among items displayed on the screen, or by inputting setup values using the connected remote control console.

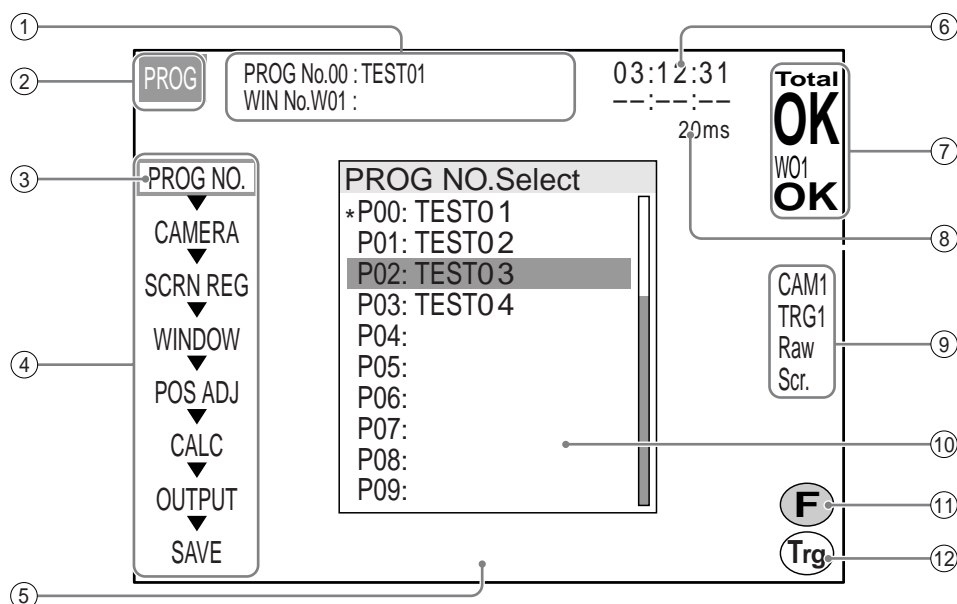
This chapter describes the layout of the displayed screens, common operations using the remote control console, and how the CV-2100 works.

# Layout of the Screen

3

Basic Operation

The standard screen of the CV-2100 is as shown below (using an example of the Program Edit mode). The display changes according to the mode (Program mode and Run mode) and state of operation.



## ① Program number and window name display

Displays the program number, window number, and name of the program in progress.

## ② Operation mode display (Program/Run/Test/Comm.)

Displays the current operation mode

## ③ Current selected menu

Displays in a green frame the menu that is currently selected.

## ④ Setting menu

Appears only in the Program mode.

## ⑤ Camera image

Displays the image that is input from the camera.

## ⑥ Date and time display

Displays the date and time at which the input screen was updated.

- **In the case of Trigger update or Continuous update:** Time of last measurement
- **In the case of NG result update:** Time of last NG occurrence

## ⑦ Inspection status display

Displays the overall inspection status and the inspection status of the currently displayed window.

## ⑧ Process time

Displays the process time of the measurement. The process time is the duration from Trigger input to the end of image processing. To know the accurate process time, select the Run mode (page 5-2) or Trial Run mode (page 5-1).

## ⑨ Information display

Displays information about the cameras connected to the CV-2100 or about the display mode of the screen.

## ⑩ Setup screen

Displays detailed setup items.

## ⑪ F (function) display

Appears when the currently selected item has a submenu, which appears when you press the [FNC] button of the console.

## ⑫ Trg (trigger) display

Appears when a Trigger signal can be input to the CV-2000 in the Program mode.

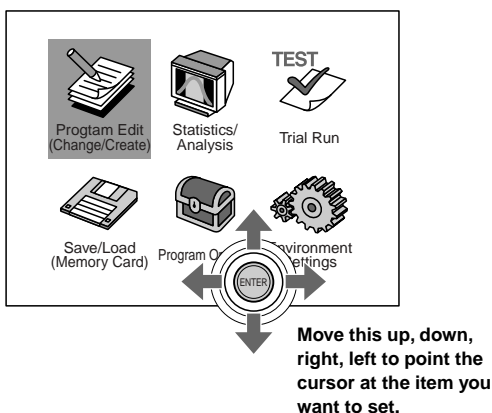
## Selecting Items

The methods of selecting or inputting items such as setup values are described below.

### Reference

The selection of an item by the following operation is described as "Select (item name)" in this manual.

- 1 Move the [ENTER] button of the console up, down, right, left to point the cursor at the item you want to set.



- 2 Press the [ENTER] button.  
The item pointed at by the cursor is selected.



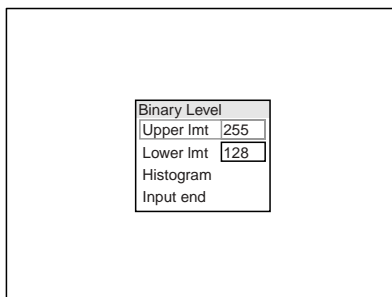
### To cancel the operation

Press the [ESCAPE] button of the console. The last menu selecting operation is cancelled.

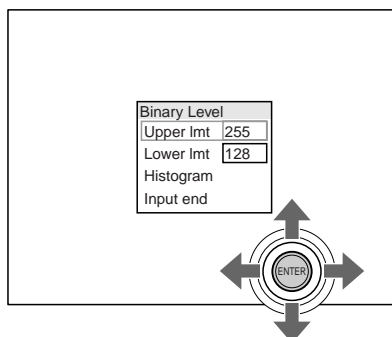
## Inputting Values

The method of inputting values such as setup values is described below.

- 1 Select the field where a value is to be input.



- 2 Move the [ENTER] button up and down to specify the value you want to input.



### Reference

You can also specify the value to be input numerically by moving the [ENTER] button to the right and left.

- 3 After specifying the value, press the [ENTER] button.

The specified value is fixed and input.

### To cancel the change of value

To cancel the change, press the [ESCAPE] button before pressing the [ENTER] button in step 3.

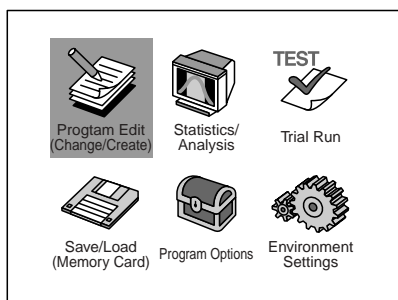
# Inputting Texts

3

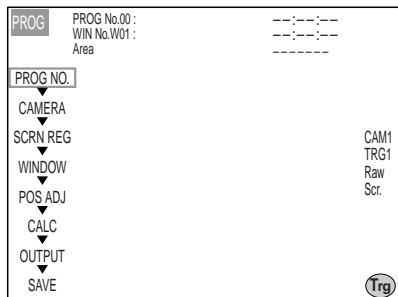
Basic Operation

You can input texts such as window names. This section describes how to register a name for a program number as an example.

## 1 Select [Create Program No. (Change/Create)] on the initial screen of the CV-2100.

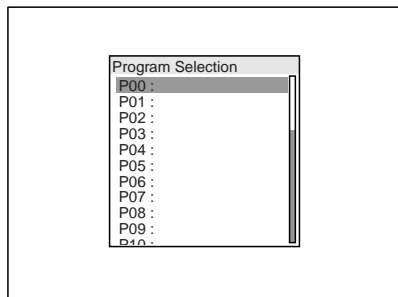


## 2 Select [PROG No.].

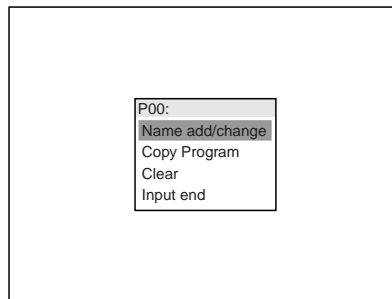


The [Program Selection] screen appears. Register the name "SAMPLE 1" for program number "P00", for example.

## 3 Point the cursor at "P00", then press the [FNC] button of the remote control console.

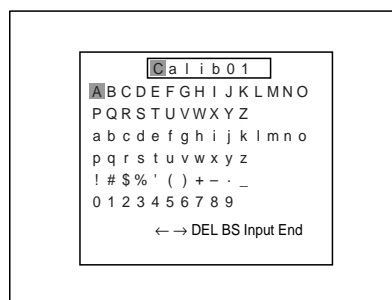


## 4 Select [Name add/change].



The character input screen appears.

## 5 Input "SAMPLE 1" character by character.



### Selecting characters

Point the cursor at the character you want to input, then press the [ENTER] button.

### Correcting a character

Select [←] or [→] at the bottom of the character input screen, and then select the <Del> (delete the selected character) or <BS> (delete the character immediately preceding the selected one).

## 6 After completing the input, select [Input end].

The program number "P00" is named "SAMPLE 1".

# Drawing a Measurement Window

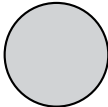
You need to draw a specific shape of window to specify the measurement area and the like.

In addition to the following seven shapes, the measurement window can be drawn with the edge detect range function (page 3-10).

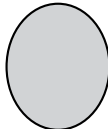
Select an appropriate shape in accordance with the measurement window.



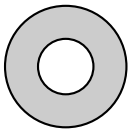
**Rectangle and rotated rectangle**  
(page 3-5)



**Circle**  
(page 3-6)



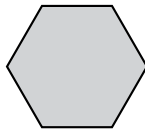
**Oval**  
(page 3-7)



**Ring**  
(page 3-7)



**Arc**  
(page 3-8)



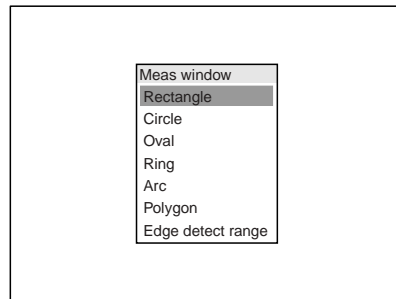
**Polygon  
(e.g. hexagon)**  
(page 3-9)

## ► Note

Some shapes cannot be selected depending on the measurement mode.

## Drawing a Rectangle and Rotated rectangle

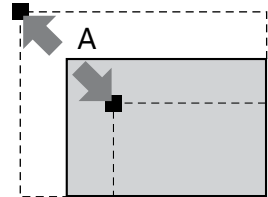
- 1 Select [Rectangle] in the window shape specification screen.



You can draw windows.

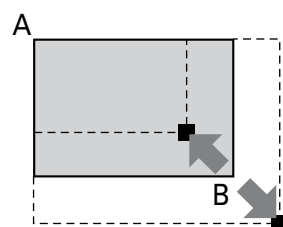
- 2 Specify the reference point of the rectangle.

Move the cursor to specify the position of point A, then press the [ENTER] button.



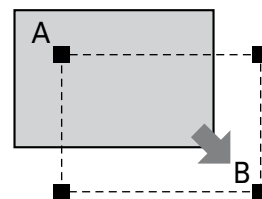
- 3 Select the position of the opposite vertex.

Move the cursor to specify the position of point B, then press the [ENTER] button.



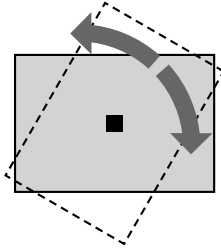
- 4 To move the rectangle, move the [ENTER] button of the console.

Whenever you press the [ENTER] button, it alternates among the adjustments of steps 2 to 4.



- 5** In the case of a rotated rectangle, specify the angle of the rectangle.

Move the [ENTER] button to specify the angle, then press the [ENTER] button.

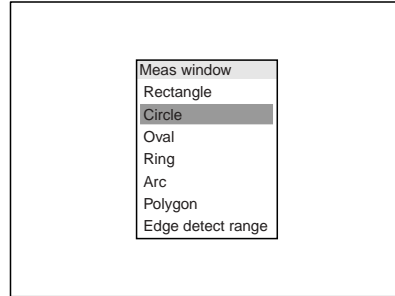


- 6** When you have completed drawing, press the [ESCAPE] button.

Whenever you press the [ENTER] button, it alternates among the adjustments of steps 2 to 4 (steps 2 to 5 for a rotated rectangle).

## Drawing a Circle

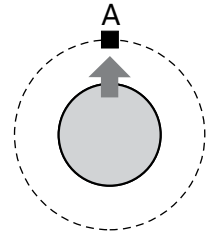
- 1** Select [Circle] in the window shape specification screen.



You can draw windows.

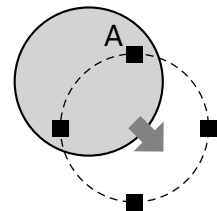
- 2** Specify the size of the circle.

Move the cursor to specify the position of point A, then press the [ENTER] button.



- 3** To move the circle, move the [ENTER] button of the console.

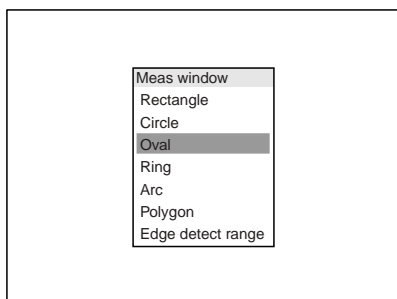
Whenever you press the [ENTER] button, it alternates among the adjustments of steps 2 to 4.



- 4** When you have completed drawing, press the [ESCAPE] button.

## Drawing an Oval

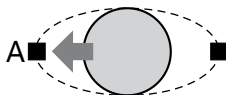
- 1 Select [Oval] in the window shape specification screen.



You can draw windows.

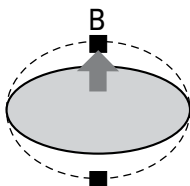
- 2 Specify the horizontal size of the oval.

Move the cursor to specify the position of point A, then press the [ENTER] button.



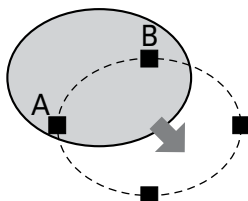
- 3 Specify the vertical size of the oval.

Move the cursor to specify the position of point B, then press the [ENTER] button.



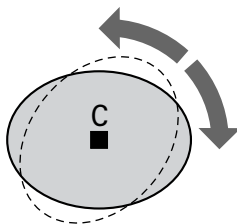
- 4 Specify the position of the oval.

To move the oval, move the [ENTER] button of the remote control console and then press the [ENTER] button.



- 5 Specify the angle of the oval.

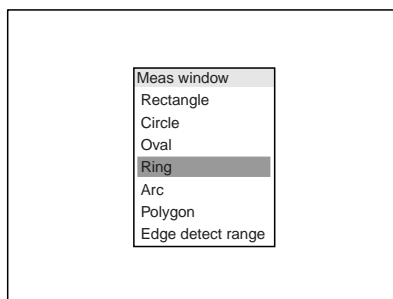
Move the [ENTER] button to specify the angle and then press the [ENTER] button. Whenever you press the [ENTER] button, it alternates among the adjustments of steps 2 to 5.



- 6 When you have completed drawing, press the [ESCAPE] button.

## Drawing a Ring

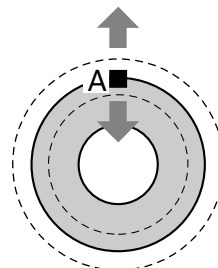
- 1 Select [Ring] in the window shape specification screen.



You can draw windows.

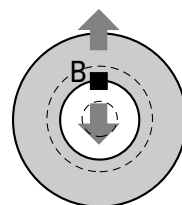
- 2 Specify the outer circle size of the ring.

Move the cursor to specify the position of point A, then press the [ENTER] button.



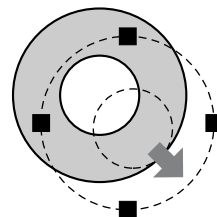
- 3 Specify the inner circle size of the ring.

Move the cursor to specify the position of point B, then press the [ENTER] button.



- 4 To move the ring, move the [ENTER] button of the console.

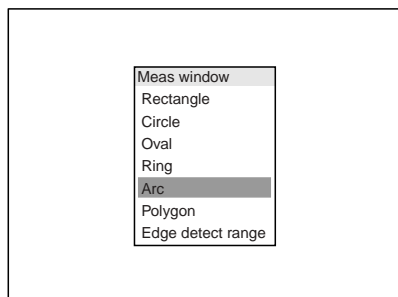
Whenever you press the [ENTER] button, it alternates among the adjustments of steps 2 to 4.



- 5 When you have completed drawing, press the [ESCAPE] button.

## Drawing an Arc

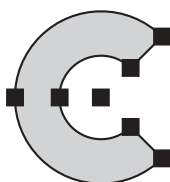
- 1 Select [Arc] in the window shape specification screen.



You can draw windows.

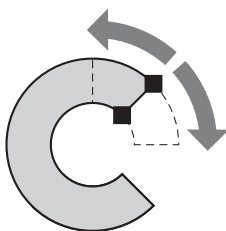
- 2 Move the [ENTER] button of the remote control console to specify the position of the arc.

When the desired position is determined, press the [ENTER] button.



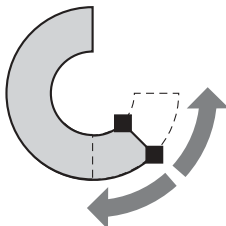
- 3 Specify the start point of the arc.

Move the [ENTER] button up and down to specify the start point, then press the [ENTER] button.



- 4 Specify the end point of the arc.

Move the [ENTER] button up and down to specify the end point, then press the [ENTER] button.



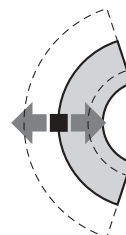
- 5 Specify the curvature of the arc.

Move the [ENTER] button up and down to specify the curvature, then press the [ENTER] button.



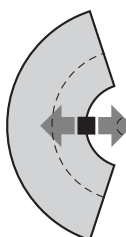
- 6 Specify the outer circle size of the arc.

Move the [ENTER] button up and down to specify the outer circle size, then press the [ENTER] button.



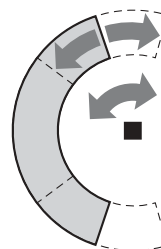
- 7 Specify the inner circle size of the arc.

Move the [ENTER] button up and down to specify the inner circle size, then press the [ENTER] button.



- 8 Specify the angle of the arc.

Move the [ENTER] button up and down to specify the angle, then press the [ENTER] button. Whenever you press the [ENTER] button, it alternates among the adjustments of steps 2 to 8.



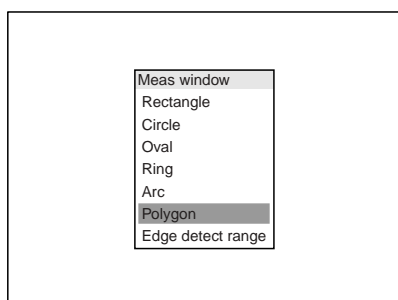
- 9 When you have completed drawing, press the [ESCAPE] button.



## Drawing a Polygon

You can draw a polygon up to a dodecagon.

- 1 Select [Polygon] in the window shape specification screen.**



You can draw windows.

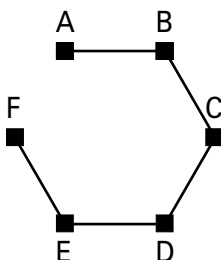
- 2 Specify a vertex of the polygon.**

Move the cursor to specify the position of point A, then press the [ENTER] button.



- 3 Select another vertex.**

Move the cursor to specify the position of point B, then press the [ENTER] button. Repeat this procedure until all the necessary vertices are specified.



### Reference

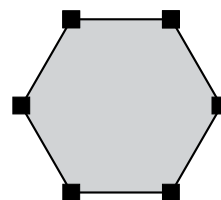
You can cancel the specified vertices by pressing the [ESCAPE] button of the remote control console when you are selecting vertices.

- 4 Select the first vertex that you selected in step 2.**

The polygon that connects the vertices selected in steps 2 and 3 is drawn.

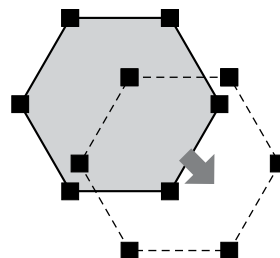
### Reference

If you want to close the polygon, press the [ENTER] button consecutively twice on the vertex currently being specified and on the one chosen initially.



- 5 To move the polygon, move the [ENTER] button of the console.**

Whenever you press the [ENTER] button, it alternates between the vertex position adjustment and the polygon location adjustment.



- 6 When you have completed drawing, press the [ESCAPE] button.**

### Reference

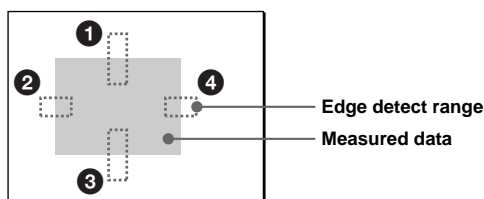
Vertices can be added or deleted after a polygon has been drawn.

- To add a vertex, press the [ENTER] button while pressing the [FNC] button.
- To delete a vertex, press the [ESCAPE] button while pressing the [FNC] button.

## Drawing an Edge Detect Range

You can draw the range in which the variation of intensity in the image is detected as edges. This is a handy function for changing the measurement window to suit the size of the work piece. Refer to "Hint for Making Full Use of Edge Detect Range" (page 3-11).

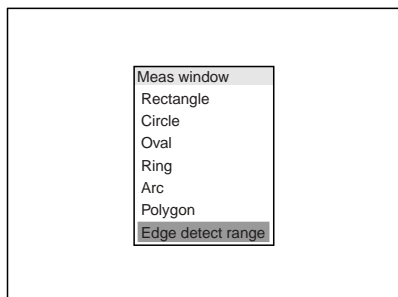
The edge detect range consists of the four rectangles shown below.



### Reference

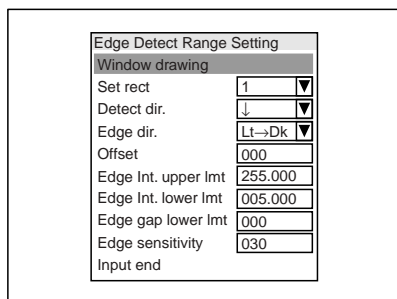
Window drawing using the edge detect range can be performed only in the area, stain, and intensity measurement modes.

### 1 Select [Edge detect range] in the window shape specification screen.



The [Edge Detect Range Setting] screen appears.

### 2 Set the edge detect as required.



### Window drawing

Draws a window in accordance with the range where you want to detect the edge. Refer to "Drawing a Rectangle and Rotated Rectangle" (page 3-5) for the drawing method. To draw or change another edge detect range, press the [ENTER] button consecutively twice. When you have completed drawing, press the [ESCAPE] button to return to the edge detect range setup screen.

### Set rect

Specify the number of edge detect ranges (1 to 4).

### Det. dir.

Specify the direction of edge detection.

### Edge dir.

Specify the direction of the edge you want to detect.

- **[Lt → Dk]:** Detects the boundary of changing from a bright area to a dark area.
- **[Dk → Lt]:** Detects the boundary of changing from a dark area to a bright area.
- **[Both]:** Detects both boundaries of changing from a bright area to a dark area, and from a dark area to a bright area.

### Offset

Specifies the offset of the edge detection in pixels. To put an offset inside, specify a positive value, and to put an offset outside, specify a negative value.

### Edge Int. upper lmt] / [Edge Int. lower lmt

Specifies the upper limit and lower limit of the edge intensity.

An edge whose intensity is not included between the upper limit and lower limit is not recognized as an edge.

### Reference

Edge is detected based on the gray scale 0 to 225 of differential waveform. The detection upper limit value of a differential waveform is called the edge intensity upper limit, and the detection lower limit value is called the edge intensity lower limit. They form the upper and lower limits to be recognized as an edge.

Refer to "What is an Edge?" (page 15-3) for details.

### Edge gap lower lmt (in pixels)

Set the range where noise is not recognized as an edge in pixels.

### Edge sensitivity

Specify the threshold value of edge recognition.

**3** To change another edge detect range setting, select the number you want to set in the [Set rect], and then perform setup identical to step 3.

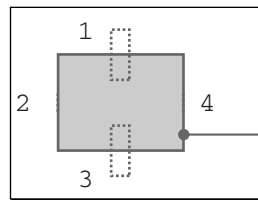
**4** Select [Input end].

Specification of the edge detect range has been completed.

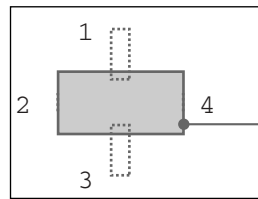
### Hint for Making Full Use of Edge Detect Range

**To modify the measurement window size only in the Y-axis direction according to the size of the work piece, while fixing the measurement window size in the X-axis direction**

In this case, the edge in the X-axis direction need not be detected. Set the width of the edge detect range ([Set rect.] 2,4) in the X-axis direction as "0".



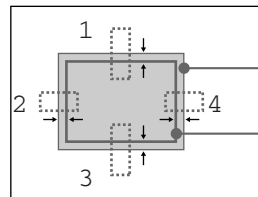
The measurement window generated in the edge detect range



When the size of the work piece in the Y-axis direction changes, the size of the measurement window changes according to the size of the work piece.

### To measure a smaller range by a given length from the detected edge

Change the offset setup in the [Edge Detect Range Setting] screen. For example, to measure the range 5 pixels inside from the detected edge, specify Offset 5 for the [Set rect]'s 1 to 4 respectively.



The measurement window generated in the edge detect range

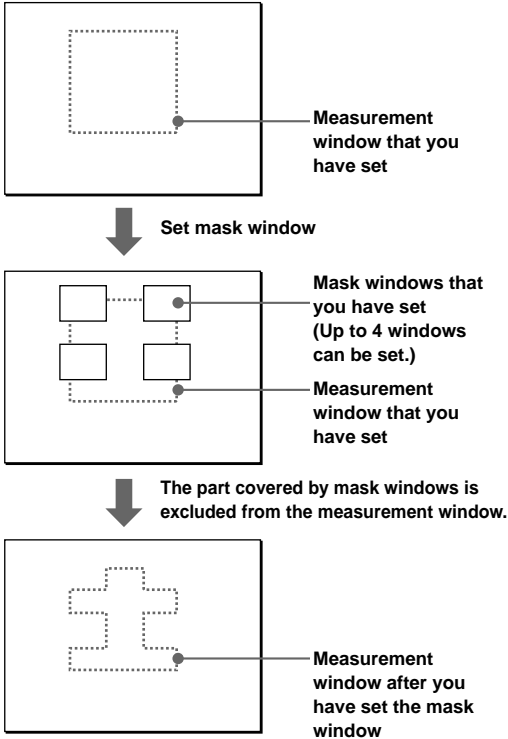
The measurement window specified inside by offset setup

### Reference

By specifying a minus value as the offset, you can specify the outside of the measurement window generated in the edge detect range.

## Hiding the Measurement Window Partially (Mask Window)

You can specify the un-measured part (Mask window) in the measurement window. This is useful when the measurement target has a complicated shape or when you want to hide the unwanted part.

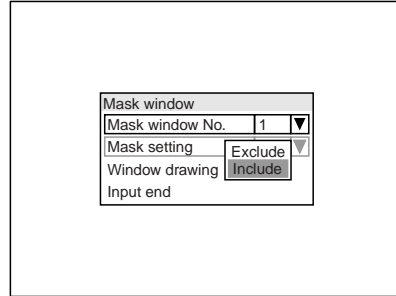


**1** Select the mask window No. in the [Mask window] screen.

Up to 4 mask windows can be set.

**2** Select [Mask setting], then select [Enable].

If [Disable] is specified, the mask window cannot be set.



**3** Select [Window drawing].

**4** Select the shape of a mask window.

**5** Draw a mask window.

Refer to "Drawing Measurement Window" (page 3-5) for details.

**6** When you have completed drawing, press the [ESCAPE] button of the console.

**7** Select [Input end].

### To clear the entire mask window

Point the cursor on [Mask window], and press the [FNC] button of the console. Then select [Clear].

### To clear the shape of a mask window you have set

On the [Mask window drawing] screen, press the [FNC] button, and then select [Clear].

# Chapter 4

## Specifying the Units (Windows) for Inspections and Measurements

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**4-1 Program No.**  
p.4-2

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**4-2 Camera**  
p.4-5

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**4-3 Image Registration**  
p.4-16

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**4-4 Window/Inspection  
Tools**  
p.4-18

---

**4-5 Position Adjustment**  
p.4-104

---

**4-6 Calculation**  
p.4-109

---

**4-7 Output Settings**  
p.4-119

---

**4-8 Save**  
p.4-125

---

## Flow for Specifying Test or Measurement Settings

The process flow for specifying test or measurement settings is as follows:

**Select a “Program No.” (page 4-2)**

Select a Program No. to register a set of test or measurement settings.



**Specify “Camera” settings (page 4-5)**

Specify how you want to import images using cameras connected to the CV-2100.



**Specify “Image registration” settings (page 4-16)**

Import a basic image to be used as a template for setting inspection or measurement parameters.



**Specify “Window” settings (page 4-18)**

Specify the measurement target range and an image processing method necessary for evaluation.



**Specify “Position adjustment” settings (page 4-104)**

Specify settings for automatically correcting the position of the inspection window.



**Specify “Calculation” settings (page 4-109)**

Specify settings required for evaluation using arithmetic expressions as needed.



**Specify “Output” settings (page 4-119)**

Specify how you want to output the evaluation results.



**“Save” settings (page 4-125)**

Save the test or measurement settings for the current Program No.



## 4-1 Selecting a Setting Number “Program No.”

### 4-1 Program No. p.4-2

### 4-2 Camera p.4-5

### 4-3 Image Registration p.4-16

### 4-4 Window/Inspection Tools p.4-18

### 4-5 Position Adjustment p.4-104

### 4-6 Calculation p.4-109

### 4-7 Output Settings p.4-119

### 4-8 Save p.4-125

## What is a Program No.?

In the CV-2100, various settings used for measurements such as camera settings, measurement target range, and evaluation settings can be grouped together under a specific “Program No.” ([PROG NO.]). You can save multiple Program Nos. and switch between them as needed. The maximum number of Program Nos. you can save is 32. It is possible to change the type of work piece just by switching the Program No.

#### ► Note

- To retain a Program No. you have previously saved, select a new Program No. that does not have any setting saved.
- An asterisk (\*) is displayed in front of the Program Nos. that already have some settings saved.

#### Reference

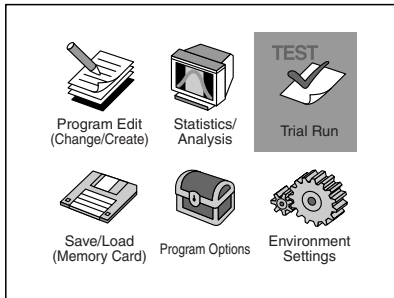
If you need to save more than 32 Program Nos., save them to a compact flash memory card (page 9-1).



# Selecting a Program No.

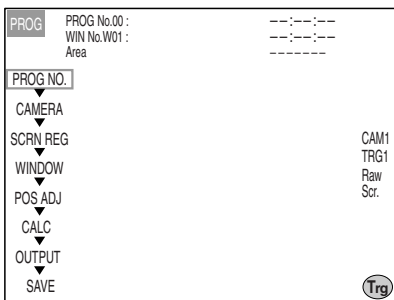
You can select a Program No. under which you can save various settings required for measurements as follows:

- 1 Select [Create a Program No.] on the initial screen of the CV-2100.



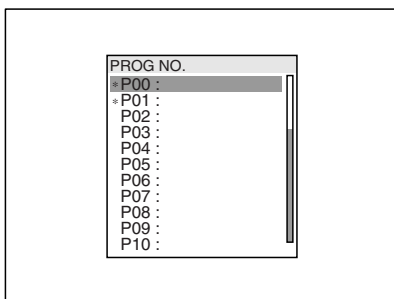
The initial setting screen appears.

- 2 Select [PROG NO.].



The [Program Selection] menu appears.

- 3 Select the desired Program No.

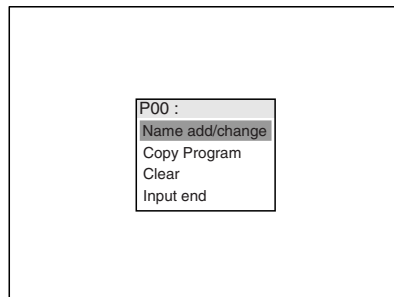


The settings saved under the selected Program No. will be used for subsequent measurements.

## Specifying or Changing the Name of a Program No.

- 1 Highlight the Program No. for which you want to specify or change the name, then press the [FNC] button on the remote control console.

- 2 Select [Name add/change].



- 3 Enter a name for the Program No.

Refer to [Inputting Text] on page 3-4 for details on how to enter characters.

- 4 After entering the name, select [Input end].

The [Program Selection] menu reappears.



## Copying One Program to Another

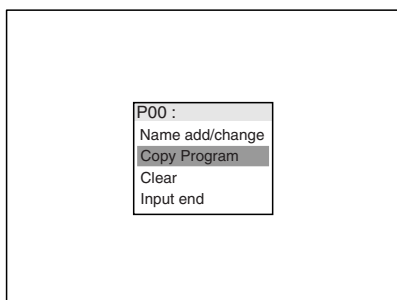
You can copy all of the settings saved under another Program No. to the Program No. you are working on.

### Note

When you copy settings from another Program No., all of the original settings are overwritten by the copied settings.

- 1 **Select the destination Program No. (the Program No. to which you want to copy the settings) following the procedure under [Selecting a Program No.] on page 4-3, then press the [FNC] button on the remote control console.**

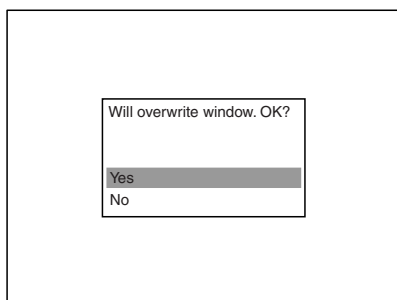
- 2 **Select [Copy Program].**



- 3 **Select the source Program No. (the Program No. from which you want to copy the settings).**

A confirmation menu appears.

- 4 **Select [Yes] to copy the settings.**



The copying process starts.

To cancel copying, select [No] instead of [Yes].

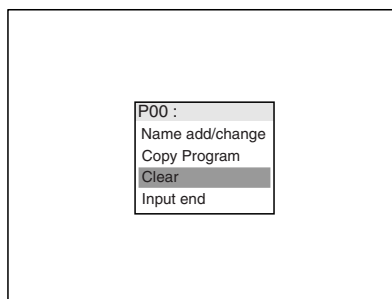
## Initializing Saved Settings

### Initializing a Single Program No.

You can reset the settings saved under a Program No. to the factory settings as follows:

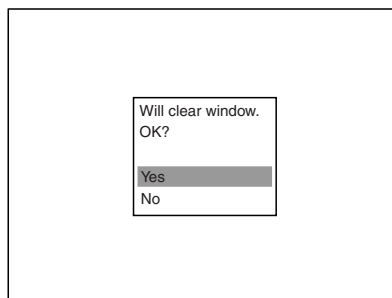
- 1 **Select the Program No. for which you want initialize the settings following the procedure under "Selecting a Program No." on page 4-3, then press the [FNC] button on the remote control console.**

- 2 **Select [Clear].**



A confirmation screen appears.

- 3 **Select [Yes] to initialize the settings.**



The initialization process starts.

To cancel initialization, select [No] instead of [Yes].

### Initializing All Program Nos.

Turn on the power of the CV-2100 while pressing the [ESC] button on the remote control console.



## 4-2 Specifying Camera Settings [Camera]

### 4-1 Program No. p.4-2

### 4-2 Camera p.4-5

### 4-3 Image Registration p.4-16

### 4-4 Window/Inspection Tools p.4-18

### 4-5 Position Adjustment p.4-104

### 4-6 Calculation p.4-109

### 4-7 Output Settings p.4-119

### 4-8 Save p.4-125

## Overview of Camera Settings

The camera settings that can be altered are as follows:

- Shutter Speed (page 4-6)
- Capture Method (page 4-6)
- Trigger Setting (page 4-7)
- Gain Adjustment (page 4-9)
- Multi-Measurements (page 4-11)
- Image Capture Range (page 4-14)
- Out of Range Intensity (page 4-15)

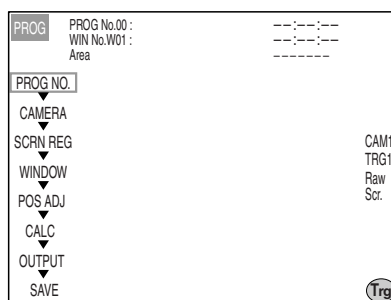
#### ► Note

When two cameras are connected to the CV-2100, you cannot specify a separate set of settings for each camera. The settings you specify using the following procedures are applied to both cameras.

### Displaying the [Camera Settings] Menu

You can change the camera settings in the [Camera Settings] menu.

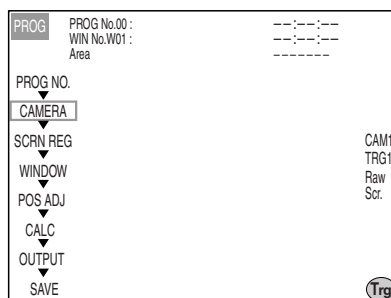
#### 1 Select [PROG NO.] in the initial setting screen.



The [Program selection] menu appears.

#### 2 Select the desired Program No. (page 4-3).

#### 3 Select [CAMERA].



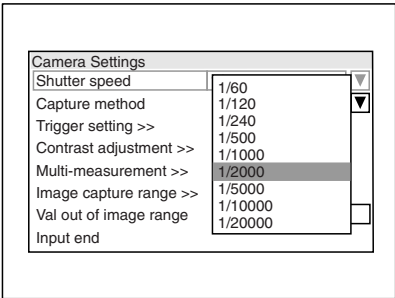
The [Camera Settings] menu appears.



# Selecting a Shutter Speed [Shutter Speed]

You can select the shutter speed according to the line speed of work pieces and lighting conditions. If you select a fast shutter speed to match a fast line, make sure you have enough light intensity to produce a quality image.

- 1 Select [Shutter Speed] on the [Camera Settings] menu (page 4-5), then select the desired shutter speed.



The default is [1/2000] (second).  
As you select different shutter speeds, the image in the background changes accordingly .

- 2 To change other settings, select the appropriate option in the [Camera Settings] menu.

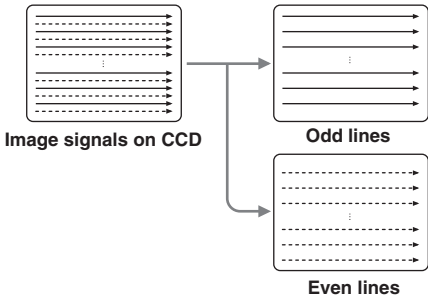
- 3 After completing the settings, select [Input end].

**Reference**  
If the menu is blocking an important part of the image, it can be made transparent or completely disappear by pressing the [VIEW] button on the remote control console.

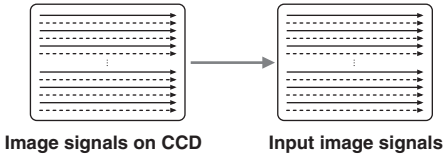
# Selecting an Image Capture Mode [Capture method]

You can select from the following two capture modes:

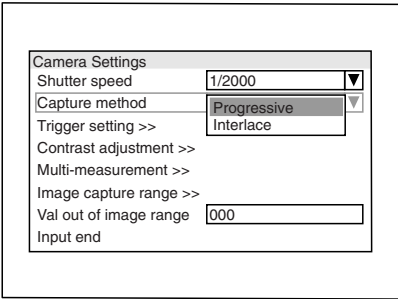
- **Interlace mode:** Transfers image signals on the CCD of the camera by separating the odd lines and even lines. The image quality for each image is degraded, but with its high transfer rate (approximately 8.3 ms), this mode is suited for fast lines.



- **Progressive mode:** Transfers the image signals on the CCD of the camera in bulk starting from the top line. The image quality is high, but the transfer rate is low (approximately 16.7 ms).



- 1 Select [Capture method] on the [Camera Settings] menu (page 4-5), then select the desired capture mode for the camera.



- **[Progressive]** (default): Captures images using progressive mode.
- **[Interlace]** : Captures images using interlace mode.

- 2 To change other settings, select the appropriate option in the [Camera Settings] menu.

- 3 After completing the settings, select [Input end].



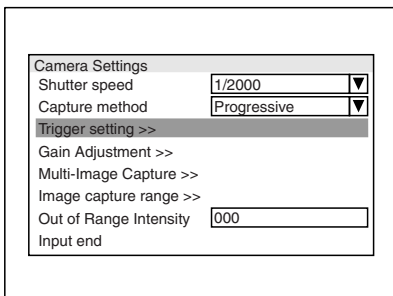
# Specifying the Image Capture Timing (Trigger Setting)

You can specify which trigger signal to use for image capture. For the CV-2100, you can select from the following two types of trigger inputs:

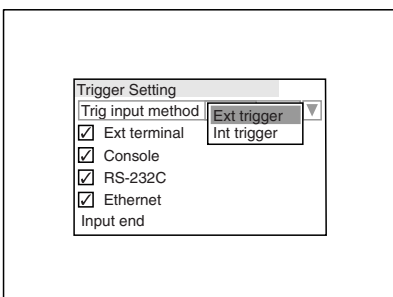
- **External triggers** (page 4-7): Captures images in response to trigger inputs from the remote control console or trigger signals from external devices. The capture is performed only once for each trigger input.
- **Internal triggers** (p.4-8): Captures images in response to trigger signals that are generated periodically according to a specified interval. It is possible to repetitively capture images even without external trigger inputs by generating internal triggers while running.

## Capturing Images Using External Triggers [External trigger]

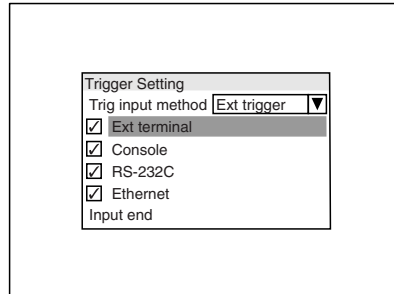
- 1 Select [Trigger setting] on the [Camera settings] menu (page 4-5).



- 2 Select [Trig input method], then select [Ext trigger].



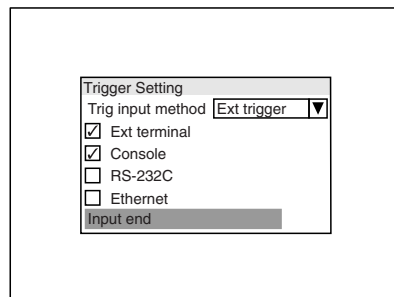
- 3 Check the trigger you want to use for image capture.



You can select more than one type of trigger.

- **[Ext terminal]**: Triggers that are input to the terminal block (I/O)
- **[Console]**: Triggers that are input using the [TRIGGER] button on the remote control console (page 1-3).
- **[RS-232C]**: Triggers that are input via RS-232C
- **[Ethernet]**: Triggers that are input via Ethernet

- 4 After completing the settings, select [Input end].

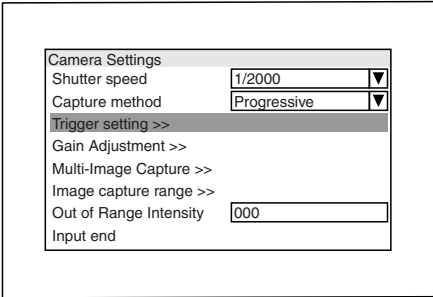


- 5 To change other settings, select the appropriate option in the [Camera Settings] menu.

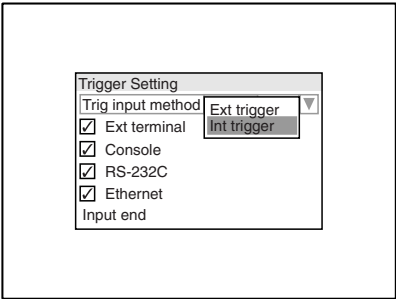
- 6 After completing the settings, select [Input end].

Capturing Images by Inputting Triggers Using Internal Timer [Internal trigger]

1 Select [Trigger setting] on the [Camera Settings] menu (page 4-5).

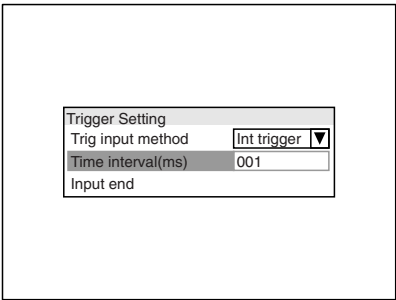


2 Select [Trig input method], then select [Int trigger].

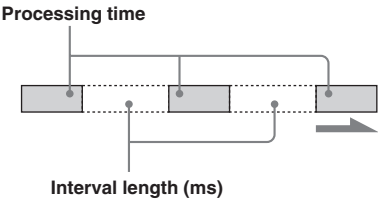


3 Select [Time interval (ms)], then specify the length of the interval.

The range of values you can specify is from 1 to 999 ms (Default: 1 ms).



Specifying the Image Capture Timing (Trigger Setting)  
The interval length represents the time between the completion of one process and the generation of the next trigger; it is not the time between two triggers.



- 4 After completing the settings, select [Input end].
- 5 To change other settings, select the appropriate option in the [Camera Settings] menu.
- 6 After completing the settings, select [Input end].



# Adjusting the Contrast for Captured Images [Gain Adjustment]

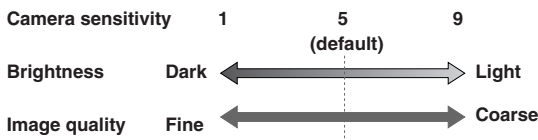
You can adjust image quality by adjusting the camera sensitivity (9 levels) and gain-adjustment of the captured images. This feature is useful when you need to lighten a dark image or import an image that tends to have black compression or white clipping.

## Adjusting the Overall Brightness of an Image Camera Sensitivity

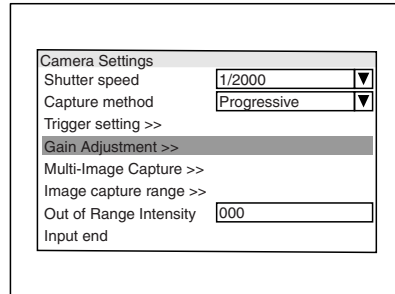
To adjust the brightness of an image, you can change the settings such as the lens aperture, shutter speed of the camera, or the lighting. However, if it is impossible to adjust these features due to a high-speed production line or other factors, you can adjust the camera sensitivity using the following procedure.

### Reference

When you raise the camera sensitivity, the overall brightness of the image improves, but the noise elements in the image become more visible (the image turns coarser). When you lower the camera sensitivity, the overall image darkens, but the noise elements lessen (texture of the image becomes finer).



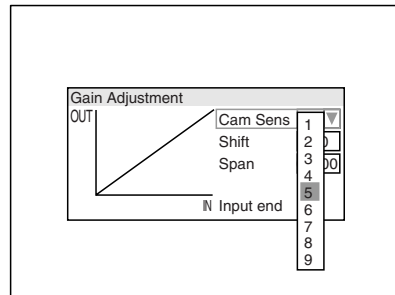
- 1 Select **[Contrast Adjustment]** on the **[Camera Settings]** menu (page 4-5).



The **[Contrast Adjustment]** menu appears.

- 2 Select **[Cam Sens]** (Camera sensitivity), then select the desired sensitivity.

The bigger the number, the brighter the image; the smaller the number, the darker the image (Default: 5).



As you change the sensitivity, the image in the background is updated accordingly.

- 3 To change other settings, select the appropriate option in the **[Camera Settings]** menu.
- 4 After completing the settings, select **[Input end]**.

### Reference

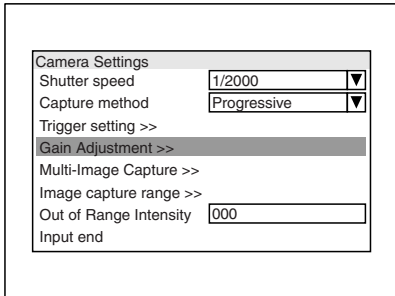
If the menu is blocking an important part of the image, it can be made transparent or completely disappear by pressing the **[VIEW]** button on the remote control console.



## Adjusting the Gain of an Image

This feature is useful when you need to lighten a dark image or import an image that tends to have black compression or white clipping.

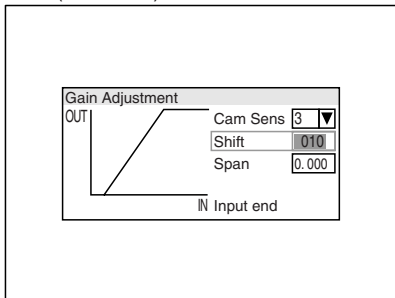
- 1 Select [Gain Adjustment] on the [Camera Settings] menu (page 4-5).



The [Gain Adjustment] menu appears.

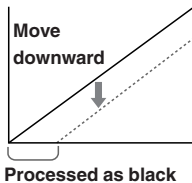
- 2 Select [Shift], then specify the shift level for the entire digital signal.

The range of values you can specify is from -127 to +127 (Default: 0).



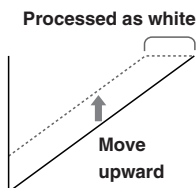
- **To darken the image:**

Specify a negative value to move the entire line downward. The section below the minimum value of the Y-axis is processed as black.



- **To lighten the image:**

Specify a positive value to move the entire line upward. The section above the maximum value of the Y-axis is processed as white.



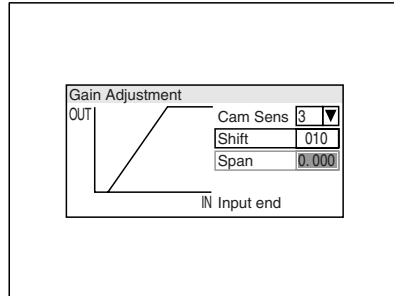
As you change the value, the image in the background is updated accordingly.

### Reference

You can also make values above (or below) a specified gray value appear white (or black).

- 3 Select [Span], then specify the degree of adjustment between the black level and the white level.

The range of values you can specify is from 0.5 to 2 (Default: 1).

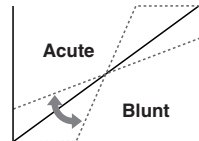


- **To increase the number:**

Specify a large value to make the tilt angle of the line acute.

- **To reduce the number:**

Specify a small value to make the tilt angle of the line blunt.



As you change the value, the image in the background is updated accordingly.

### Note

Similar to [Shift] in step 2, the section below the minimum value of the Y-axis is processed as black, and the section above the maximum value is processed as white.

- 4 To change other settings, select the appropriate option in the [Camera Settings] menu.

- 5 After completing the settings, select [Input end].



# Multiple Capturing of Images [Multi-Image Capture]

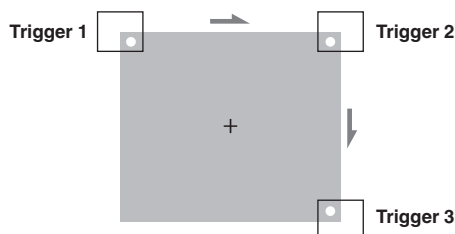
You can capture images multiple times and use each of the captured images for separate measurements (Multi-trg) or make a measurement from multiple images and calculate the average, the maximum, or the minimum value (Multi-measure).

## Capturing Multiple Images [Multi-trg]

You can input multiple (2 to 4) triggers and perform specified image processing on each of the captured images. You can also use the measurement results obtained through the multiple trigger inputs and perform calculations. This feature may be useful when you want to capture four corners of a large work piece and use the measurement results to detect its position.

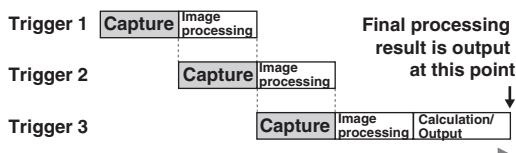
### Example

Capturing three images to detect positional or angular deviation of a circuit board



#### Note

- Multi-trg takes more time compared to normal capture since multiple images must be captured and processed. In the above example, capturing and processing for each trigger is performed as follows:



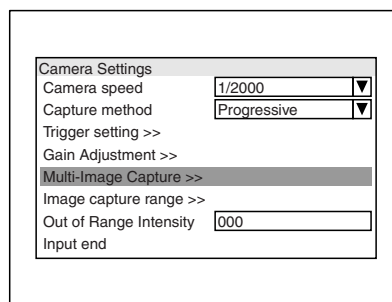
- All of the window and position correction settings saved in the current Program No. will be lost in the following cases:
  - When you select [Multi-trg] (changing from [Multi-measure] to [Multi-trg] or selecting [Multi-trg] when [Multi-Measurement] has not been previously selected)
  - When you deselect [Multi-trg] (changing from [Multi-trg] to [Multi-measure] or disabling [Multi-Image Capture])
  - When you change the number of triggers for a Multi-trg

- When a signal is input to the RST (Reset) terminal or the STOP terminal of the terminal block, the Multi-trg is cancelled at that point and the process starts over from capturing the image for trigger 1.
- When you are using two cameras simultaneously, Multi-trg is limited to 2 triggers.
- When you capture images using Multi-trg, you can only use certain windows for processing the captured images. The following table shows the number of captures and the associated window numbers that can be used for processing images captured by each trigger:

	Window used by trigger 1	Window used by trigger 2	Window used by trigger 3	Window used by trigger 4
Number of captures=1 (Normal measurement)	1 - 64	—	—	—
Number of captures=2	1 - 32	33 - 64	—	—
Number of captures=3	1 - 21	22 - 42	43 - 64	—
Number of captures=4	1 - 16	17 - 32	33 - 48	49 - 64

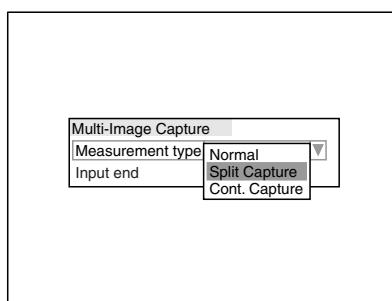
For example, if the number of captures (triggers) for a Multi-trg is 3, the window numbers that can be used for processing on the third trigger are 43 to 64 (22 windows).

- Select [Multi-Image Capture] on the [Camera Settings] menu (page 4-5).



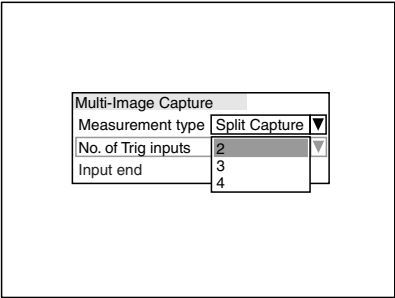
The [Multi-Image Capture] menu appears.

- Select [Measurement type], then select [Split Capture].



3 Select [Trg input no], then select the desired number of triggers.

Images are captured for the selected number of triggers.



4 When you are done with the settings, select [Input end].

5 To change other settings, select the appropriate option in the [Camera Settings] menu.

6 After completing the settings, select [Input end].

Deselecting Multiple Measurements

Select [Normal] for [Measurement type] in Step 2.

Capturing an Image Multiple Times and Importing the Results [Multi-measure]

You can automatically capture an image up to 32 times using one trigger input. Data from these images can be used to obtain the average, the maximum, or the minimum value. This feature is useful when you want to even out scattered measurement results by averaging them.

Example

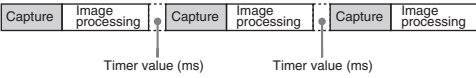
Capturing an image three times to obtain an average.

- 1st capture: 123.000
- 2nd capture: 123.020
- 3rd capture: 124.150

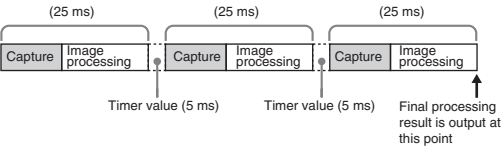
→The measurement value is 123.390.

Note

- [Multi-measure] takes more time compared to normal capture since capturing and processing must be repeated the specified number of times for each image.



For example, if capturing and image processing take 25 ms to complete and the timer value is set to 5 ms as shown in the illustration below, it takes 85 ms for a single [Multi-measure] to complete.



- When a signal is input to the RST (Reset) terminal of the terminal block, [Multi-measure] is cancelled at that point and the process starts over from capturing the image for trigger 1.
- In [Blob] measurement mode, you may not be able to take a measurement if the numbers of blobs varies widely.



- 1 Select **[Multi-Image Capture]** on the **[Camera Settings]** menu (page 4-5).

Camera Settings	
Camera speed	1/2000
Capture method	Progressive
Trigger setting >>	
Gain Adjustment >>	
<b>Multi-Image Capture &gt;&gt;</b>	
Image capture range >>	
Out of Range Intensity	000
Input end	

The **[Multi-measurement]** menu appears.

- 2 Select **[Measurement type]**, then select **[Multi-measure]**.

Multi-Measurement	
Measurement type	Normal
Input end	Multi-trig
	<b>Multi-measure</b>

- 3 Select **[Measured value]**, then select the desired processing output for the image that is captured multiple times.

Multi-Image Capture	
Measurement type	Multi-measure
<b>Measured value</b>	Average
No. of Captures	Max.
Timer value(ms)	Min.
Input end	

- **[Average]** (default): Uses the average of the measurement values obtained through multiple captures as the measurement result.
- **[Max.]**: Uses the maximum measurement value obtained through multiple captures as the measurement result.
- **[Min.]**: Uses the minimum measurement value obtained through multiple captures as the measurement result.

- 4 Select **[No. of measurements]**, then specify the number of times to capture the image.

Multi-Image Capture	
Measurement type	Multi-measure
Measured value	Average
<b>No. of Captures</b>	01
Timer value(ms)	001
Input end	

- 5 Select **[Timer value (ms)]**, then specify the interval (in milliseconds) between two captures.

The range of values you can specify is from 1 to 999 ms (Default: 1 ms).

Multi-Image Capture	
Measurement type	Multi-measure
Measured value	Average
No. of Captures	01
<b>Timer value(ms)</b>	001
Input end	

- 6 After completing the settings, select **[Input end]**.

- 7 To change other settings, select the appropriate option in the **[Camera Settings]** menu.

- 8 After completing the settings, select **[Input end]**.

## Deselecting

Select **[Normal]** for **[Measurement type]** in Step 2.

# Specifying the Image Capture Range[Image Capture Range]/[Out of Range Intensity]

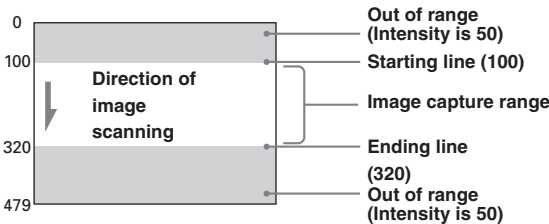
You can specify a capture range within an image. By excluding the areas that will not be used for measurement, you can accelerate the process. You can also specify a particular intensity value for the areas outside the specified region.

**Note**

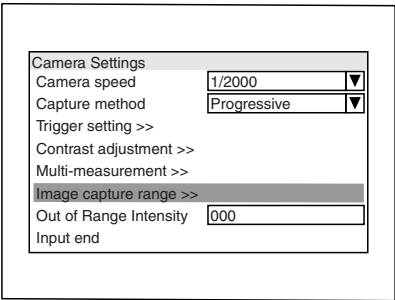
- Anything located outside of the image capture range is not considered to be a measurement targets.
- In pattern search measurement mode (page 4-27) or multiple pattern search measurement mode (page 4-34), the search area and the pattern area must fit within the image capture range. If a part of the search area or the pattern area falls outside the image capture range, a correct measurement cannot be made.

## Example for setting the image capture range

When the [Image Capture Range] is set to "100 - 320" and [Out of Range Intensity] is set to "50"

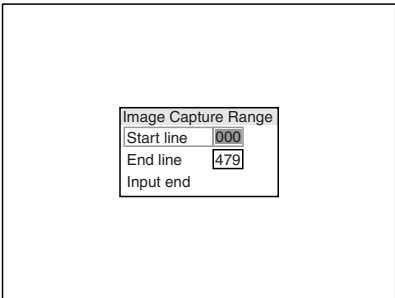


- 1 Select [Image capture range] on the [Camera Settings] menu (page 4-5).



- 2 Select [Starting line], then select the desired line number.

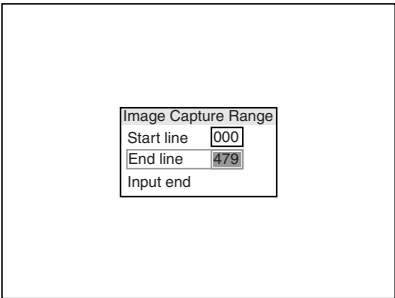
The range of values you can specify is from 0 to 479 (Default: 0).



As you change the value, the image in the background is updated accordingly.

- 3 Select [Ending line], then select the desired line number.

The range of values you can specify is from 0 to 479 (Default: 479).



**Note**

The value of the ending line cannot be smaller than the value of the starting line.



**4** To change other settings, select the appropriate option in the [Camera Settings] menu.

**5** After completing the settings, select [Input end].

### Specifying the Intensity for Out of Range Areas [Out of Range Intensity]

You can set a specific intensity value for the areas outside of the specified image capture region.

**Select [Out of Range Intensity] on the [Camera Settings] menu (page 4-5), then specify the desired intensity value to be applied to the areas outside of the image capture region.**

The range of values you can specify is from 0 to 255 (Default: 0).

The screenshot shows a 'Camera Settings' menu with the following options and values:

Camera Settings	
Camera speed	1/2000
Capture method	Progressive
Trigger setting >>	
Contrast adjustment >>	
Multi-measurement >>	
Image capture range >>	
Out of Range Intensity	000
Input end	

## 4-3 Registering an Image Used for Measurements [Screen Registration]

### 4-1 Program No. p.4-2

### 4-2 Camera p.4-5

### 4-3 Image Registration p.4-16

### 4-4 Window/Inspection Tools p.4-18

### 4-5 Position Adjustment p.4-104

### 4-6 Calculation p.4-109

### 4-7 Output Settings p.4-119

### 4-8 Save p.4-125

## Overview of Screen Registration

You can register an image that is used as a template for measurement and evaluation settings using the following procedure. It is recommended that you update the registered image every time lighting conditions and focus change since this image is used as a reference for setting the inspection windows and inspection tools.

#### Reference

When you are capturing images using [Multi-trg] of [Multi-Measurement] (page 4-11), you can save the registered image for each camera or trigger.

### Displaying the [Screen Registration] Menu

You can display the [Screen Registration] menu as follows:

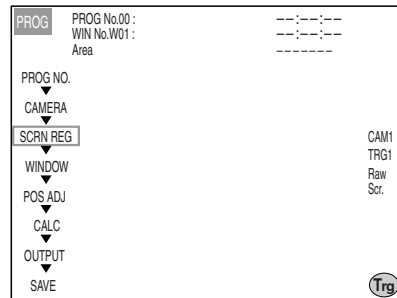
#### 1 Select the [PROG NO.] under which you want to register an image.

Refer to page 4-3 for details.

#### 2 Adjust the camera settings as needed.

Refer to page 4-5 for details.

#### 3 Select [SCRN REG].

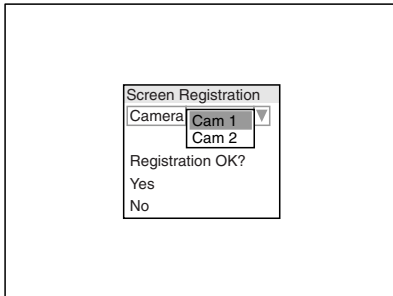


The [Screen Registration] menu appears.



# Registering an Image

- 1** Select the work piece you want to use as a reference for measurement and evaluation settings and take the steps necessary to prepare it to be captured by the camera.
- 2** Select [Camera] on the [Screen Registration] menu (page 4-16), then select the camera that is capturing the image you want to register.



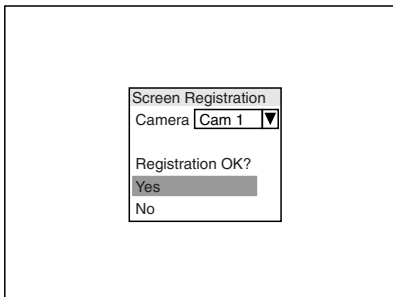
- 3** Press the [TRIGGER] button on the remote control console.

The image captured by the camera selected in step 2 is displayed in the background.

## Reference

If the menu is blocking an important part of the image, it can be made transparent or completely disappear by pressing the "VIEW" button on the remote control console.

- 4** Select [Yes] to register the displayed image.



The displayed image is saved to the CV-2100 as the reference image for measurement and evaluation settings.

- 5** Repeat steps 2 and 3 to register an image for another camera.

## Canceling the Registration

If the displayed image is not appropriate, select [No] in step 4 above, then retry the registration after repositioning the work piece and readjusting the camera settings as needed.

## Registering an Image Capture Using [Multi-trg]

When you are capturing images using [Multi-trg] of [Multi-Measurement] (page 4-11), you must select one image at a time and repeat the registration steps for each of the images. Note that you cannot register images captured by camera 2 when the number of triggers is set to more than 3.

- **When number of triggers=2:** 4 images (trigger 1 and trigger 2 for camera 1 and trigger 1 and trigger 2 for camera 2)
- **When number of triggers=3:** 3 images (trigger 1, trigger 2, and trigger 3 for camera 1)
- **When number of triggers=4:** 4 images (trigger 1, trigger 2, trigger 3, and trigger 4 for camera 1)



# 4-4 Setting Units of Inspection and Measurement Windows

## 4-1 Program No. p.4-2

## 4-2 Camera p.4-5

## 4-3 Image Registration p.4-16

## 4-4 Window/Inspection Tools p.4-18

## 4-5 Position Adjustment p.4-104

## 4-6 Calculation p.4-109

## 4-7 Output Settings p.4-119

## 4-8 Save p.4-125

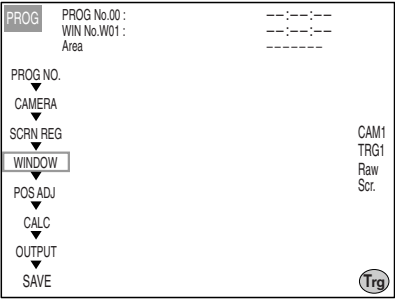
# Overview of Setting Inspection Windows

Select the measurement tool for each unit (window) of inspection and measurement. Thirteen different measurement tools can be used in this system. Refer to the “List of Measurement Mode Functions” on the next page for the types of measurement tools.

## Select the [Window Setting] menu as follows.

Use the [Window Setting] menu to set windows.

- 1 Select [PROG NO.]**  
Refer to page 4-3 for details.
- 2 Adjust the camera settings.**  
Refer to page 4-5 for details.
- 3 Register the images that you are going to use for the measurement.**  
Refer to page 4-17 for details..
- 4 Select [WINDOW]**



The [Window Setting] menu appears.

# List of Measurement Mode Functions

You can perform various inspections by combining the following measurement functions.

Measurement name	Description	Size		Position			Shape		Number	Stain	Intensity
		Area	Gap	Pitch	Coordinate	Angle	Feature characteristics	Correlation value			
<b>Area</b> (page 4-22)	Measures the area.	○	—	—	—	—	—	—	—	—	—
<b>Pattern search</b> (page 4-27)	Detects a pattern.	—	—	—	○	○	—	○	—	—	—
<b>Multiple pattern search</b> (page 4-34)	Detects multiple patterns.	—	—	—	○	○	—	○	○	—	—
<b>Edge position</b> (page 4-42)	Measures the edge position.	—	—	—	○	○	—	—	○	—	—
<b>Edge gap</b> (page 4-49)	Measures the edge gap.	—	○	—	—	○	—	—	○	—	—
<b>Edge pitch</b> (page 4-56)	Measures the maximum, minimum and average distance between edges.	—	—	○	—	○	—	—	○	—	—
<b>Number of edges</b> (page 4-63)	Counts the number of edges.	—	—	—	—	—	—	—	○	—	—
<b>Edge angle</b> (page 4-68)	Measures the edge angle.	—	—	—	—	○	—	—	○	—	—
<b>Stain</b> (page 4-73)	Detects flaws from the change of intensity.	—	—	—	—	—	—	—	—	○	—
<b>Blob</b> (page 4-78)	Measures the feature characteristics of blobs.	○	—	—	○	○	○	—	○	—	—
<b>Trend edge position</b> (page 4-86)	Scans the measurement area in a specified direction and measures the edge position.	—	—	—	○	—	—	—	○	—	—
<b>Trend edge gap</b> (page 4-93)	Scans the measurement area in a specified direction and measures the edge gap.	—	○	—	—	—	—	—	○	—	—
<b>Intensity inspection</b> (page 4-100)	Measures the maximum, minimum and average values of intensities within the measurement area and also measures the standard deviation.	—	—	—	—	—	—	—	—	—	○

# Selecting a Measurement Window Number

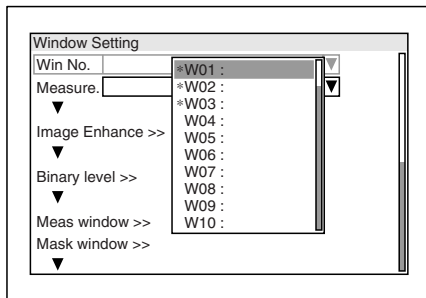
4



Specifying the Units (Windows) for Inspections and Measurements

This system uses the [Measurement Window] to perform measurement. A unique window name in the format “Wxx” (xx is a two-digit numeral) is given to each measurement window. A maximum of 64 measurement windows can be set for each Program No. Each of the 64 measurement windows can be assigned a unique measurement tool.

**Select [Win No.] from the window menu (page 4-18), then select the measurement window that you want to use.**

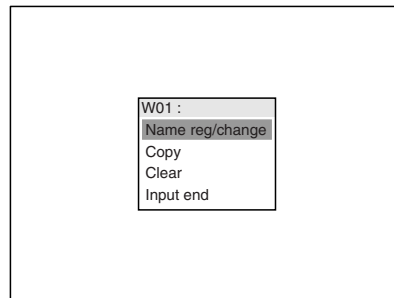


## Reference

The measurement windows that have already been set have an asterisk “\*” before the window No.

## How to specify or change the name of a measurement window

- 1** Select [Win No.] from the window menu (page 4-18), then select the measurement window for which you want to specify or change the name.
- 2** Press the FNC button on the remote control console and select [Name reg/change].



- 3** Enter the desired name for the Window No.  
Refer to “Inputting Text” (page 3-4) for details.
- 4** After entering the name, select [Input end].  
The name of the measurement window is changed.





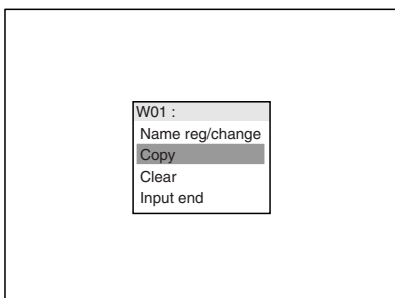
## How to copy and use the setting values of another measurement windows

All of the setting values that have been saved for another measurement window can be copied to the current measurement window.

### ► Note

When the setting values are copied, the contents that have been saved before will be overwritten by the new contents.

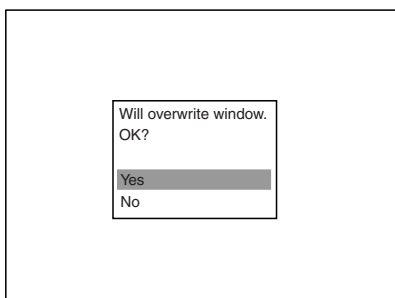
- 1** Select [Win No.] from the window menu (page 4-18), then select the measurement window (copy target) to which you want to copy the setting values.
- 2** Press the [FNC] button on the remote control console and select [Copy].



- 3** Select the measurement window (copy source) from which you want to copy the setting values.

A menu prompting you to confirm appears.

- 4** To proceed to copy, select [Yes].



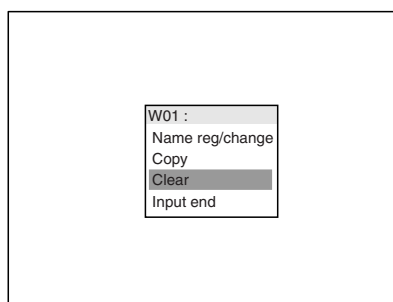
Copying will be executed.

To stop copying, select [No] instead of [Yes] in Step 4.

## How to clear a setting value

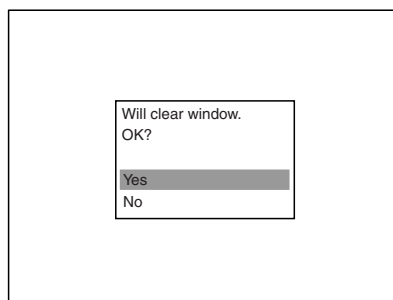
You can initialize all of the setting values that have been registered in the selected window to the default settings.

- 1** Select [Win No.] from the window menu (page 4-18), then select the measurement window that you want to initialize.
- 2** Press the [FNC] button on the remote control console and select [Clear].



A menu prompting you to confirm appears.

- 3** To proceed to initialize, select [Yes].



Initialization will be executed.

To stop initialization, select [No] instead of [Yes] in Step 3.

# Area

4

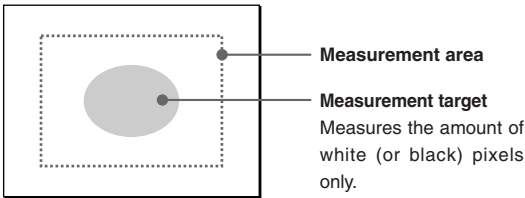


Specifying the Units (Windows) for Inspections and Measurements

## What is the [Area] measurement mode?

You can binarize (convert into black-and-white binary data) the captured image and measure either the white area or the black area.

### Measurement image



### Measurement results

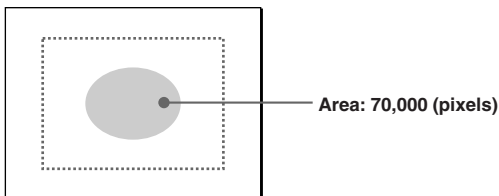
The following measurement results are output in the area measurement mode.

- **Area of a work piece:** The number of black/white pixels is output.
- **OK / NG:** If the measurement value exceeds the specified tolerance (upper and lower limit), an [NG] message is displayed. If it is within the specified tolerance, an [OK] message is displayed.

### Sample measurement

Example of measuring the amount of dark pixel for a given object:

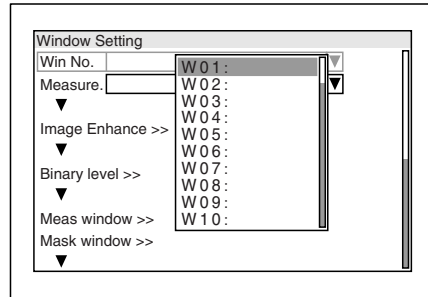
- Detect color: Black



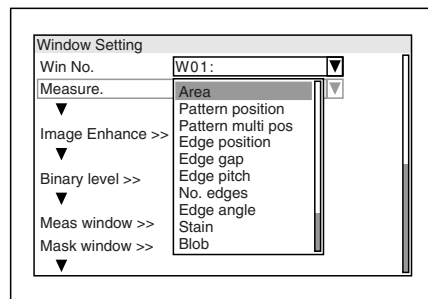
## 1. Selecting the Measurement Method

Select the [Area] measurement mode as follows.

### 1 Select a measurement window (page 4-20).



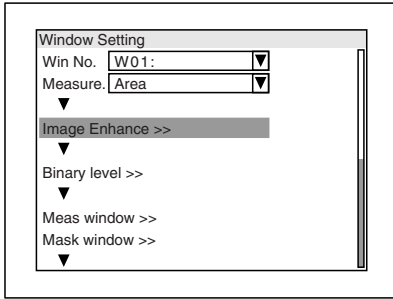
### 2 Select [Measure.] and then select [Area].





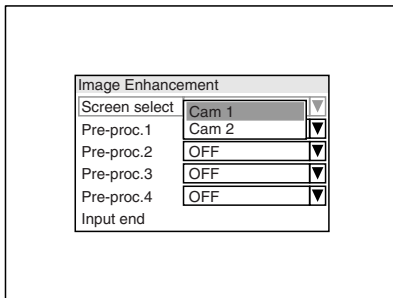
## 2. Selecting an Image Enhancement

### 1 Select [Image Enhance].

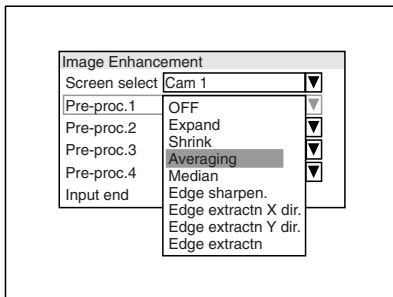


The [Image Enhancement] menu appears.

### 2 Select the camera that you want to use for an Image Enhancement.



### 3 Select the pre-processing number, then select the type of Image Enhancement that you want to perform.



Details of each enhancement are shown below.

**[OFF]** : Pre-processing will not be executed.

**[Expand]** : The white pixels are expanded and the black pixel noise is removed.

**[Shrink]** : The white pixels are shrunk and the white pixel noise is removed.

**[Averaging]**: Intensity is averaged to remove noise.

**[Median]** : Noise is removed while the outline is maintained.

**[Edge sharpen.]**:

Region where there is a change in intensity is enhanced.

**[Edge extractn X dir.]**:

Region where there is a change in intensity in the horizontal (X) direction is extracted.

**[Edge extractn Y dir.]**:

Region where there is a change in intensity in the vertical (Y) direction is extracted.

**[Edge extractn]**:

Region where there is a change in intensity is extracted.

Refer to the "Filter List" (page 15-2) for an example showing the Image Enhancements.

#### Multiple Image Enhancements can be set.

When multiple Image Enhancements are set, they are executed starting from Pre-processing 1.

Example: Pre-processing 1 (shrink) → Pre-processing 2 (expand) → Pre-processing 3 (shrink) → Pre-processing 4 (expand)

### 4 To set multiple Image Enhancements, repeat Steps 3 and 4.

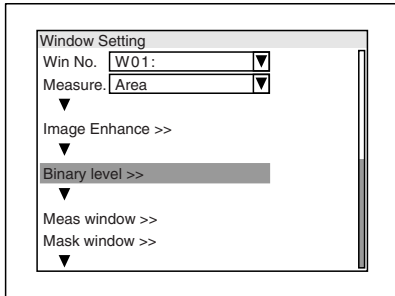
### 5 After completing the settings, select [Input end].



### 3. Setting the Binary Level

The captured image is converted to gray scale with a 256 steps. The threshold level for the binary conversion is set as follows.

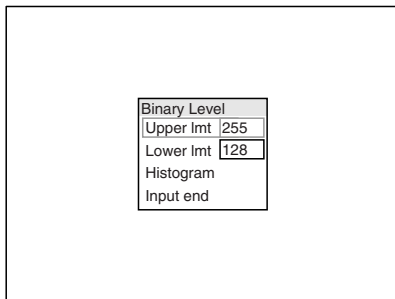
#### 1 Select [Binary level].



The [Binary level] menu appears.

#### 2 Select [Upper lmt] and then specify the upper limit value.

The upper limit value can be set at any level between "Lower limit value" and 255.



#### 3 Select [Lower lmt] and then specify the lower limit value.

The lower limit value can be set at any level between 0 and "Upper limit value".

#### 4 After completing the settings, select [Input end].

##### Reference

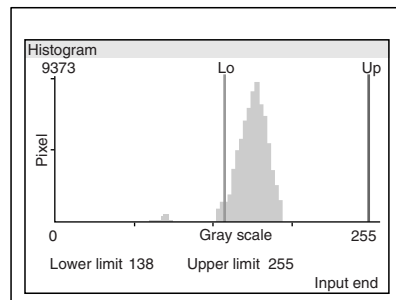
If the menu is blocking an important part of the image, it can be made transparent or completely disappear by pressing the "VIEW" button on the remote control console.

### Setting the upper and lower limit values of the binary level using a histogram

#### 1 Select [Histogram] in the [Binary level] menu.

The [Histogram] menu appears.

#### 2 Press the [ENTER] button to select [Upper limit], then press the right and left arrow keys and set the upper limit value.



You can check the background screen by pressing the [VIEW] button on the remote control console.

##### Reference

- When the measurement area is not set, intensity distribution over the entire screen is shown as the histogram. When the measurement area is set, distribution information only within the measurement area is shown as the histogram.
- If the menu is blocking an important part of the image, it can be made transparent or completely disappear by pressing the "VIEW" button on the remote control console.

#### 3 Press the [ENTER] button to select [Lower limit], then press the right and left arrow keys and set the lower limit value.

#### 4 After completing the settings, select [Input end].

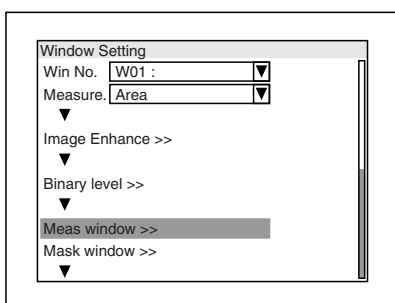
## 4. Setting the Measurement Area

Within the captured image, the measurement window is set as follows.

### Reference

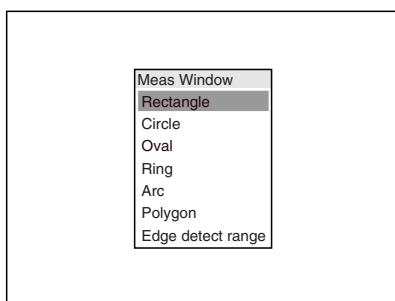
If there are sections of the measurement area that you do not wish to detect, you can set a mask to hide the unwanted parts. For details, refer to “Hiding an unwanted area (mask window)” located after “Setting the Measurement Area”.

### 1 Select [Meas window].



The [Meas window] menu appears.

### 2 Select the shape of the measurement area.



### 3 Draw the measurement area.

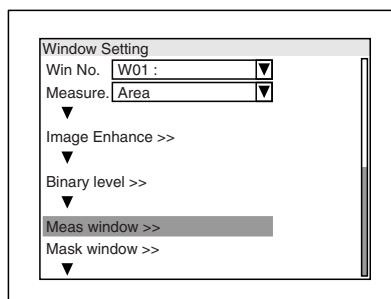
Refer to “Drawing a Measurement Area” (page 3-5) for details.

### 4 After completing the drawing, press the [ES-CAPE] key on the remote control console.

## Clearing the measurement area

You can clear the measurement area that has been set by following the procedure below.

### 1 Highlight [Meas window].

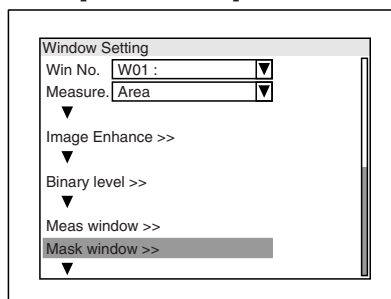


### 2 Press the [FNC] button on the remote control console and select [Clear].

## Hiding an unwanted area (mask window)

You can set an area (mask window) that will not be measured inside the measurement area. This function is useful when the measurement area has a complicated shape and you want to hide an unwanted area.

### Select [Mask window].



The [Mask Window] menu appears.

Refer to “Hiding the Measurement Window Partially (Mask Window)” (page 3-12) for the subsequent operations.

## Clearing the entire mask area

Move the cursor to [Mask Window], then press the [FNC] button on the remote control console and select [Clear].

## Clearing the shape of the mask area that has been set

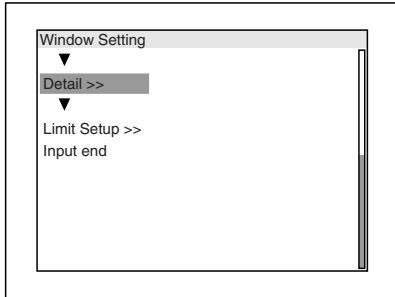
Press the [FNC] button on the remote control console on the setting screen of the mask area, then select [Clear].



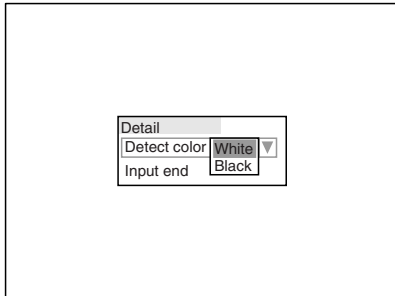
## 5. Specifying the Detection Color

You can specify the color of pixel (black/white) to be detected. Only the area having the specified color will be detected for measurement.

### 1 Select [Detail].



### 2 Select [Detect color] and then select either black or white.



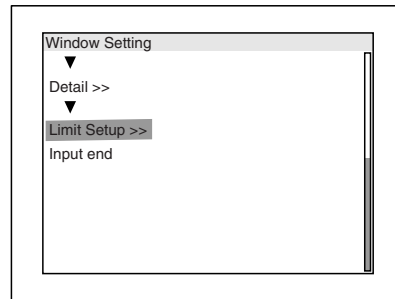
- **[White]** (default value): Only white pixels are measured.
- **[Black]**: Only black pixels are measured.

### 3 After completing the settings, select [Input end].

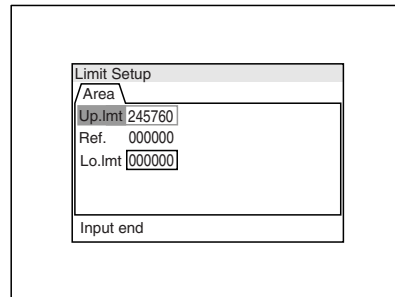
## 6. Setting the Limit Setup

You can set the tolerance (upper and lower limits) for the measurement value as follows. If the measurement value exceeds the specified tolerance, an [NG] message appears. If it is within the specified tolerance, an [OK] message appears.

### 1 Select [Limit Setup].



### 2 Press the [ENTER] button to select [Up. lmt] and set the upper limit value of the tolerance.



The unit of tolerance is the "Number of pixels" of the measurement area.

### 3 Select [Lo. lmt] and set the lower limit value of the tolerance.

### 4 After completing the settings, press the [ESCAPE] button on the remote control console and select [Input end].

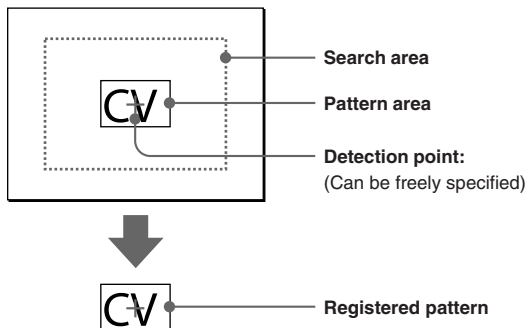
# Pattern Search

## What is the [Pattern Search] Measurement Mode?

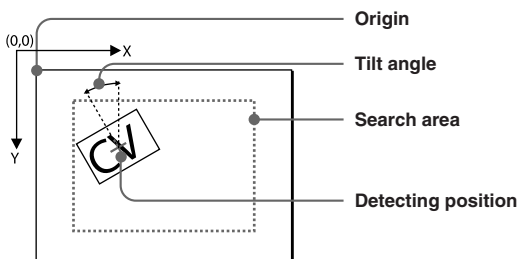
A particular shape or pattern from the registered image can be stored and compared to the current image. Through this comparison, the position, angle, and correlation value can be output.

### Measurement image

#### When registering a pattern



#### While the system is in operation

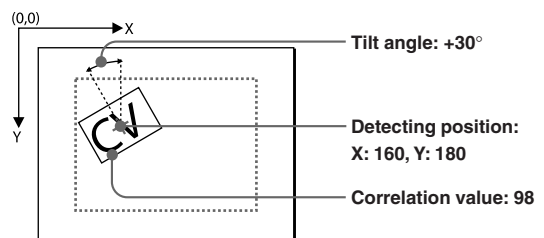


### Measurement results to be output

The measurement results that can be output in the pattern search measurement mode are shown below.

- **Detecting position coordinates (X, Y):** Output in units of pixel coordinates.
- **Tilt angle:** The angle of difference between the registration pattern and the detected pattern is output in units of angle. The angle difference in the clockwise direction is shown with the minus (−) sign. The angle difference in the counter-clockwise direction is shown with the positive (+) sign.
- **Correlation value:** The similarity between the pattern detected within the measurement area and the registered pattern is output in units of percentage in the range of 0 to 99.9.
- **OK / NG:** If the measurement value exceeds the specified tolerance (upper and lower limits), an [NG] message is displayed. If it is within the specified tolerance, an [OK] message is displayed.

### Sample of measurement



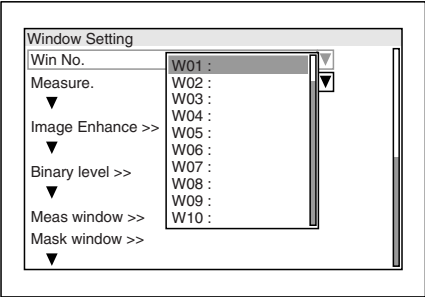
#### Reference

The measurement value (position coordinates) can be displayed in absolute size using the calibration function. Refer to "Displaying the Measurement Values in Absolute Sizes (Calibration)" (page 6-3) for details.

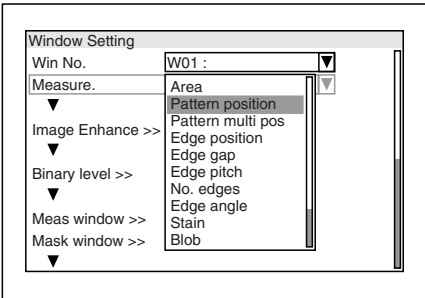
1. Selecting the Measurement Tool

Select the [Pattern positn] measurement mode as follows.

1 Select the measurement window (page 4-20).

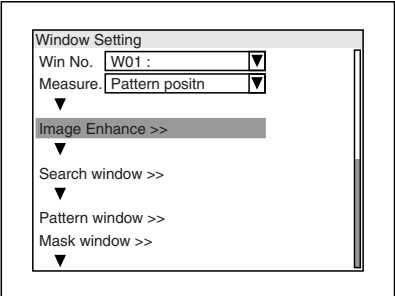


2 Select [Measure.] and then select [Pattern position].



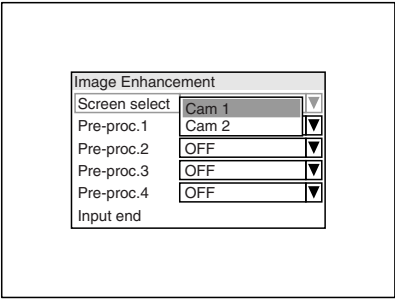
2. Selecting an Image Enhancement

1 Select [Image Enhance].

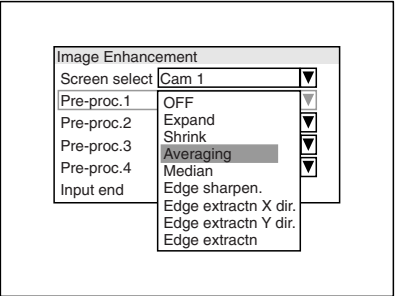


The [Image Enhancement] menu appears.

2 Select the camera that you want to use for pre-processing.



3 Select the pre-processing number, then select the type of Image Enhancement that you want to perform.



Details of each enhancement are shown below.

[OFF] : Pre-processing will not be executed.

[Expand] : The white pixels are expanded and the black pixel noise is removed.

[Shrink] : The white pixels are shrunk and the white pixel noise is removed.



**[Averaging]:** Intensity is averaged to remove noise.

**[Median]** : Noise is removed while the outline is maintained.

**[Edge sharpen]:**

Region where there is a change in intensity is enhanced.

**[Edge extractn X dir.]:**

Region where there is a change in intensity in the horizontal (X) direction is extracted.

**[Edge extractn Y dir.]:**

Region where there is a change in intensity in the vertical (Y) direction is extracted.

**[Edge extractn]:**

Region where there is a change in intensity is extracted..

Refer to the “Filter List” (page 15-2) for an example showing the Image Enhancements.

#### Multiple Image Enhancements can be set.

When multiple Image Enhancements are set, they are executed starting from Pre-processing 1.

Example: Pre-processing 1 (shrink) → Pre-processing 2 (expand) → Pre-processing 3 (shrink) → Pre-processing 4 (expand)

**4 To set multiple pre-processing methods, repeat Steps 3 and 4.**

**5 After completing the settings, select [Input end].**

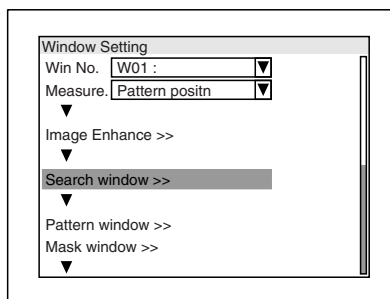
## 3. Setting the Measurement Area

You can set the area within the image that the pattern is searched for as follows.

### Reference

The smaller the search area, the shorter the processing time becomes.

**1 Select [Search window].**



**2 Move the [ENTER] key on the remote control console up, down, right, and left to draw the search window.**

Refer to “Drawing a Measurement Window” (page 3-5) for details.

**3 After completing the drawing, press the [ES-CAPE] button on the remote control console.**

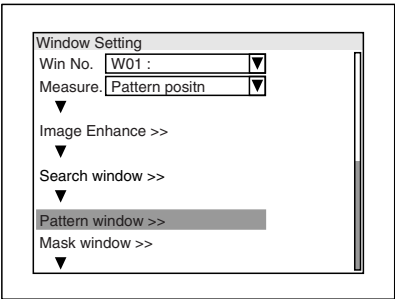
## 4.Registering the Pattern

You can save the area designated to be the pattern as follows.

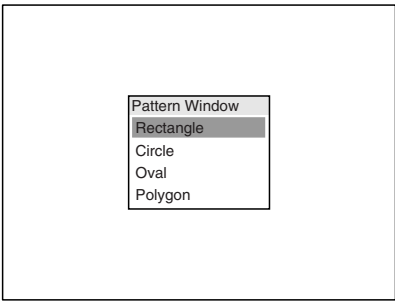
**Reference**

If there are sections of the measurement area that you do not wish to detect, you can set a mask to hide the unwanted parts. For details, refer to “Hiding an unwanted area (mask window)” located after “Setting the Measurement Area”.

**1 Select [Pattern window].**



**2 Select the shape of the pattern window.**



**3 Move the [ENTER] key on the remote control console up, down, right, and left to draw the pattern area.**

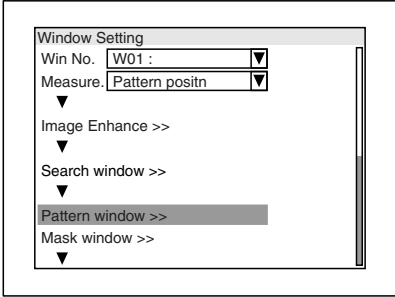
Refer to “Drawing a Measurement Window” (page 3-5) for details.

**4 After completing the drawing, press the [ESCAPE] button on the remote control console.**

## Selecting the Shape of Another Measurement Area / Clearing the Measurement Area

You can clear the measurement area that has been set by following the procedure below.

**1 Highlight [Pattern window].**

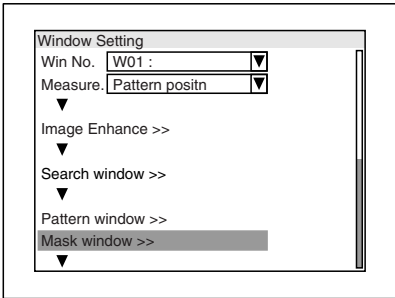


**2 Press the [FNC] button on the remote control console and select [Clear].**

## Hiding an unwanted area (mask window)

You can set an area (mask window) that will not be measured inside the measurement area. This function is useful when the measurement area has a complicated shape and you want to hide an unwanted area.

**Select [Mask window].**



The [Mask Window] menu appears.  
Refer to “Hiding the Measurement Window Partially (Mask Window)” (page 3-12) for the subsequent operations.

## Clearing the entire mask area

Move the cursor to [Mask Window], then press the [FNC] button on the remote control console and select [Clear].

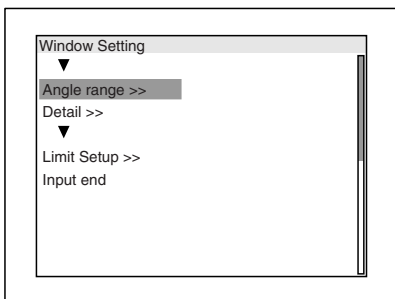
## Clearing the shape of the mask area that has been set

Press the [FNC] button on the remote control console on the setting menu of the mask area, then select [Clear].

## 5. Setting the Measurement Range in the Rotating Direction

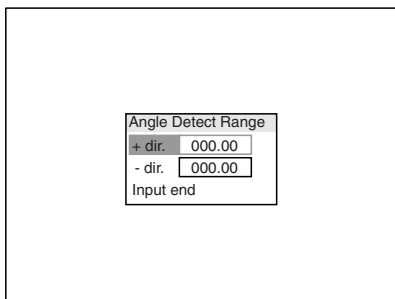
When a pattern is rotated, you can specify the angle to be measured in the range between  $-179.99^{\circ}$  and  $180.00^{\circ}$ .

### 1 Select [Angle range].



The [Angle Detect Range] menu appears.

### 2 Select [+ dir.] (counter-clockwise rotation) and set the maximum range of the angle in which angle measurement can be made.

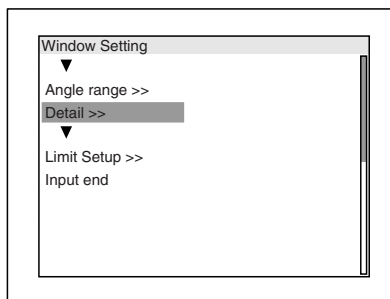


### 3 Select [-dir.] (clockwise rotation) and set the maximum range of the angle in which angle measurement can be made.

### 4 After completing the settings, select [Input end].

## 6. Specifying the Detailed Conditions

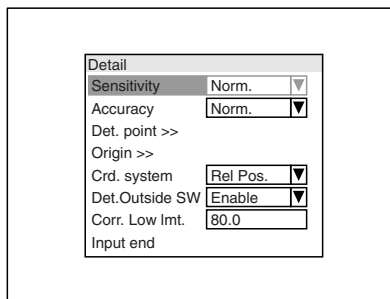
### 1 Select [Detail].



The [Detail] menu appears.

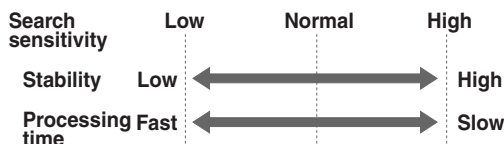
### 2 Make the necessary settings.

After completing the settings, select [Input end].



### Selecting the Search Sensitivity

You can select the level of search sensitivity using [Sensitivity] on the [Detail] menu. When detection is unstable, increase the level of sensitivity.



#### Note

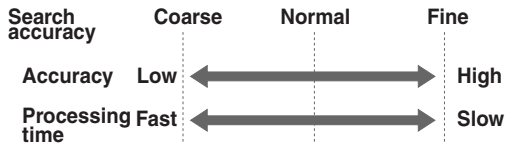
Increasing the level of search sensitivity may improve the stability of detection, but the processing time will become longer.



### Selecting the Search Accuracy

You can select the level of search accuracy using [Accuracy] on the [Detail setting] menu.

To measure with a high level of accuracy, set the search accuracy to [Fine].



#### Note

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

### Changing the Position of the Detection Point

You can change the position of the detection point using [Det. point] on the [Detail] menu.

#### Reference

Normally, the detection point is at the center position of the pattern area.

### Changing the Reference Position of Origin

You can change the reference position of origin using [Origin] on the [Detail] menu.

You can make the necessary setting as shown below on the [Origin Selection] menu.

- **Designate Origin point** (Default value): The origin point is set at the top left of the screen by default. However, you can freely specify the origin point by first selecting [Origin Pt.Select]. Move the [+] cursor to the position where you want to set the origin point and then press the ESCAPE button. The coordinates of the set position are displayed in the [Origin Value X = ] and [Origin Value Y = ] columns.
- **Registered position**: The position of the "Detection point" in the pattern area is used as the origin point. The present origin point is displayed in the [Origin Value X =] and [Origin Value Y =] columns.

#### Reference

To measure the amount of error (deviation) from the reference position where the image is registered, select [Registered position].

### Selecting the Coordinate System for Position

#### Adjustment

You can select the coordinate system using [Crđ. system] on the [Detail] menu. If a position correction is not being done, this setting will have no effect on the output.

- **[Rel Pos]** (default value): If the position of the window that is used as the source of correction has shifted, the amount of this error is reflected on the measurement.
- **[Abs Pos]**: The distance from the position "Origin point"

### Enabling the Pattern Window to be Detected outside the Search Window.

You can set this item using [Det. Outside SW] on the [Detail] menu.

- **Enable**: Pattern will be detected even if it is roughly 50% outside of the search window.
- **Disable** (default value): Pattern will be detected only within the search window.

### Eliminating Patterns based on Correlation Value

You can specify this item using [Corr. Low lmt] on the [Detail] menu.

This function is used as follows. When [Corr. Low lmt] is set to 80, only those patterns having a correlation value of 80 or more are actually measured. Thus, you can eliminate the patterns that have a correlation value of less than 80. This function is convenient to use for preventing erroneous detection.

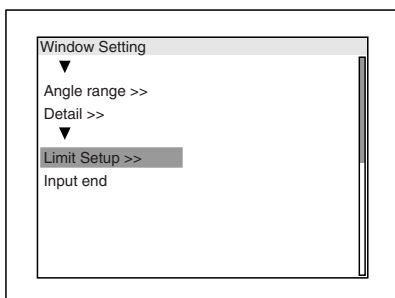


## 7. Setting the Limit Setup

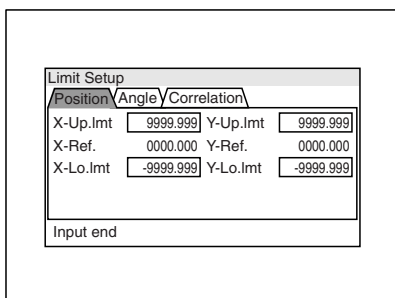
You can set the tolerance (upper and lower limits) for the measurement value.

If the measurement value exceeds the specified tolerance, an [NG] message is displayed. If it is within the specified tolerance, an [OK] message is displayed.

### 1 Select [Limit Setup].



### 2 Move the [ENTER] button to the right or left to select an item for which you want to specify a tolerance.



### 3 Press the [ENTER] button to specify the upper and lower limit values of the tolerance.

The units of tolerance change depending on the type of measurement value.

- **Position (Detecting position coordinates of pattern):**  
Number of pixels (X/Y coordinates)
- **Angle (Tilt angle of pattern):** Angle
- **Correlation (Correlation value of pattern):**  
Numerical value in the range of 0 to 99.9.

### 4 To specify the tolerance of another measurement values, press the [ESCAPE] button and repeat Steps 2 and 3 as described above.

### 5 After completing the settings, press the [ESCAPE] button on the remote control console and select [Input end].

# Multiple Pattern Search

4

Specifying the Units (Windows) for Inspections and Measurements

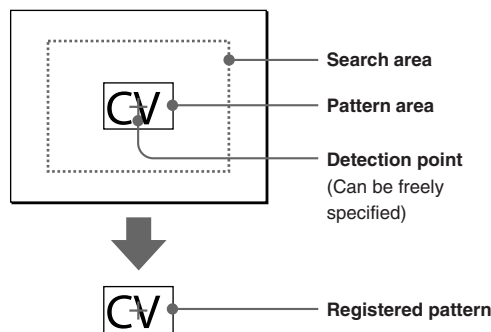
## What is the [Multiple Pattern Search] Measurement Mode?

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

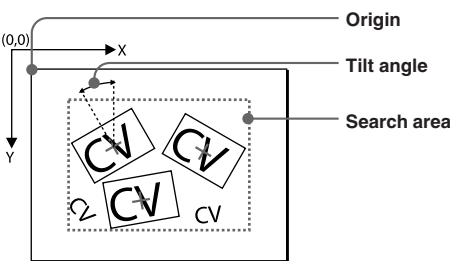
The Multiple Pattern Search is different from the “Pattern Search” (page 4-27) in that a maximum of 16 pieces of the same pattern can be detected and the number of detected patterns can be counted. This function is convenient when there are many identical work pieces within the screen.

### Measurement image

#### When registering a pattern



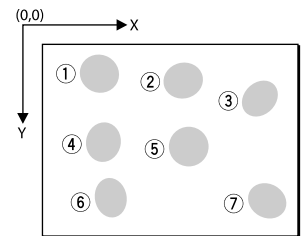
#### While the system is in operation



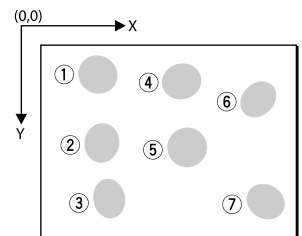
The pattern can be ordered in three different fashions.

The order of the detected patterns can be selected. There are three types in which the pattern can be ordered. When applying label numbers, the following three types are prepared.

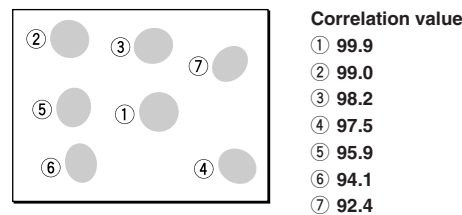
- $Y > X$ , ascending order



- $X > Y$ , ascending order



- Correlation value descending order



To select a different order, refer to [Det. Order] (page 4-40) on the [Detail] menu.



## Measurement results

The measurement results that can be output in the pattern search measurement mode are shown below.

- **Number of detected targets**
- **Detected position coordinates (X, Y):** Output in units of pixel coordinates.
- **Tilt angle:** The angle of difference between the registration pattern and the detected pattern is output in units of angle. The angle difference in the clockwise direction is shown with the minus (–) sign. The angle difference in the counter-clockwise direction is shown with the positive (+) sign.
- **Correlation value:** The similarity between the pattern detected within the measurement area and the registered pattern is output in units of percentage in the range of 0 to 99.9.
- **OK / NG:** If the measurement value exceeds the specified tolerance (upper and lower limits), an [NG] message is displayed. If it is within the specified tolerance, an [OK] message is displayed.

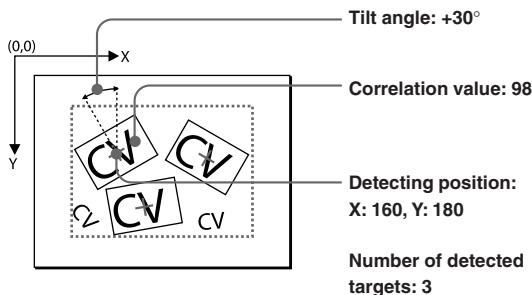
### Note

Only data for a single pattern can be used for evaluation. The pattern can be selected in the [Detail] menu (page 4-40).

## Sample of measurement

Example measuring multiple patterns:

- [Det. Order]: X > Y, ascending order
- [No.Patt Disp]: 1



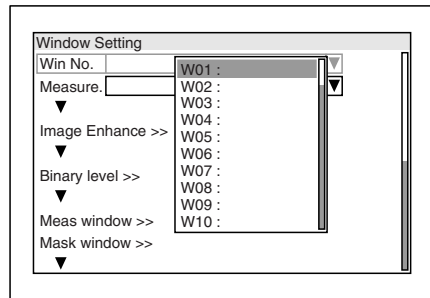
### Reference

The measurement value (position coordinates) can be displayed in absolute size using the calibration function. Refer to "Displaying the Measurement Values in Absolute Sizes (Calibration)" (page 6-3) for details.

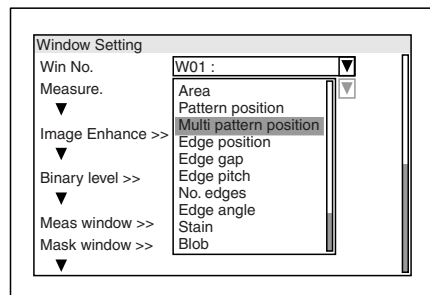
## 1. Selecting the Measurement Tool

Select the [Pattern multi pos] measurement mode as follows.

### 1 Select the measurement window (page 4-20).



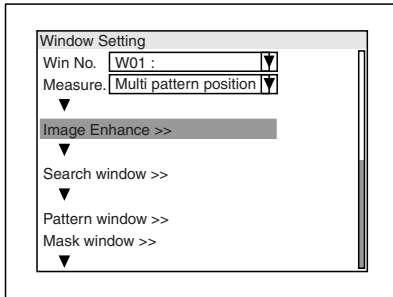
### 2 Select [Measure.] and then select [Multi pattern position].





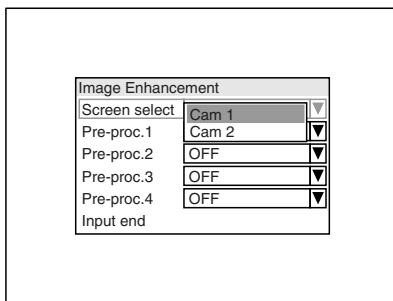
## 2. Selecting an Image Enhancement

### 1 Select [Image Enhance].

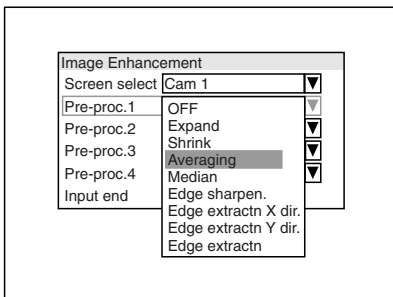


The [Image Enhancement] menu appears.

### 2 Select the camera that you want to use for an Image Enhancement.



### 3 Select the pre-processing number, then select the type of Image Enhancement that you want to perform.



Details of each enhancement are shown below.

**[OFF]** : Pre-processing will not be executed.

**[Expand]** : The white pixels are expanded and the black pixel noise is removed.

**[Shrink]** : The white pixels are shrunk and the white pixel noise is removed.

**[Averaging]**: Intensity is averaged to remove noise.

**[Median]** : Noise is removed while the outline is maintained.

**[Edge sharpen]**:

Region where there is a change in intensity is enhanced.

**[Edge extractn X dir.]**:

Region where there is a change in intensity in the horizontal (X) direction is extracted.

**[Edge extractn Y dir.]**:

Region where there is a change in intensity in the vertical (Y) direction is extracted.

**[Edge extractn]**:

Region where there is a change in intensity is extracted.

Refer to the “Filter List” (page 15-2) for an example showing the Image Enhancements.

**Multiple pre-processing methods can be set.**

When multiple methods are set, pre-processing is executed starting from Pre-processing 1.

Example: Pre-processing 1 (shrink) → Pre-processing 2 (expand) → Pre-processing 3 (shrink) → Pre-processing 4 (expand)

### 4 To set multiple Image Enhancements, repeat Steps 3 and 4.

### 5 After completing the settings, select [Input end].



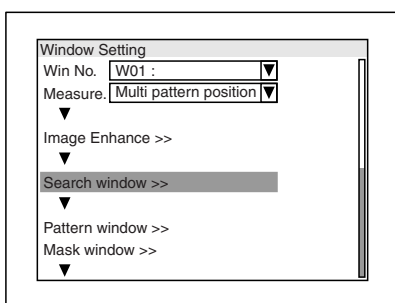
### 3. Setting the Measurement Area

You can set the area within the image that the pattern is searched for as follows.

#### Reference

The smaller the search area, the shorter the processing time becomes.

#### 1 Select [Search window].



#### 2 Select [Search window].

Move the [ENTER] key on the remote control console up, down, right, and left to draw the search window. Refer to “Drawing a Measurement Window” (page 3-5) for details.

#### 3 After completing the drawing, press the [ES-CAPE] button on the remote control console.

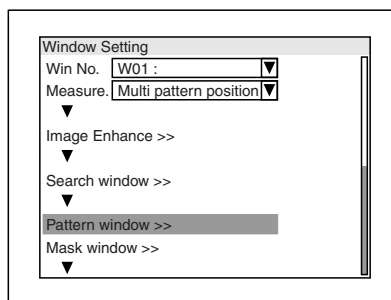
### 4. Registering the Pattern

You can save the area designated to be the pattern as follows.

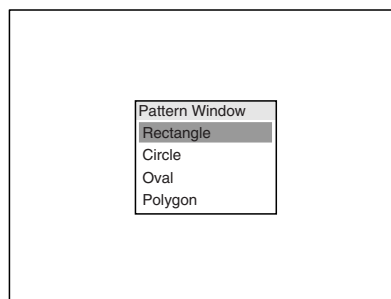
#### Reference

If there are sections of the measurement area that you do not wish to detect, you can set a mask to hide the unwanted parts. For details, refer to “Hiding an unwanted area (mask window)” located after “Setting the Measurement Area”.

#### 1 Select [Pattern window].



#### 2 Select the shape of the pattern window.



#### 3 Move the [ENTER] key on the remote control console up, down, right, and left to draw the pattern area.

Refer to “Drawing a Measurement Window” (page 3-5) for details.

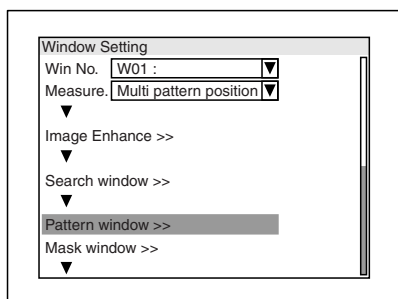
#### 4 After completing the drawing, press the [ES-CAPE] button on the remote control console.



## Clearing the Measurement Area

You can clear the measurement area that has been set by following the procedure below.

### 1 Highlight [Pattern window].

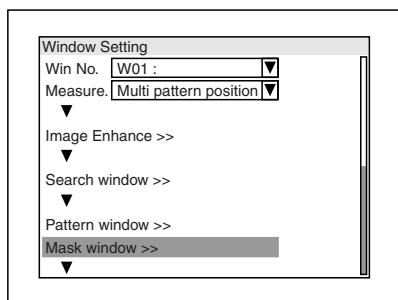


### 2 Press the [FNC] button on the remote control console and select [Clear].

## Hiding an unwanted area (mask window)

You can set an area (mask window) that will not be measured inside the measurement area. This function is useful when the measurement area has a complicated shape and you want to hide an unwanted area.

### Select [Mask window].



The [Mask Window] menu appears.

Refer to "Hiding the Measurement Window Partially (Mask Window)" (page 3-12) for the subsequent operations.

### Clearing the entire mask area

Move the cursor to [Mask Window], then press the [FNC] button on the remote control console and select [Clear].

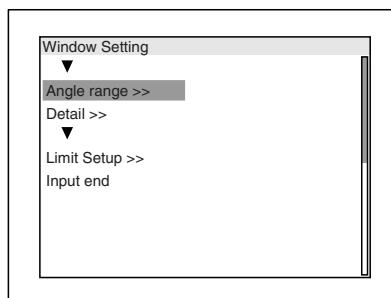
### Clearing the shape of the mask area that has been set

Press the [FNC] button on the remote control console on the setting menu of the mask area, then select [Clear].

## 5. Setting the Measurement Range in the Rotating Direction

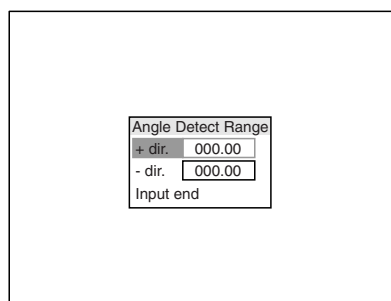
When a pattern is rotated, you can specify the angle to be measured in the range between  $-179.99^\circ$  to  $180.00^\circ$ .

### 1 Select [Angle range].



The [Angle Detect Range] menu appears.

### 2 Select [+ dir.] (counter-clockwise rotation) and set the maximum range of the angle in which angle measurement can be made.



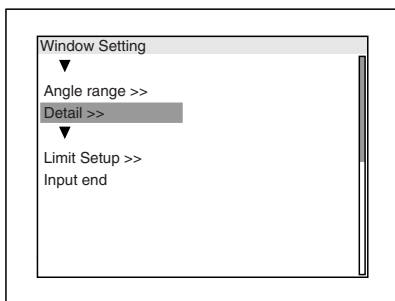
### 3 Select [- dir.] (clockwise rotation) and set the maximum range of the angle in which angle measurement can be made.

### 4 After completing the settings, select [Input end].



## 6. Specifying the Detailed Conditions

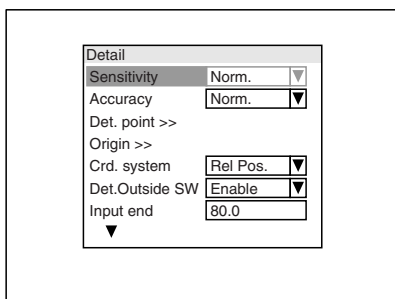
### 1 Select [Detail].



The [Detail] menu appears.

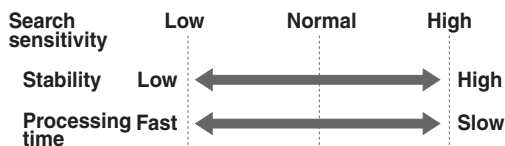
### 2 Make the necessary settings.

After completing the settings, select [Input end].



### Selecting the Search Sensitivity

You can select the level of search sensitivity using [Sensitivity] on the [Detail] menu. When detection is unstable, increase the level of sensitivity.



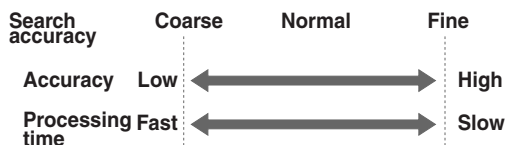
#### Note

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

### Selecting the Search Accuracy

You can select the level of search accuracy using [Accuracy] on the [Detail setting] menu.

To measure with a high level of accuracy, set the search accuracy to [Fine].



#### Note

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

### Changing the Position of the Detection Point

You can change the position of the detection point using [Det. point] on the [Detail] screen.

#### Reference

Normally, the detection point at the center position of the pattern area.

### Changing the Reference Position of Origin

You can change the reference position of origin using [Origin] on the [Detail] menu.

You can make the necessary setting as shown below on the [Origin Selection] menu.

- **Designate Origin point (Default):** The origin point is set at the top left of the screen by default. However, you can freely specify the origin point by first selecting [Origin Pt.Select]. Move the [+] cursor to the position where you want to set the origin point and then press the ESCAPE button. The coordinates of the set position are displayed in the [Origin Value X = ] and [Origin Value Y = ] columns.
- **Registered position:** The position of the "Detection point" in the pattern area is used as the origin point. The present origin point is displayed in the [Origin Value X = ] and [Origin Value Y = ] columns.

#### Reference

To measure the amount of error (deviation) from the reference position where the image is registered, select [Registered position].

### Selecting the Coordinate System for Position Adjustment

You can select the coordinate system using [Crd. system] on the [Detail] menu. If a position correction is not being done, this setting will have no effect on the output.

- **[Rel Pos]** (Default value): If the position of the window that is used as the source of correction has shifted, the amount of this error is reflected on the measurement.
- **[Abs Pos]:** The distance from the position "Origin point" is measured.

**Enabling the Pattern Window to be Detected****outside the Search Window.**

You can set this item using [Det. Outside SW] on the [Detail] menu.

- **Enable:** Pattern will be detected even if it is roughly 50% outside of the search window.
- **Disable** (default value): Pattern will be detected only within the search window.

**Eliminating Patterns based on Correlation Value**

You can specify this item using [Corr. Low Lmt] on the [Detail] menu.

This function is used as follows. When [Corr. Low Lmt] is set to 80, only those patterns having a correlation value of 80 or more are actually measured. Thus, you can eliminate the patterns that have a correlation value of less than 80. This function is convenient to use for preventing erroneous detection.

**Enabling the Pattern Window to be Detected****outside the Search Window.**

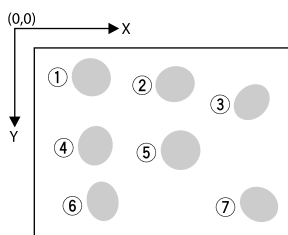
You can set this item using [Det. Outside SW] on the [Detail] menu.

- **Enable:** Pattern will be detected even if it is roughly 50% outside of the search window.
- **Disable** (default value): Pattern will be detected only within the search window.

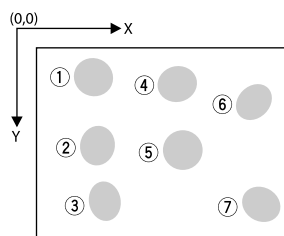
**The detected patterns can be sorted using the following methods:**

The pattern order can be assigned using [Det. Order] on the [Detail] menu.

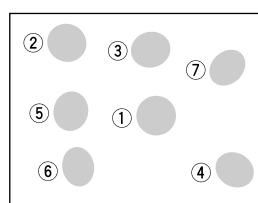
- **Y > X, ascending order** (Default value):



- **X > Y, ascending order**



- **Correlation value descending order:** Patterns are sorted in order starting from the pattern having the highest correlation value.

**Correlation value**

- ① 99.9
- ② 99.0
- ③ 98.2
- ④ 97.5
- ⑤ 95.9
- ⑥ 94.1
- ⑦ 92.4

**Specifying the pattern to be evaluated**

You can specify which pattern will use the set tolerances for evaluation using the [No.Patt Disp] on the [Detail] menu. [No. to Judge] from 1 to 16 can be set, but [1] is normally specified.

**Note**

Tolerances set in the [Limit Setup] menu can only be used for one pattern.

**Specifying the Maximum Number of Targets****Detected within the Measurement Area**

You can set the maximum number of targets using [No.Patt Det] on the [Detail] menu.

For example, when [3] is set, the pattern position of a up to 3 targets can be detected.

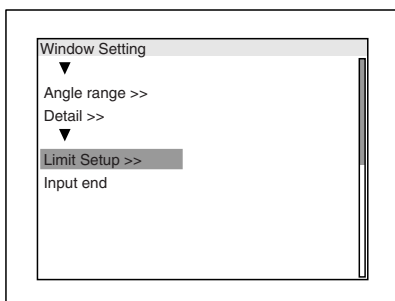


## 7. Setting the Limit Setup

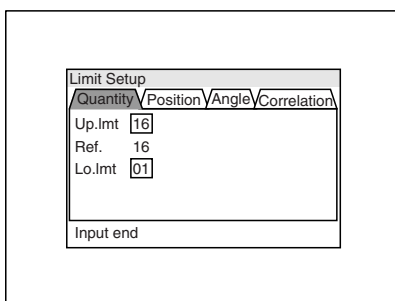
You can set the tolerance (upper and lower limits) for the measurement value.

If the measurement value exceeds the specified tolerance, an [NG] message is displayed. If it is within the specified tolerance, an [OK] is displayed.

### 1 Select [Limit Setup].



### 2 Move the [ENTER] button to the right or left to select an item for which you want to specify a tolerance.



### 3 Press the [ENTER] button to specify the upper and lower limit values of the tolerance.

The units of tolerance change depending on the type of measurement value.

- **[Quantity] (Number of detecting patterns)** : Number of patterns
- **[Position] (Detecting position coordinates of the pattern)**: Number of pixels (X/Y coordinates)
- **[Angle] (Tilt angle of pattern)**: Angle
- **[Correlation] (Correlation value of pattern)**: Numerical value in the range of 0 to 99.9.

### 4 To specify the tolerance of other measurement values, press the [ESCAPE] button and repeat Steps 2 and 3 as described above.

### 5 After completing the settings, press the [ESCAPE] button on the remote control console and select [Input end].

# Edge Position

4



Specifying the Units (Windows) for Inspections and Measurements

## What is the [Edge Position] Measurement Mode?

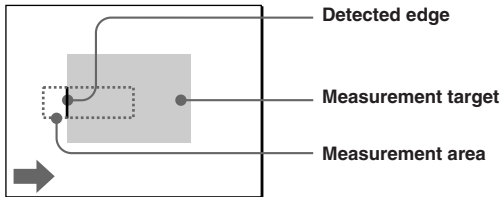
You can scan a target in the desired direction within a specified measurement area to detect the edge. The [Edge position] measurement mode enables you to measure the position of a specified edge among all detected edges.

Because edge detection is based on transitions from light to dark (or dark to light), not on the absolute value of the intensity, it is less affected by illumination fluctuation at the time the image is taken.

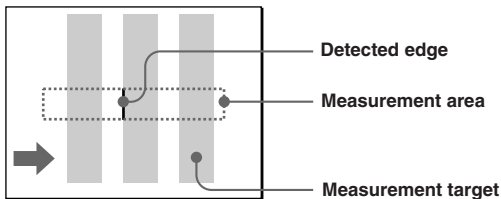
### Measurement image

#### Example: When the measurement area is a rectangle

- [Specified edge]: 1
- [Detect dir]: →
- [Edge dir]: Bright → Dark

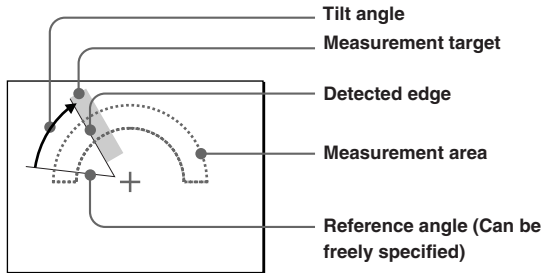


- [Specified edge]: 2
- [Detect dir]: →
- [Edge dir]: Bright → Dark



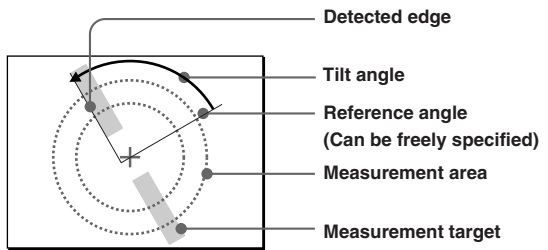
#### Example: When the measurement area is an arc

- [Specified edge]: 1
- [Detect dir]: ↻ (clockwise)
- [Edge dir]: Bright → Dark



#### Example: When the measurement is a ring

- [Specified edge]: 1
- [Detect dir]: ↻ (counterclockwise)
- [Edge dir]: Dark → Bright



## Measurement results

The measurement results that can be output in the edge position measurement mode are shown below.

### When the measurement area is a rectangle or rotated rectangle

- **Number of edges:** The number of detected edges is output.
- **Edge position coordinates (X, Y):** Edge position coordinates are output in units of pixels.
- **OK / NG:** If the measurement value exceeds the specified tolerance (upper and lower limits), an [NG] message is displayed. If it is within the specified tolerance, an [OK] message is displayed.

### When the measurement area is a ring or an arc

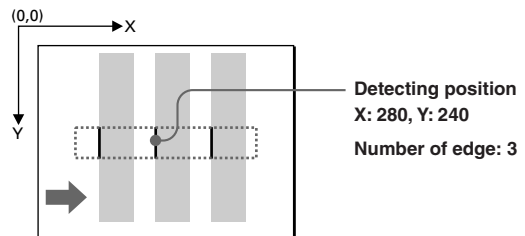
- **Number of edges:** The number of detected edges is output.
- **Tilt angle:** The difference between the reference angle and the angle of the detected edge is output.
- **OK / NG:** If the measurement value exceeds the specified tolerance (upper and lower limits), an [NG] message is displayed. If it is within the specified tolerance, an [OK] message is displayed.

## Sample of measurement

### When the measurement area is a rectangle

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

- [Specified edge]: 2
- [Detect dir]: →
- [Edge dir]: Bright → Dark



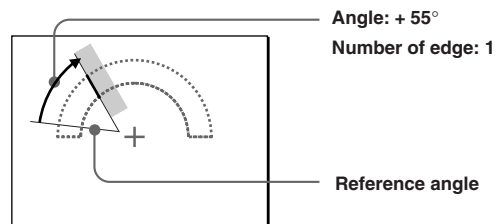
#### Reference

You can display the measurement value (position coordinates) in absolute size using the calibration function. For details, refer to "Displaying Measurement Values in Absolute Sizes (Calibration)" (page 6-3).

### When the measurement area is an arc

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

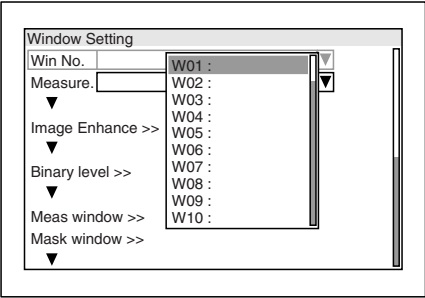
- [Specified edge]: 1
- [Detect dir]: ↻ (clockwise)
- [Edge dir]: Bright → Dark



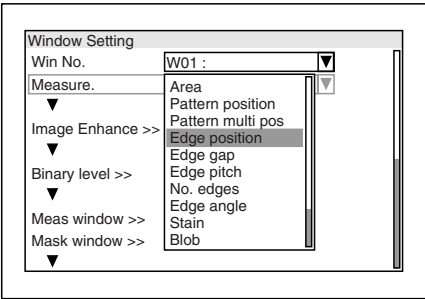
1. Selecting the Measurement Tool

Select the [Edge position] measurement mode.

1 Select the measurement window (page 4-20).

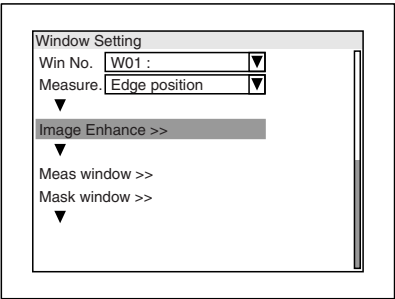


2 Select [Measure.] and then select [Edge position].



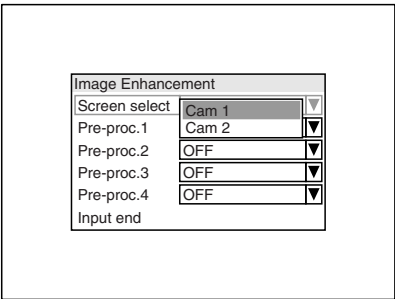
2. Selecting an Image Enhancement

1 Select [Image Enhance].

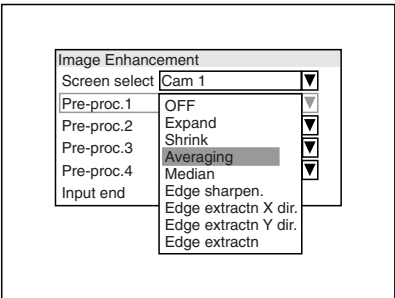


The [Image Enhancement] menu appears.

2 Select the camera that you want to use for an Image Enhancement.



3 Select the pre-processing number, then select the type of Image Enhancement that you want to perform.



Details of each enhancement are shown below.

**[OFF]** Pre-processing will not be executed.

**[Expand]** The white pixels are expanded and the black pixel noise is removed.

**[Shrink]** The white pixels are shrunk and the white pixel noise is removed.



**[Averaging]** Intensity is averaged to remove noise.

**[Median]** Noise is removed while the outline is maintained.

**[Edge sharpen.]**  
Region where there is a change in intensity is enhanced.

**[Edge extractn X dir.]**  
Region where there is a change in intensity in the horizontal (X) direction is extracted.

**[Edge extractn Y dir.]**  
Region where there is a change in intensity in the vertical (Y) direction is extracted.

**[Edge extractn]**  
Region where there is a change in intensity is extracted.

Refer to the “Filter List” (page 15-2) for an example showing the Image Enhancements.

**Multiple Image Enhancements can be set.**  
When multiple Image Enhancements are set, they are executed starting from Pre-processing 1.  
Example: Pre-processing 1 (shrink) → Pre-processing 2 (expand) → Pre-processing 3 (shrink) → Pre-processing 4 (expand)

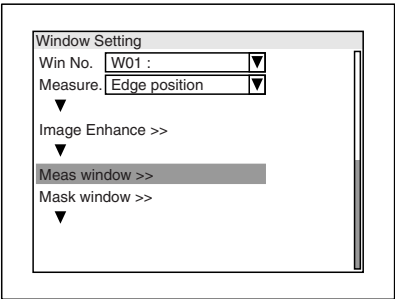
- 4
- To set multiple Image Enhancements, repeat Steps 3 and 4.
- 5
- After completing the settings, select [Input end].

### 3. Setting the Measurement Area

Within the captured image, the measurement window is set as follows.

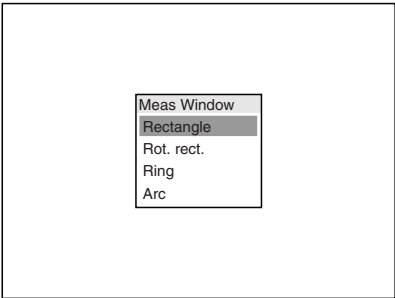
**Reference**  
If there are sections of the measurement area that you do not wish to detect, you can set a mask to hide the unwanted parts. For details, refer to “Hiding an unwanted area (mask window)” located after “Setting the Measurement Area”.

- 1
- Select [Meas window].



The [Meas window] menu appears.

- 2
- Select the shape of the measurement area.



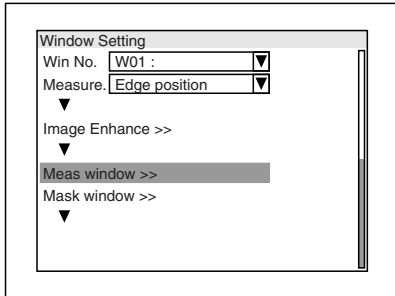
- 3
- Draw the measurement area.  
Refer to “Drawing a Measurement Window” (page 3-5) for details.
- 4
- After completing the drawing, press the [ESCAPE] key on the remote control console.



## Clearing the measurement area

You can clear the measurement area that has been set by following the procedure below.

### 1 Highlight [Meas window].

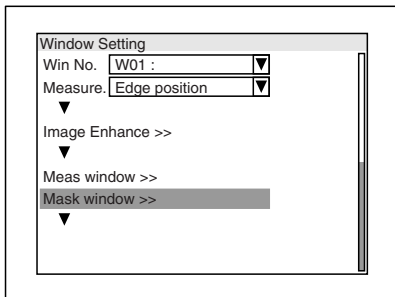


### 2 Press the [FNC] button on the remote control console and select [Clear].

## Hiding an unwanted area (mask window)

You can set an area (mask window) that will not be measured inside the measurement area. This function is useful when the measurement area has a complicated shape and you want to hide an unwanted area.

### Select [Mask window].



The [Mask Window] menu appears.

Refer to "Hiding the Measurement Window Partially (Mask Window)" (page 3-12) for the subsequent operations.

## Clearing the entire mask area

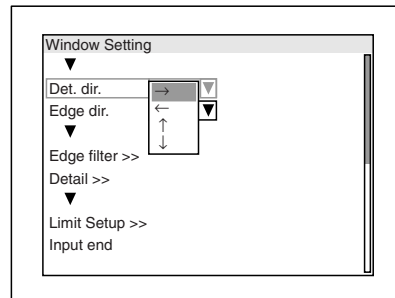
Move the cursor to [Mask Window], then press the [FNC] button on the remote control console and select [Clear].

## Clearing the shape of the mask area that has been set

Press the [FNC] button on the remote control console on the setting screen of the mask area, then select [Clear].

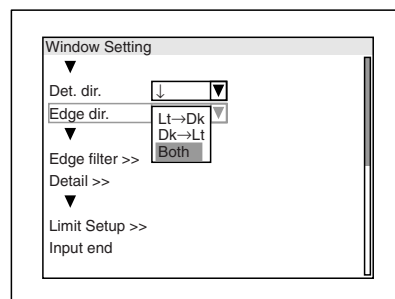
## 4. Setting the Detecting Direction / Edge Direction

### 1 Select [Det. dir.] and then select the direction to be detected.



- When the measurement area is a rectangle: →, ←, ↑, ↓
- When the measurement area is a rotated rectangle: ↓ (from top to bottom only)  
For this shape measurement window, edge can only be detected from top to bottom.
- When the measurement area is a ring or an arc: ↻ (clockwise), or ↺ (counter-clockwise)

### 2 Select [Edge dir.] and then select the edge direction to be detected.



- [Lt → Dk] (default): Detects the transition from light to dark.
- [Dk → Lt]: Detects the transition from dark to light.
- [Both]: Detects the transition from both light to dark and dark to light.



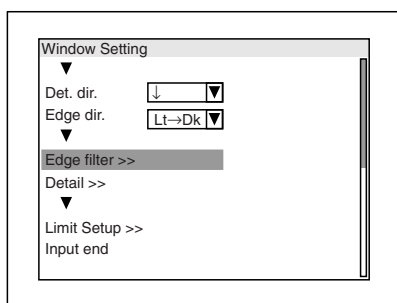
## 5. Setting the Detecting Conditions

### Reference

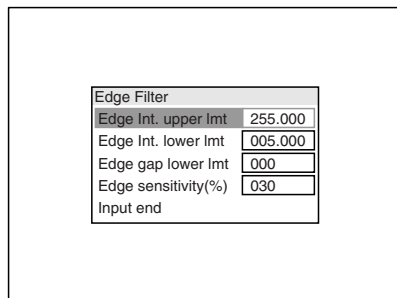
Edges are detected based on where transition in the 0 – 255 gray scale occur. Edge strength is the size of the transition (ex. Gray (50) to white (250) = Edge strength of 200). The [Edge int. upper lmt] and [Edge int. lower lmt] can be set to include or exclude edges based on the edge strength.

For details, refer to “What is an Edge?” (page 15-3).

### 1 Select [Edge filter].



### 2 Specify the necessary conditions.

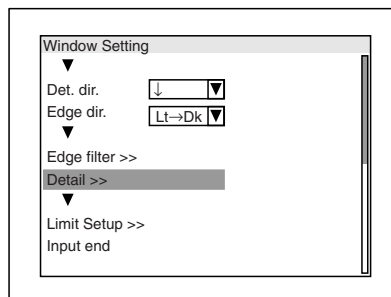


- **[Edge int. upper lmt]:** Specify the upper limit of edge strength that can be detected (Default: 255).
- **[Edge int. lower lmt]:** Specify the lower limit of edge strength that can be detected (Default: 5).
- **[Edge gap lower lmt]:** Specify the minimum distance between the edges pixels to help filter out noise (Default: 0).
- **[Edge sensitivity (%)]:** Specify the threshold value for recognizing edges (Default: 30).

### 3 After completing the settings, select [Input end].

## 6. Specifying the Detailed Conditions

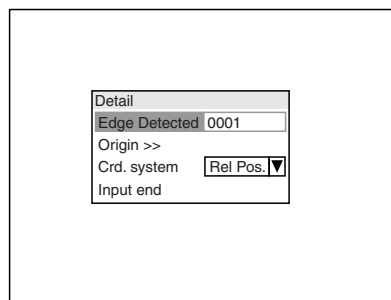
### 1 Select [Detail].



The [Detail] menu appears.

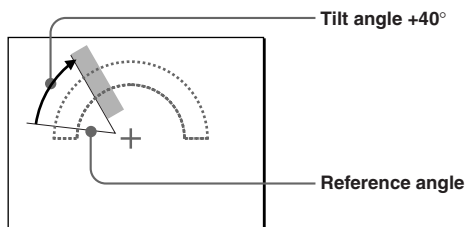
### 2 Make the necessary settings.

After completing the settings, select [Input end].



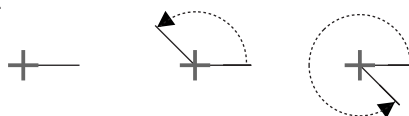
**Specify the position that will be used as the reference angles (only when the measurement area is a ring or an arc).**

You can specify the reference angle in the range of 0° to 359.99°. Normally, this value is set to 0°.



### Note

The reference angle should be specified using positive value in the counter-clockwise direction against the horizontal line as shown.



Reference angle 0°    Reference angle 135°    Reference angle 315°



### Reference

The reference angle that you are setting is indicated as an orange line on Process screen 1 displayed by pressing the [SCREEN] button on the remote control console. When setting the reference angle, it is convenient to make the menu transparent by pressing the [VIEW] button on the remote control console.

### Specify the edge to be measured

Specify the measured edge using [Edge Detected] on the [Detail] menu.

Selected edges are numbered in the order specified in the Detection direction. If you specify a negative value for the Detection direction, the edges are numbered in the reverse order of the Edge Detected.

### Changing the reference position of the origin (only when the measurement area is a rectangle)

Specify the reference position of the origin in [Origin] on the [Detail] menu.

Make the necessary settings on the [Origin Selection] menu displayed.

- **Designate origin point** (Default): The origin is set at the top left position on the screen by default. However, you can freely specify the origin point by first selecting [Origin Pt.Select]. Move the "+" cursor to the position where you want to set the origin point, and then press the [ESCAPE] button. The coordinates of the set position are displayed in the [Origin Value X = ] and [Origin Value Y = ] columns.
- **Registered position:** Use the detected position in the registered image as an origin. The current origin position is displayed in the [Origin Value X = ] and [Origin Value Y = ] columns.

### Reference

Select [Reference position] to measure the deviation based on the position of the registered image.

### Selecting the Coordinate System for Position Adjustment (only when the measurement area is [Rectangle])

You can select the coordinate system using [Crd. system] on the [Detail] menu. If a position correction is not being done, this setting will have no effect on the output.

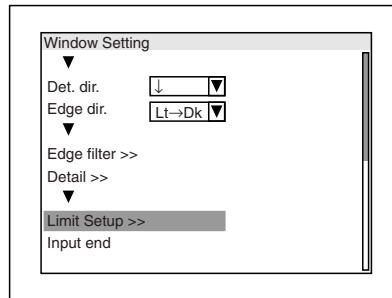
- **[Rel Pos]** (Default): If the position of the position deviates, the measurement is performed on the corrected position.
- **[Abs Pos]**: The measurement is performed on the origin position specified above.

## 7. Setting the Limit Setup

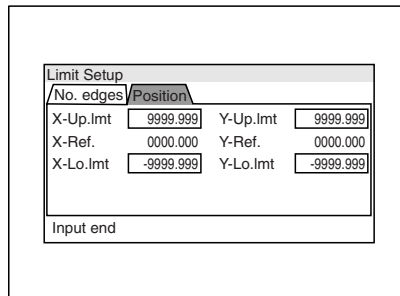
You can set the tolerance (upper and lower limits) for the measured value.

If the measured value exceeds the specified tolerance, an [NG] message is displayed. If it is within the specified tolerance, an [OK] message is displayed.

### 1 Select [Limit Setup].



### 2 Move the [ENTER] button to the right or left to select an item for which you want to specify a tolerance.



### 3 Press the [ENTER] button to specify the upper and lower limit values of the tolerance.

The contents of the limit setup and units of tolerance are different depending on the shape of the measurement area.

- **[No. edges]**: The number of edges
- **[Position]** (Measurement value of the edge): Pixels (only when the measurement area is a rectangle or a rotated rectangle)
- **[Angle]** (tilt angle): Angle (only when the measurement area is a ring or an arc).

### 4 To specify the tolerance of another measured values, press the [ESCAPE] button and repeat Steps 2 and 3 as described above.

### 5 After completing the settings, press the [ESCAPE] button on the remote control console and select [Input end].

# Edge Gap

## What Is the [Edge gap] Measurement Mode?

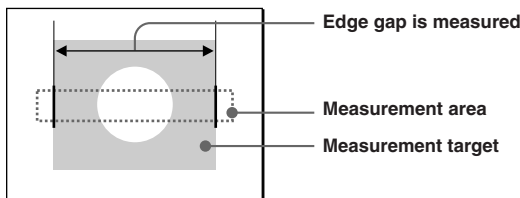
You can scan a target in the desired direction within the specified measurement area to detect multiple edges. The [Edge gap] measurement mode enables you to measure the distance between two edges.

Because edge detection is based on transitions from light to dark (or dark to light), not on the absolute value of the intensity, it is less affected by illumination fluctuation at the time the image is taken.

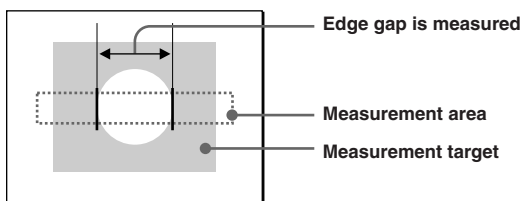
### Measurement image

**Example: When the measurement area is a rectangle or a rotated rectangle**

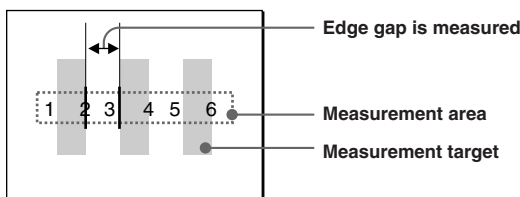
- When [Outer diameter] is specified for measurement



- When [Inner diameter] is specified for measurement

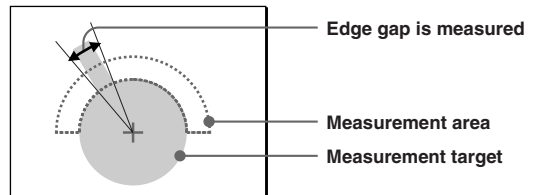


- When [Specified edge] (example:  $2 \geq 3$ ) is specified for measurement

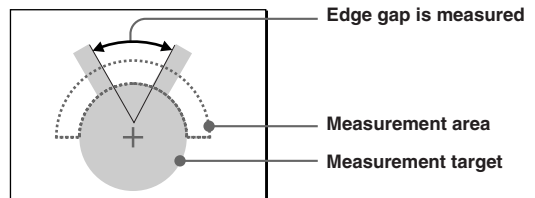


**Example: When the measurement area is a ring or an arc**

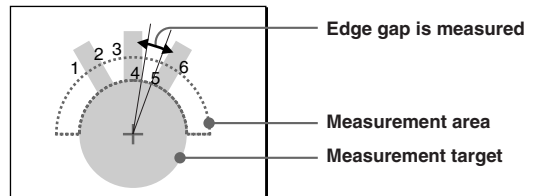
- When [Outer diameter] is specified for measurement



- When [Inner diameter] is specified for measurement



- When [Specified edge] (example:  $4 \geq 5$ ) is specified for measurement



### Measurement results

The measurement results that can be output in the [Edge gap] mode

**When the measurement area is a rectangle or a rotated rectangle**

- [No. edge]:** The number of detected edges is output.
- [Edge gap] (X or Y):** The distance between edges is output in units of pixels.
- OK / NG:** If the measurement value exceeds the specified tolerance (upper and lower limits), an [NG] message is displayed. If it is within the specified tolerance, an [OK] message is displayed.

**When the measurement area is a ring or an arc**

- [No. edge]:** The number of detected edges is output.
- [Edge angle]:** The angle between edges is output.
- OK / NG:** If the measurement value exceeds the specified tolerance (upper and lower limits), an [NG] message is displayed. If it is within the specified tolerance, an [OK] message is displayed.

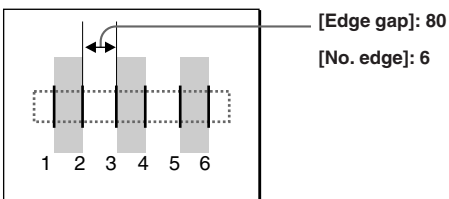


## Sample measurement

### When the measurement area is a rectangle

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

- [Det. dir.]: →
- [Edge dir.]: Both
- [Edge Detected 1]: 2
- [Edge Detected 2]: 3



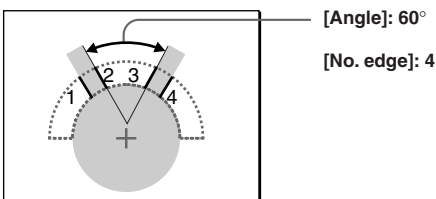
#### Reference

You can display the measurement value (Edge gap) in absolute size using the calibration function. For details, refer to "Displaying Measurement Values in Absolute Sizes (Calibration)" (page 6-3).

### When a measurement area is an arc

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

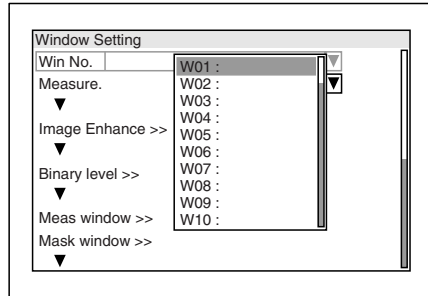
- [Det. dir.]: ↻ (clockwise)
- [Edge dir.]: Both
- [Edge Detected 1]: 2
- [Edge Detected 2]: 3



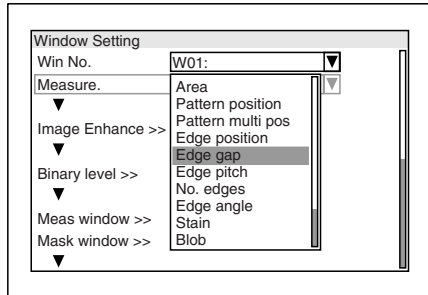
## 1. Selecting the Measurement Tool

Select the [Edge gap] measurement mode.

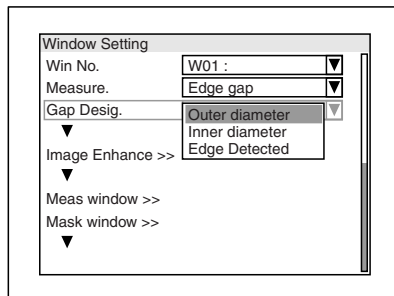
### 1 Select the measurement window. (page 4-20)



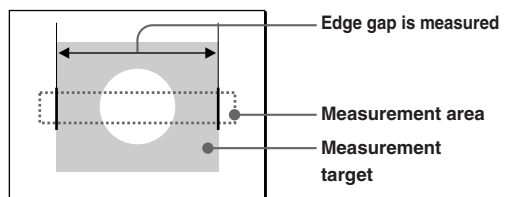
### 2 Select [Measure] and then select [Edge gap].



### 3 Select [Gap Desig.] and then select the type of Edge gap to be used for detection.

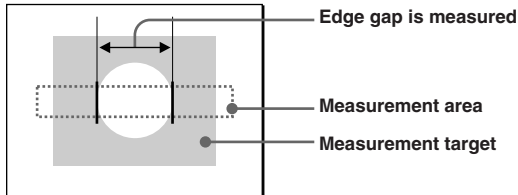


- **Outer diameter** (Default value): The distance between the outermost edges within the window.

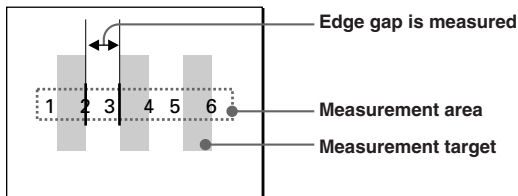




- **Inner diameter:** The distance between the innermost edges within the window is measured.

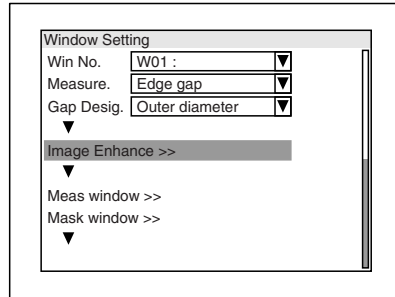


- **Specified edge:** The gap between the specified edges is measured.



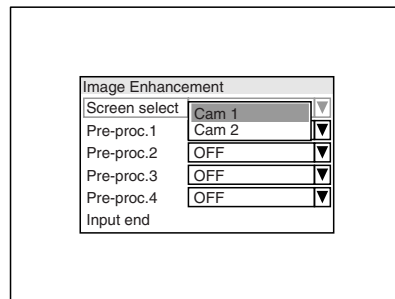
## 2. Selecting an Image Enhancement

### 1 Select [Image Enhance].

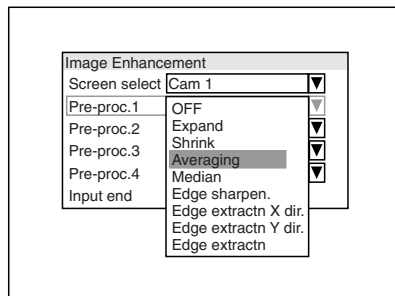


The [Image Enhancement] menu appears.

### 2 Select the camera that you want to use for an Image Enhancement.



### 3 Select the pre-processing number, then select the type of Image Enhancement that you want to perform.



Details of each enhancement are shown below.

**[OFF]** Pre-processing will not be executed.

**[Expand]** The white pixels are expanded and the black pixel noise is removed.

**[Shrink]** The white pixels are shrunk and the white pixel noise is removed.



[Averaging] Intensity is averaged to remove noise.

[Median] Noise is removed while the outline is maintained.

[Edge sharpen.]  
Region where there is a change in intensity is enhanced.

[Edge extractn X dir.]  
Region where there is a change in intensity in the horizontal (X) direction is extracted.

[Edge extractn Y dir.]  
Region where there is a change in intensity in the vertical (Y) direction is extracted.

[Edge extractn]  
Region where there is a change in intensity is extracted.

Refer to the “Filter List” (page 15-2) for an example showing the Image Enhancements.

**Multiple Image Enhancements can be set.**

When multiple Image Enhancements are set, they are executed starting from Pre-processing 1.

Example: Pre-processing 1 (shrink) → pre-processing 2 (expand) → pre-processing 3 (shrink) → pre-processing 4 (expand)

**4 To set multiple Image Enhancements, repeat Steps 3 and 4.**

**5 After completing the settings, select [Input end].**

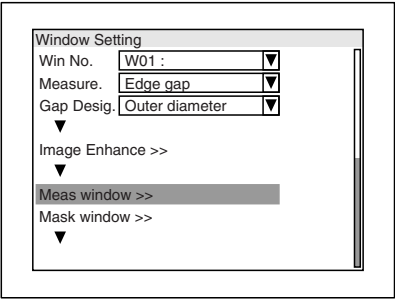
**3. Setting the Measurement Area**

Within the captured image, the measurement window is set as follows.

**Reference**

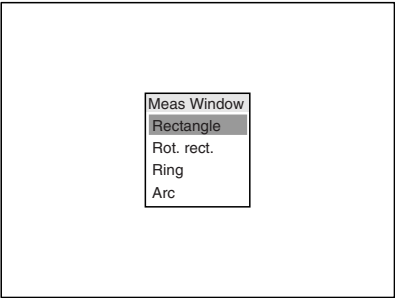
If there are sections of the measurement area that you do not wish to detect, you can set a mask to hide the unwanted parts. For details, refer to “Hiding an unwanted area (mask window)” located after “Setting the Measurement Area”.

**1 Select [Meas window].**



The [Meas window] menu appears.

**2 Select the shape of the measurement area.**



**3 Draw the measurement area.**

Refer to “Drawing a Measurement Window” (page 3-5) for details.

**4 After completing the drawing, press the [ESCAPE] key on the remote control console.**

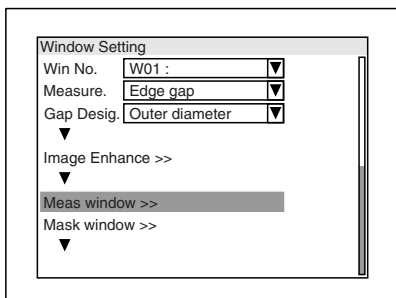




## Clearing the measurement area

You can clear the measurement area that has been set by following the procedure below.

### 1 Highlight [Meas window].

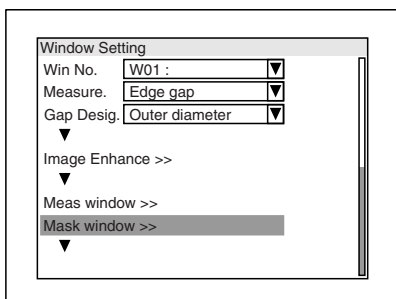


### 2 Press the [FNC] button on the remote control console and select [Clear].

## Hiding an unwanted area (mask window)

You can set an area (mask window) that will not be measured inside the measurement area. This function is useful when the measurement area has a complicated shape and you want to hide an unwanted area.

### Select [Mask window].



The [Mask Window] menu appears.

Refer to "Hiding the Measurement Window Partially (Mask Window)" (page 3-12) for the subsequent operations.

### Clearing the entire mask area

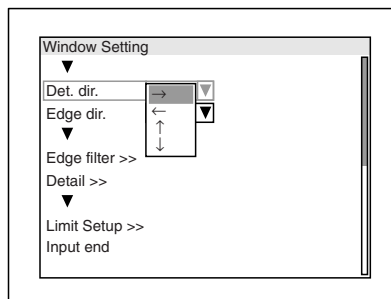
Move the cursor to [Mask Window], then press the [FNC] button on the remote control console and select [Clear].

### Clearing the shape of the mask area that has been set

Press the [FNC] button on the remote control console on the setting screen of the mask area, then select [Clear].

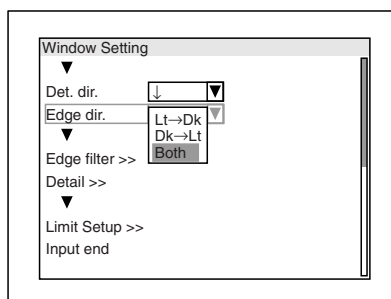
## 4. Setting the Detecting Direction / Edge Direction

### 1 Select [Det. dir.] and then select the direction to be detected.



- When the measurement area is a rectangle: →, ←, ↑, ↓
- When the measurement area is a rotated rectangle: ↓ (From the top to bottom only)  
For this shape measurement window, edge can only be detected from top to bottom.
- When the measurement area is a ring or an arc: ↻ (clockwise), or ↺ (counter-clockwise)

### 2 Select [Edge dir.] and then select the edge direction to be detected.



- [Lt → Dk]: Detects the transition from light to dark.
- [Dk → Lt]: Detects the transition from dark to light.
- [Both]: Detects the transition from both light to dark and dark to light.

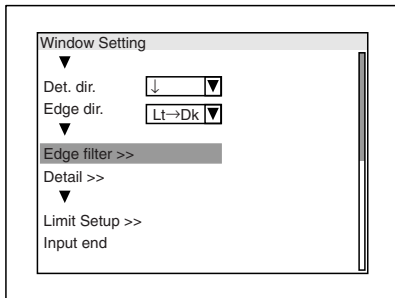
## 5. Setting the Detecting Conditions

### Reference

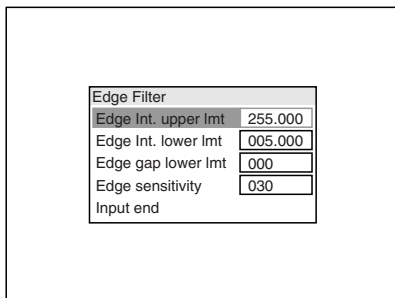
Edges are detected based on where transition in the 0 – 255 gray scale occur. Edge strength is the size of the transition (ex. Gray (50) to white (250) = Edge strength of 200). The [Edge int. upper lmt] and [Edge int. lower lmt] can be set as the upper limit value and the lower limit value.

For details, refer to “What is an Edge?” (page 15-3).

### 1 Select [Edge filter].



### 2 Specify the necessary conditions.

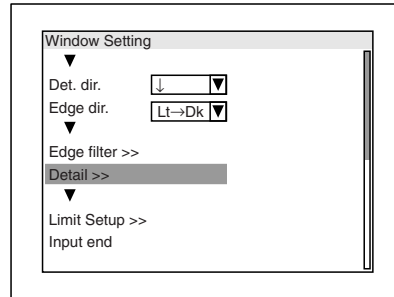


- **[Edge int. upper lmt]:** Specify the upper limit of edge strength that can be detected (Default: 255).
- **[Edge int. lower lmt]:** Specify the lower limit of edge strength that can be detected (Default: 5).
- **[Edge gap lower lmt] (in pixel):** Specify the minimum distance between the edges pixels to help filter out noise (Default: 0).
- **[Edge sensitivity] (in %):** Specify the threshold value for recognizing edges (Default: 30).

### 3 After completing the settings, select [Input end].

## 6 Specifying the Detailed Conditions

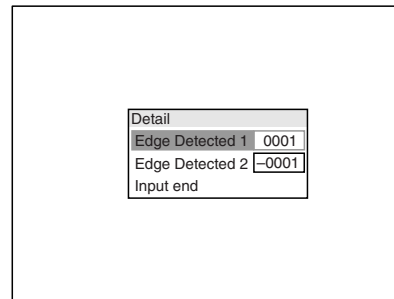
### 1 Select [Detail].



The [Detail] menu appears.

### 2 Make the necessary settings.

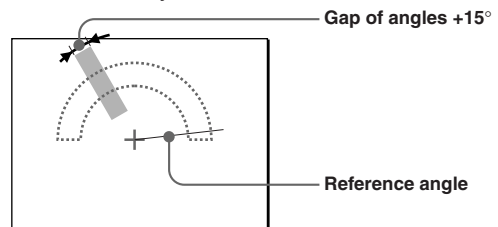
After completing the settings, select [Input end]



**Specify the position that will be used as the reference angles (only when the measurement area is a ring or an arc).**

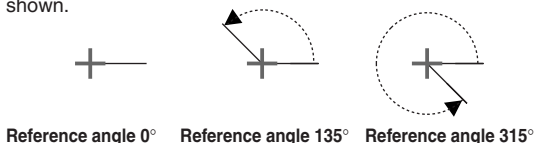
You can specify the position using [Reference angle] on the [Details] screen.

You can specify the reference angle in the range of 0° to 359.99°. Normally, this value is set to 0°.



### Note

The reference angle should be specified using positive value in the counter-clockwise direction against the horizontal line as shown.





### Reference

The reference angle that you are setting is indicated as an orange line on Process screen 1 displayed by pressing the [SCREEN] button on the remote control console. When setting the reference angle, it is convenient to make the menu transparent by pressing the [VIEW] button on the remote control console.

### Use the edge numbers to specify the starting point and ending point of the measurement.

Specify the starting point by using [Edge Detected 1] on the [Detail] menu and specify the ending point by using [Edge Detected 2] on the same menu.

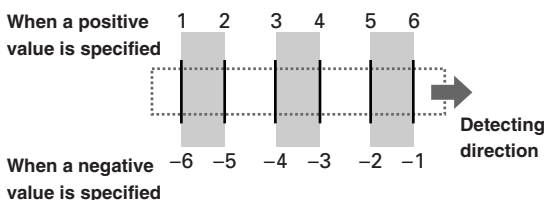
### Note

This function is valid only when [Edge Detected] is selected in the mode selection (page 4-50).

### Reference

When a negative value is specified in [Edge Detected 2], you can specify the number in the reverse direction starting from the last edge or reference angle. This technique is convenient when there is a large number of edges.

Example: If “-3” is specified in [Edge Detected 2] when the detecting direction “→”, the third edge from the right is specified as the end point.

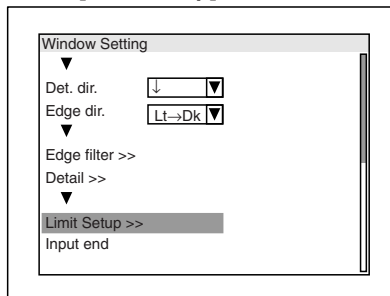


## 7. Setting the Limit Setup

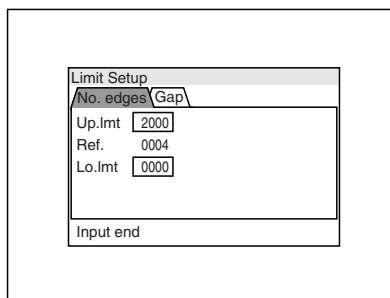
You can set the tolerance (upper and lower limits) for the measurement value.

If the measurement value exceeds the specified tolerance, an [NG] message is displayed. If it is within the specified tolerance, an [OK] message is displayed.

### 1 Select [Limit Setup].



### 2 Move the [ENTER] button to the right or left to select an item for which you want to specify the tolerance.



### 3 Press the [ENTER] button to specify the lower and upper limit values of the tolerance.

The contents of the evaluation conditions and units of tolerance are different depending on the shape of the measurement area.

- **[No. edge]:** The number of edges
- **[Gap] (Edge gap):** Pixels (only when the measurement area is a rectangle or a rotated rectangle)
- **[Angle gap] (Angle between edges):** Angle (only when the measurement area is a ring or an arc.)

### 4 To specify the tolerance of another measurement values, press the [ESCAPE] button and repeat Steps 2 and 3 as described above.

### 5 After completing the settings, press the [ESCAPE] button on the remote control console and select [Input end].

# Edge Pitch

4



## What Is the [Edge Pitch] Measurement Mode?

Within a specified measurement area, multiple edges can be detected in a selected direction.

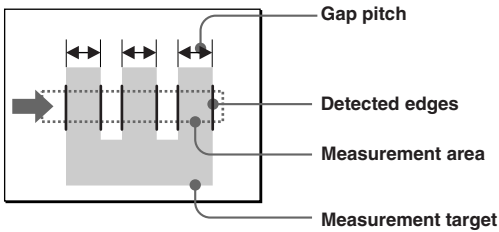
The [Edge Pitch] measurement mode measures the maximum values, minimum values and average values of the distances between multiple edges.

Because edge detection is based on transitions from light to dark (or dark to light), not on the absolute value of the intensity, it is less affected by illumination fluctuation.

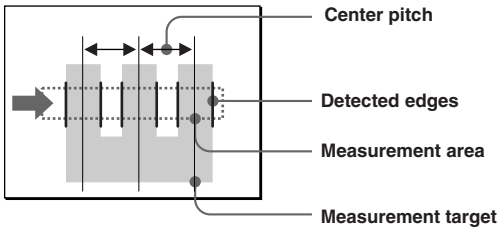
### Measurement image

**Example: When the measurement area is a rectangle**

- Example of measuring the gap pitch

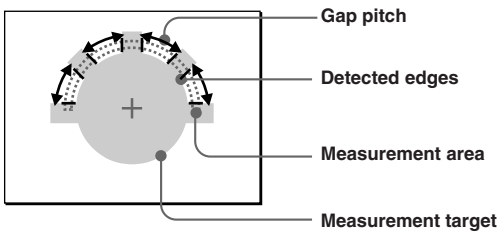


- Example of measuring the center pitch

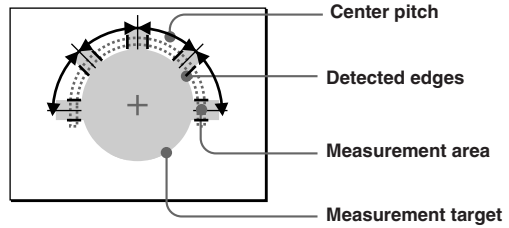


**Example: When the measurement area is a ring or an arc**

- Example of measuring the gap pitch



- Example of measuring the center pitch



### Measurement result to be output

The measurement results that can be output in the Edge pitch measurement mode are shown below.

**When the measurement area is a rectangle**

- **[No. pitches]:** The number of detected pitches is output.
- **[Edge pitch]:** The edge pitch is output in units of number of pixels.
- **OK / NG:** If the measurement value exceeds the specified tolerance (upper and lower limits), a [NG] message is displayed. If it is within the specified tolerance, a [OK] message is displayed.

**When the measurement area is a ring or an arc**

- **[No. pitches]:** The number of detected pitches is output.
- **Edge pitch angle:** The angle of the edge pitch is output.
- **OK / NG:** If the measurement value exceeds the specified tolerance (upper or lower limits), a [NG] message is displayed. If it is within the specified tolerance, a [OK] message is displayed.

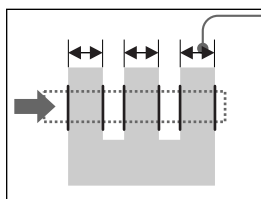


## Sample of measurement

### When the measurement area is a rectangle

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

- Detection of pitch: Gap pitch
- Direction of detection: →
- Direction of edges: Both



Pitch width:

- Maximum value: 100
- Minimum value: 90
- Average value: 95

Number of pitches: 3

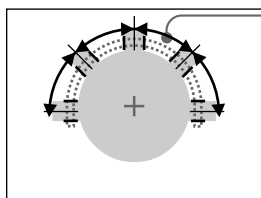
#### Reference

Displaying the measurement value (Pitch gap) in absolute size can be accompanied using the calibration function. For details, refer to “Displaying Measurement Values in Absolute Sizes (Calibration)” (page 6-3).

### When the measurement area is a ring or an arc

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

- Detection of pitch: Center pitch
- Direction of detection: ↻ (counter-clockwise)
- Direction of edges: Both



Pitch gap angle:

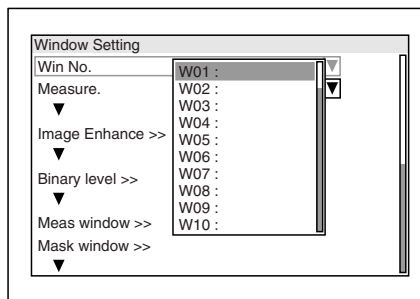
- Maximum value: 47°
- Minimum value: 44°
- Average value: 45°

Number of pitches: 5

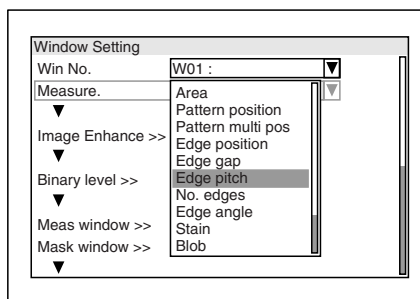
## 1. Selecting the Measurement Tool

Select the [Edge pitch] measurement mode.

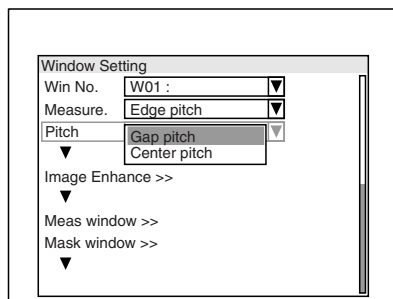
### 1 Select the measurement window. (page 4-20)



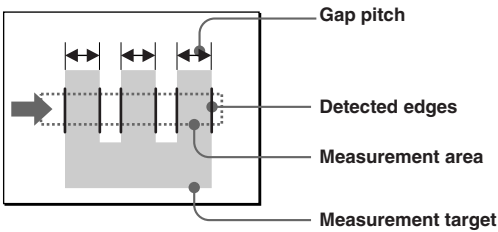
### 2 Select [Measure] and then select [Edge pitch].



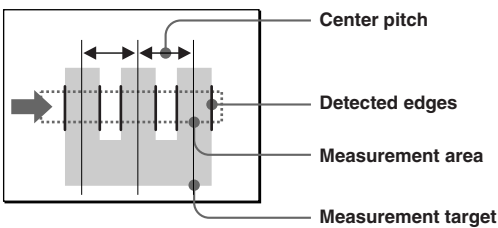
### 3 Select [Pitch.] and then select the type of edge pitch to be used for detection.



- **Gap pitch** (default value): The maximum value, minimum value and average value of the distances are measured. Measurements are made from odd-numbered edges to even-numbered edges in a specified direction.

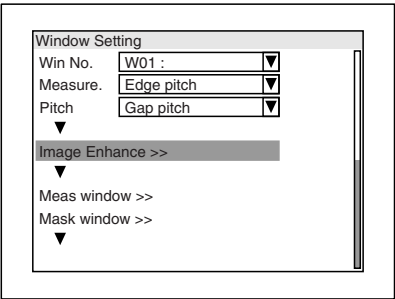


- **Center pitch**: The maximum value, minimum value and average value of the distance between the midpoint of the odd-numbered and even-numbered edges is measured.



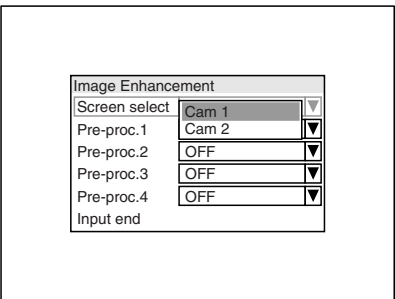
## 2. Selecting the Pre-processing Method of Images

### 1 Select [Image enhance].

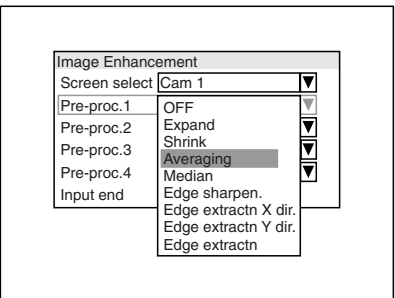


The [Image enhancement] menu appears.

### 2 Select the camera that you want to have an Image Enhancement.



### 3 Select the pre-processing number, then select Image Enhancement that you want to perform.



The contents of each process are shown below.

**[OFF]** Pre-processing will not be executed.

**[Expand]** The white pixels are expanded and the black pixel noise is removed.

**[Shrink]** The white pixels are shrunk and the white pixel noise is removed.



**[Averaging]** Intensity is averaged to remove noise.

**[Median]** Noise is removed while the outline is maintained.

**[Edge sharpen.]**

Region where there is a change in intensity is enhanced.

**[Edge extractn X dir.]**

Region where there is a change in intensity in the horizontal (X) direction is extracted.

**[Edge extractn Y dir.]**

Region where there is a change in intensity in the vertical (Y) direction is extracted.

**[Edge extractn]**

Region where there is a change in intensity is extracted.

Refer to the "Filter List" (page 15-2) for an example showing the Image Enhancements.

#### Multiple Image Enhancements can be set.

When multiple Image Enhancements are set, they are executed starting from Pre-processing 1.

Example: Pre-processing 1 (shrink) → Pre-processing 2 (expand) → Pre-processing 3 (shrink) → Pre-processing 4 (expand)

**4 To set multiple Image Enhancements, repeat Steps 3 and 4.**

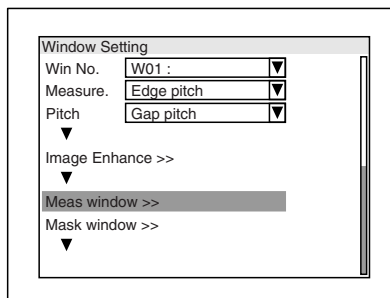
**5 After completing the settings, select [Input end].**

## 3. Setting the Measurement Area

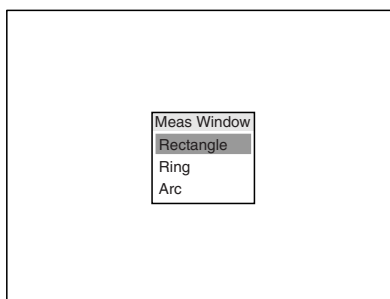
### Reference

If the measurement area has a complicated shape, you can set the mask to hide the unwanted parts. For details, refer to "Hiding an unwanted area (mask window)".

### 1 Highlight [Meas window]



### 2 Select the desired shape of the measurement area.



### 3 Draw the measurement area.

Refer to "Drawing a Measurement Window" (page 3-5) for details.

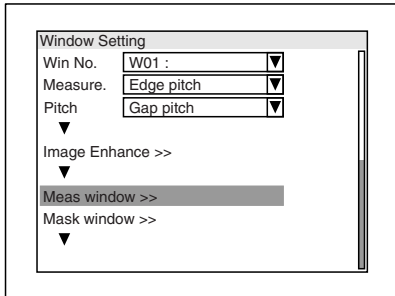
### 4 After completing the drawing, press the [ES-CAPE] button on the remote control console.



## Clearing the measurement area

You can clear the specified measurement area that has been set by following the procedure below.

### 1 Highlight [Meas window].

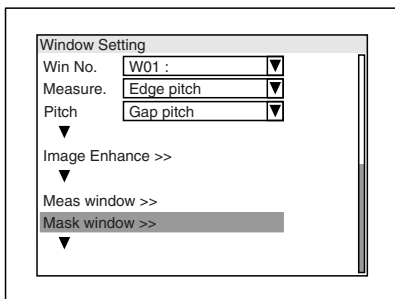


### 2 Press the [FNC] button on the console and select [Clear].

## Hiding an unwanted area (mask window)

You can set an area (mask window) that will not be measured inside the measurement area. This function is useful when the measurement area has a complicated shape and you want to hide an unwanted parts.

### Select [Mask window].



The [Mask Window] menu appears.

Refer to "Hiding the Measurement Window Partially (Mask Window)" (page 3-12) for the subsequent operations.

### Clearing the entire area of the mask window

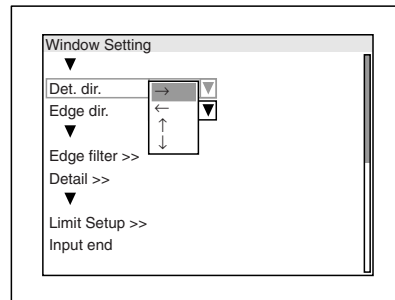
Move the cursor to the [Mask window]. Press the [FNC] button on the console on the setting screen of the mask window, then select [Clear].

### Clearing the shape of the mask window that has been set

Press the [FNC] button on the remote control console on the setting screen of the mask window, then select [Clear].

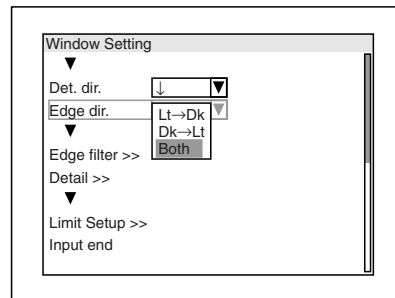
## 4. Setting the Detecting Direction / Edge Direction

### 1 Select [Det. dir] , and then select the direction to be detected.



- When the measurement area is a rectangle: →, ←, ↑, ↓
- When the measurement area is a ring or an arc: ↻ (clockwise), or ↺ (counter-clockwise)

### 2 Select [Edge dir] and then select the edge direction to be detected.



- **Lt → Dk**: Detects the transition for light to dark.
- **Dk → Lt**: Detects the transition from dark to light.
- **Both** (default): Detects transitions from both light to dark and dark to light.



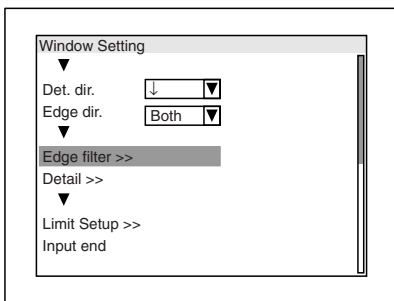
## 5. Setting the Detecting Conditions

### Reference

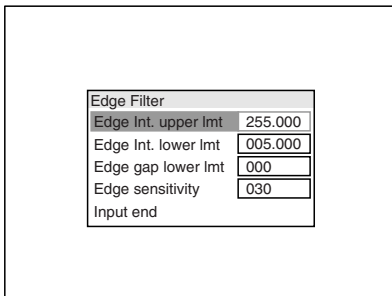
Edges are detected based on where transition in the 0-255 gray scale occur. Edge strength is the size of the transition (ex.Gray (50) to white (250) = Edge strength of 200). The [Edge int. upper lmt] and [Edge int. lower lmt] can be set to include or exclude edges based on the edge strength.

For details, refer to "What is an Edge?" (page 15-3).

### 1 Select [Edge filter].



### 2 Specify the necessary conditions.

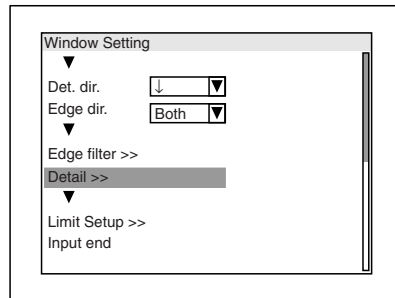


- **[Edge Int. upper lmt]:** Specify the upper limit of edge strength that can be detected (Default: 255).
- **[Edge Int. lower lmt]:** Specify the lower limit of edge strength that can be detected (Default: 5).
- **[Edge gap lower lmt] (in pixel):** Specify the minimum distance between the edges pixels to help filter out noise (Default: 0).
- **[Edge sensitivity] (in %):** Specify the threshold value for recognizing edges (Default: 30).

### 3 After completing the settings, select [Input end].

## 6 Specifying the Detailed Conditions

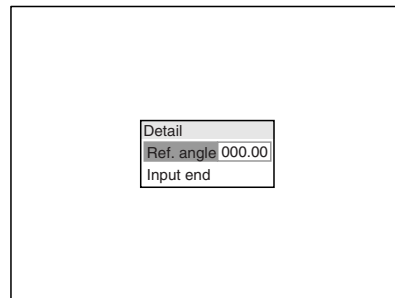
### 1 Select [Detail].



The [Detail] menu appears.

### 2 Make the necessary settings.

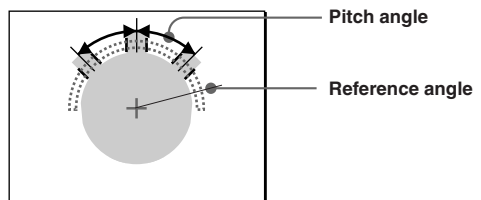
After completing the settings, select [Input end].



**Specify the position that will be used as the reference angles (only when the measurement window is a ring or an arc).**

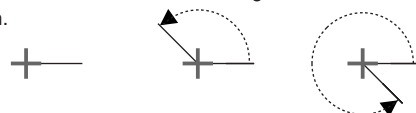
You can specify the position using [Ref. angle] on the [Detail] screen.

You can specify the reference angle in the range of 0° to 359.99°. Normally, this value is set to 0°.



### Note

The reference angle should be specified using positive value in the counter-clockwise direction against the horizontal line as shown.



Reference angle 0°    Reference angle 135°    Reference angle 315°

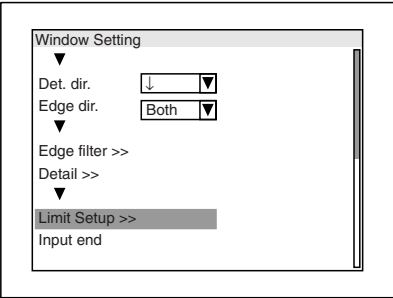
Reference

The reference angle that you are setting is indicated as an orange line on Process screen 1 displayed by pressing the [SCREEN] button on the remote control console. When setting the reference angle, it is convenient to make the menu transparent by pressing the [VIEW] button on the remote control console.

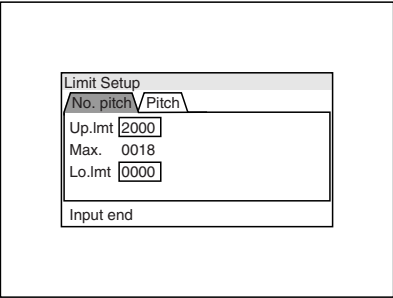
7. Setting the Limit Setup

You can set the tolerance (upper and lower limits) for the measurement value.  
If the measurement value exceeds the specified tolerance, a [NG] message is displayed. If it is within the specified tolerance, a [OK] message is displayed.

1 Select [Limit Setup].



2 Move the [ENTER] button to the right or left to select an item for which you want to specify a tolerance.



3 Press the [ENTER] button to specify the lower and upper limit values of the tolerance.

The contents of the judging conditions and units of tolerance are different depending on the shape of the measurement area.

- [No. pitch]: The number of edge pitches
- [Pitch]: The number of pixels (rectangle only)
- [Pitch angle]: Angle (only when the measurement area is a ring or an arc)

4 To specify the tolerance of another measured values, press the [ESCAPE] button and repeat Steps 2 and 3 as described above.

5 After completing the settings, press the [ESCAPE] button on the remote control console and select [Input end].

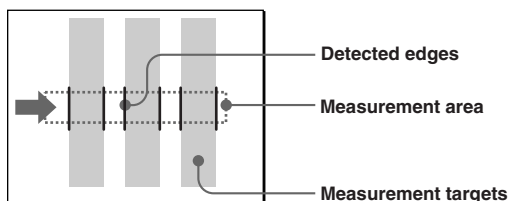


## What Is the [No. edges] Measurement Mode?

Within a specified measurement area, multiple edges can be detected in a specified direction. The [No. edges] measurement mode enables the number of edges to be counted.

Because edge detection is based on transmission from light to dark (or dark to light) not on the absolute value of the intensity, it is less affected by illumination fluctuation.

### Measurement image



### Measurement result to be output

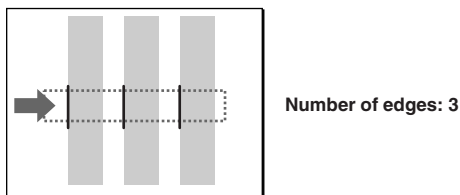
The measurement results that can be output in the Number of edges measurement mode are shown below.

- **[No. edges]:** The number of detected edges is output.
- **OK / NG:** If the measurement value exceeds the specified tolerance (upper or lower limits), a [NG] message is displayed. If it is within the specified tolerance, a [OK] message is displayed.

### Sample of measurement

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

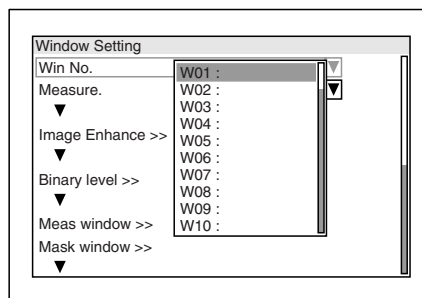
- Direction of edges: →
- Direction of edge detection: Lt → Dk



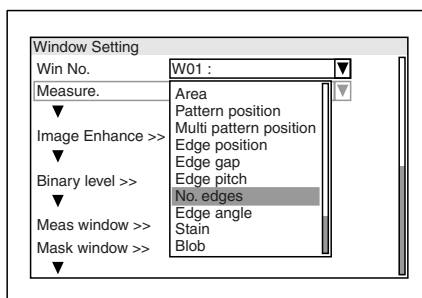
## 1. Selecting the Measurement Tool

Select the [No. edges] measurement mode.

### 1 Select the measurement window. (page 4-20)



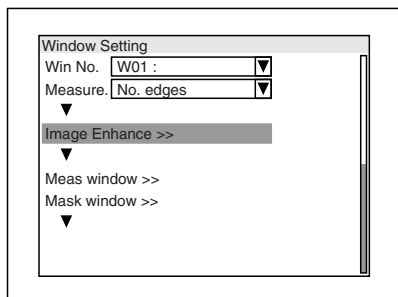
### 2 Select [Measure.] and then select [No. edges].





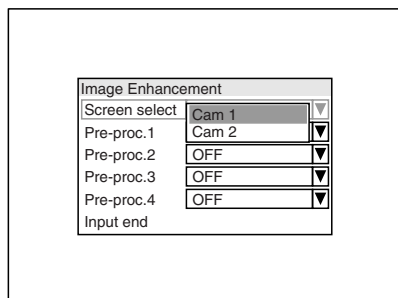
## 2. Selecting the Pre-processing Method of Images

### 1 Select [Image Enhance].

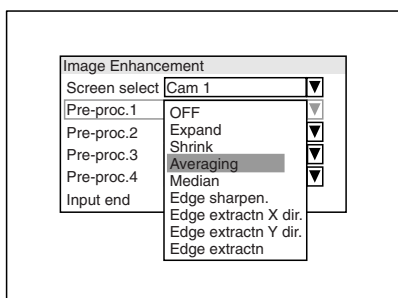


The [Image Enhancement] screen appears.

### 2 Select the camera that you want to use for pre-processing.



### 3 Select the pre-processing number, then select the pre-processing methods that you want to perform.



The contents of each process are shown below.

<b>OFF</b>	Pre-processing will not be executed.
<b>Expand</b>	The white pixels are expanded and the black pixel noise is removed.
<b>Shrink</b>	The white pixels are shrunk and the white pixel noise is removed.

---

**Averaging** Intensity is averaged to remove noise.

---

**Median** Noise is removed while the outline is maintained.

#### Edge sharpen

Region where there is a change in intensity is enhanced.

#### Edge extractn X dir.

Region where there is a change in intensity in the horizontal (X) direction is extracted.

#### Edge extractn Y dir.

Region where there is a change in intensity in the vertical (Y) direction is extracted.

#### Edge extractn

Region where there is a change in intensity is extracted.

---

Refer to the "Filter List" (page 15-2) for an example showing the Image Enhancements.

#### Multiple Image Enhancements can be set.

When multiple Image Enhancements are set, they are executed starting from Pre-processing 1.

Example: Pre-processing 1 (shrink) → Pre-processing 2 (expand) → Pre-processing 3 (shrink) → Pre-processing 4 (expand)

### 4 To set multiple Image Enhancements, repeat Steps 3 and 4.

### 5 After completing the settings, select [Input end].

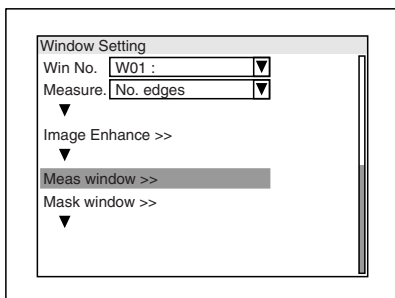


### 3. Setting the Measurement Area

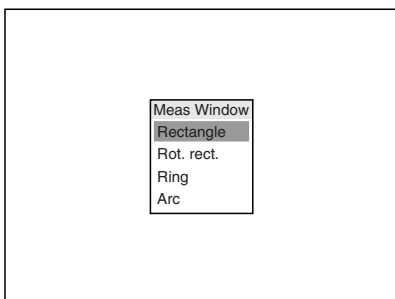
#### Reference

If the measurement area has a complicated shape, you can set the mask to hide the unwanted parts. For details, refer to “Hiding an unwanted area (mask window)”.

#### 1 Highlight [Meas window]



#### 2 Select the desired shape of the measurement area.



#### 3 Draw the measurement window.

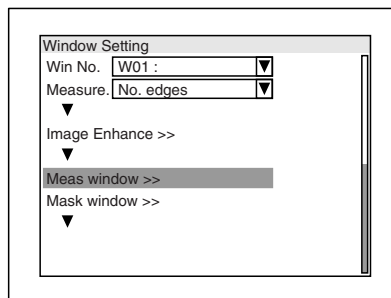
Refer to “Drawing a Measurement Window” (page 3-5) for details.

#### 4 After completing the drawing, press the [ES-CAPE] button on the remote control console.

### Selecting another shape for measurement/ Clearing the measurement area

You can clear the specified measurement area that has been set by following the procedure below.

#### 1 Highlight [Meas window].

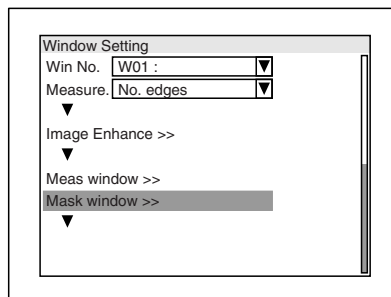


#### 2 Press the [FNC] button on the console and select [Clear].

### Hiding an unwanted area (mask window)

You can set the area (mask window) that will not be measured inside the measurement area. This function is useful when the measurement area has a complicated shape and you want to hide the unwanted parts.

#### Select [Mask window].



The [Mask Window] screen appears.

Refer to “Hiding the Measurement Window Partially (Mask Window)” (page 3-12) for the subsequent operations.

### Clearing the entire area of the mask window

Move the cursor to the [Mask window]. Press the [FNC] button on the console on the setting screen of the mask area, then select [Clear].

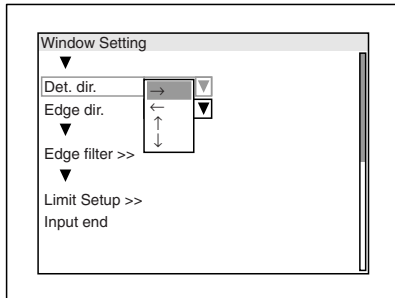
### Clearing the shape of the mask area that has been set

Press the [FNC] button on the remote control console on the setting screen of the mask area, then select [Clear].



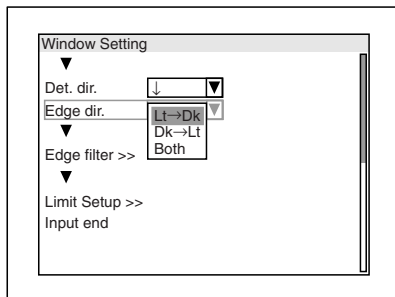
## 4. Setting the Detecting Direction / Edge Direction

- 1 Select [Det. dir.], and then select the direction to be detected.



- When the measurement area is a rectangle: →, ←, ↑, ↓
- When the measurement area is a rotated rectangle: ↓ (From the top to bottom only)  
When setting the measurement area, be careful that the direction that can be set for this shape is from top to bottom only.
- When the measurement area is a ring or an arc: ↻ (clockwise), or ↺ (counter-clockwise)

- 2 Select [Edge dir.] and then select the edge direction to be detected.



- **Lt → Dk:** Detects the transition for light to dark.
- **Dk → Lt:** Detects the transition from dark to light.
- **Both** (default): Detects transitions from both light to dark and dark to light.

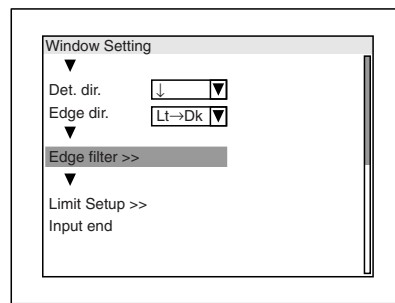
## 5. Setting the Detecting Conditions

### Reference

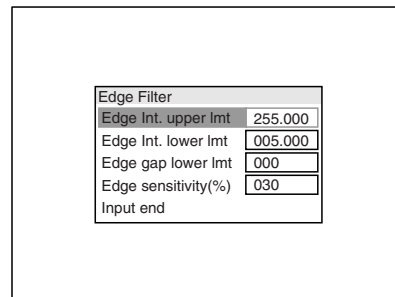
Edges are detected based on where transition in the 0-255 gray scale occur. Edge strength is the size of the transition (ex.Gray (50) to white (250) = Edge strength of 200). The [Edge int. upper lmt] and [Edge int. lower lmt] can be set to include or exclude edges based in the edge strength.

For details, refer to “What is an Edge?” (page 15-3).

- 1 Select [Edge filter].



- 2 Specify the necessary conditions.



- **[Edge Int. upper lmt]:** Specify the upper limit of edge strength that can be detected (Default: 255).
- **[Edge Int. lower lmt]:** Specify the lower limit of edge strength that can be detected (Default: 5).
- **[Edge gap lower lmt]** (in pixel): Specify the minimum distance between the edges pixels to help filter out noise (Default: 0).
- **[Edge sensitivity]** (in %): Specify the threshold value for recognizing edges (Default: 30).

- 3 After completing the settings, select [Input end].

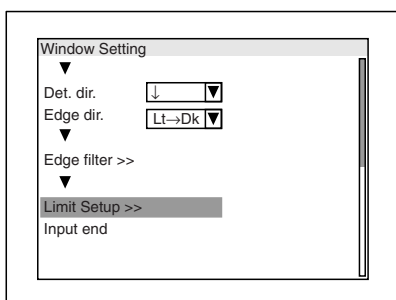


## 6. Setting the Limit Setup

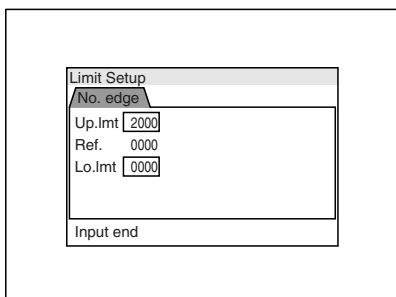
You can set the tolerance (upper and lower limits) for the measurement value.

If the measurement value exceeds the specified tolerance, a [NG] message is displayed. If it is within the specified tolerance, a [OK] message is displayed.

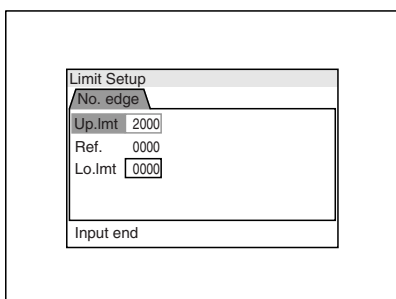
### 1 Select [Limit Setup].



### 2 Select [No. edge].



### 3 Move the [ENTER] button and select [Up. lmt]. Then specify the upper limit value of the number of edges.



### 4 Select [Lo. lmt] and then specify the lower limit value of number of edges.

### 5 After completing the settings, press the [ESCAPE] button on the remote control console and select [Input end].

# Edge Angle

4



Specifying the Units (Windows) for Inspections and Measurements

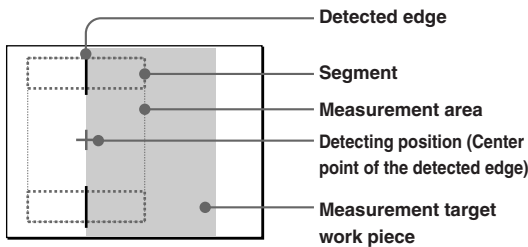
## What Is the [Edge angle] Measurement Mode?

Within a specified measurement area, edge can be detected. The [Edge angle] measurement mode enables the measurement of the tilt angle of the target work piece by setting the two windows in the measurement area and detecting the edges within the respective windows. The tilt angle has a positive (+) value when it is in the counterclockwise direction, and a negative (−) value when it is in the clockwise direction. Because edge detection is based on transitions from light to dark (or dark to light), not the absolute value of the intensity, the edge detection is less affected by the illumination fluctuation.

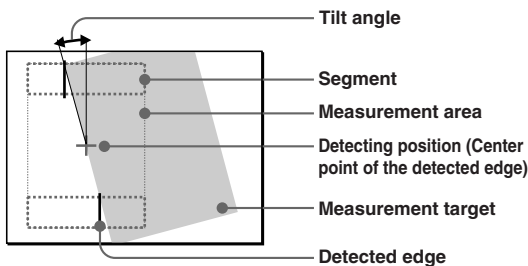
### Measurement image

**Example: When the detecting angle is “→”**

- When the detected angle is “0°”:

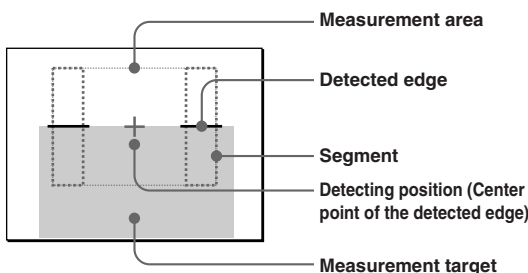


- When the detected angle is “+15°”:

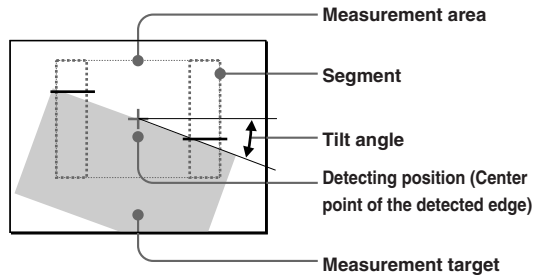


**Example: When the detecting angle is “↓”**

- When the detected angle is “0°”:



- When the detected angle is “−20°”:



### Measurement result to be output

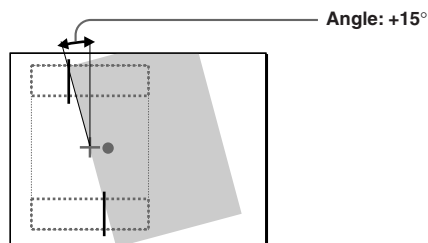
The measurement results that can be output in the edge angle measurement mode are shown below.

- [Angle]:** The angle of the two detected edges is output.
- OK / NG:** If the measurement value exceeds the specified tolerance (upper or lower limits), a [NG] message is displayed. If it is within the specified tolerance, a [OK] message is displayed.

### Sample of measurement

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

- Direction of detection: →
- Edge direction: Both



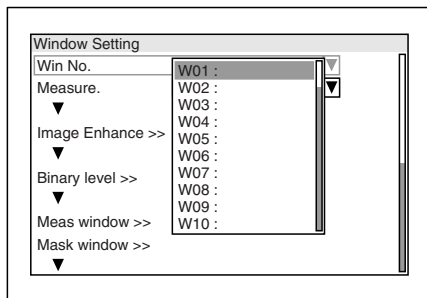




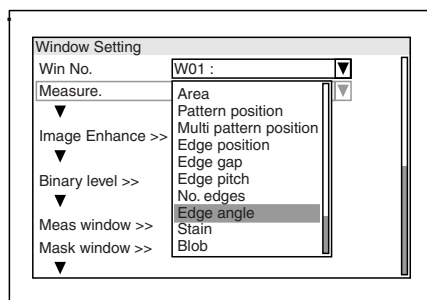
## 1. Selecting the Measurement Tool

Select the [Edge angle] measurement mode.

### 1 Select the measurement window. (page 4-20)

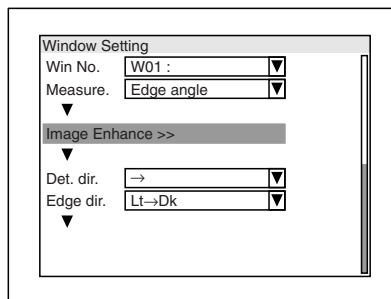


### 2 Select [Measure.] and then select [Edge angle]



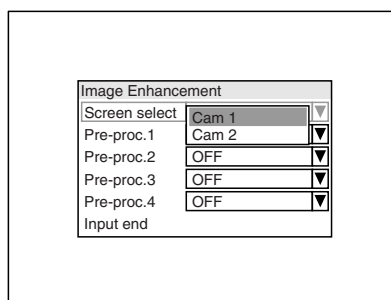
## 2. Selecting the Pre-processing Method of Images

### 1 Select [Image Enhance].

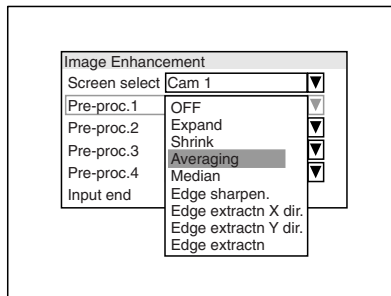


The [Image Enhancement] menu appears.

### 2 Select the camera that you want to have an Image Enhancement.



### 3 Select the pre-processing number, then select Image Enhancement that you want to perform.



The contents of each process are shown below.

<b>OFF</b>	Pre-processing will not be executed.
<b>Expand</b>	The white pixels are expanded and the black pixel noise is removed.
<b>Shrink</b>	The white pixels are shrunk and the white pixel noise is removed.

<b>Averaging</b>	Intensity is averaged to remove noise.
<b>Median</b>	Noise is removed while the outline is maintained.
<b>Edge sharpen</b>	Region where there is a change in intensity is enhanced.
<b>Edge extractn X dir.</b>	Region where there is a change in intensity in the horizontal (X) direction is extracted.
<b>Edge extractn Y dir.</b>	Region where there is a change in intensity in the vertical (Y) direction is extracted.
<b>Edge extractn</b>	Region where there is a change in intensity is extracted.

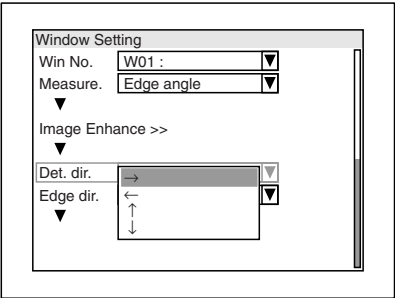
Refer to the “Filter List” (page 15-2) for an example showing the Image Enhancements.

**Multiple Image Enhancements can be set.**  
When multiple Image Enhancements are set, they are executed starting from Pre-processing 1.  
Example: Pre-processing 1 (shrink) → Pre-processing 2 (expand) → Pre-processing 3 (shrink) → Pre-processing 4 (expand)

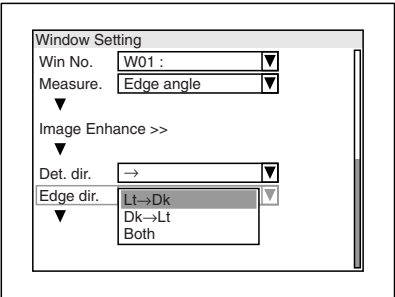
- 4 To set multiple Image Enhancements, repeat Steps 3 and 4.
- 5 After completing the settings, select [Input end].

### 3. Setting the Detecting Direction / Edge Direction

1 Select [Det. dir.] and then select the direction to be detected.



2 Select [Edge dir.] and then select the edge direction to be detected.

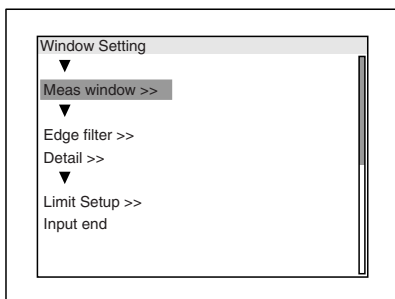


- **Lt → Dk:** Detects the transition for light to dark.
- **Dk → Lt:** Detects the transition from dark to light.
- **Both** (default): Detects transitions from both light to dark and dark to light.

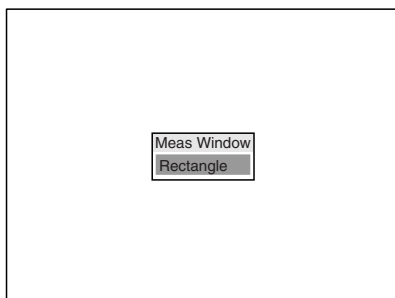


## 4. Setting the Measurement Window

### 1 Select [Meas window]



### 2 Select the desired shape of the measurement window.



### 3 Draw the measurement window.

The measurement areas are shown as parallel blue windows. The edge to be measured must intersect both windows.

#### ► Note

The size of the two segments cannot be modified respectively.

### 4 After completing the drawing, press the [ESCAPE] button on the console.

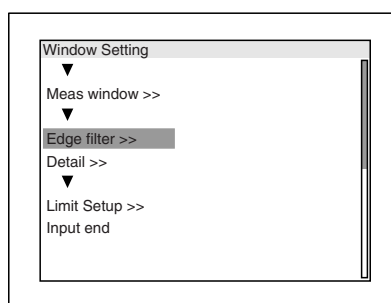
## 5. Setting the Detecting Conditions

#### Reference

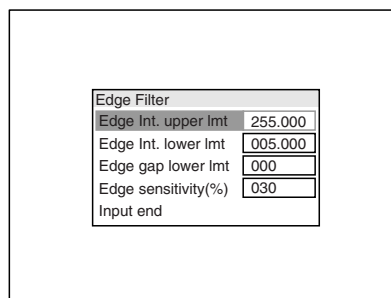
Edges are detected based on where transition in the 0-255 gray scale occur. Edge strength is the size of the transition (ex.Gray (50) to white (250) = Edge strength of 200). The [Edge int. upper lmt] and [Edge int. lower lmt] can be set to include or exclude edges based in the edge strength.

For details, refer to "What is an Edge?" (page 15-3).

### 1 Select [Edge filter].



### 2 Specify the necessary conditions.



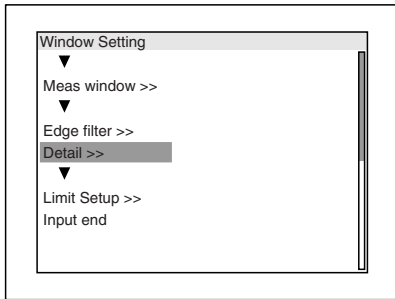
- **[Edge Int. upper lmt]:** Specify the upper limit of edge strength that can be detected (Default: 255).
- **[Edge Int. lower lmt]:** Specify the lower limit of edge strength that can be detected (Default: 5).
- **[Edge gap lower lmt] (in pixel):** Specify the minimum distance between the edges pixels (Default: 0).
- **Edge sensitivity (in %):** Specify the threshold value for recognizing edges (Default: 30).

### 3 After completing the settings, select [Input end].



## 6. Specifying the Detailed Conditions

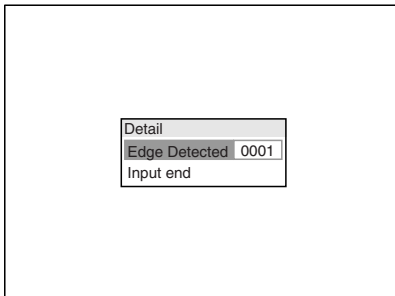
### 1 Select [Detail].



The [Detail] menu appears.

### 2 Make the necessary settings.

After completing the settings, select [Input end].



#### Specify which edge to measure from the detected multiple edges

Specify the measurement target using [Ref. Angel] on the [Detail] menu.

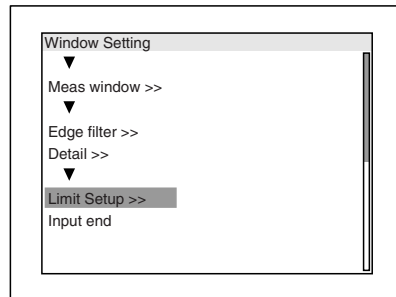
Selected edges are numbered in the order specified in the Detection direction. If you specify a negative value for the Detection direction, the edges are numbered in the reverse order of the Detection direction.

## 7. Setting the Limit setup

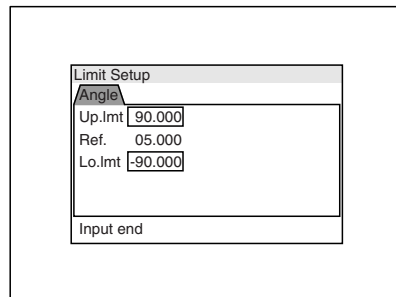
You can set the tolerance (upper and lower limits) for the measurement value.

If the measurement value exceeds the specified tolerance, a [NG] message is displayed. If it is within the specified tolerance, a [OK] message is displayed.

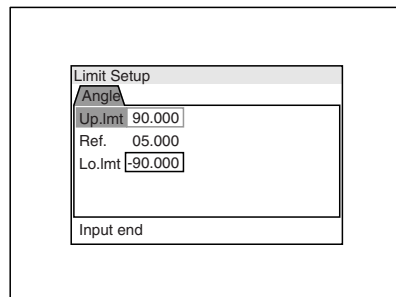
### 1 Select [Limit setup].



### 2 Select [Angle].



### 3 Press the ENTER button to specify the [Up Lmt.] and set the upper limit value of the edge angle.



### 4 Press the ENTER button to specify the [Lo Lmt.] and set the lower limit value of the edge angle.

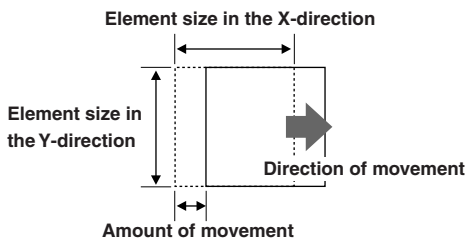
### 5 After completing the settings, press the [ESCAPE] button on the console and select [Input end].

## What Is the [Stain] Measurement Mode?

Within a specified measurement area, a small area can be defined (element). Within this element, the average intensity can be calculated. The area having the intensity more than the threshold level is detected as the stain. This function is convenient when you want to detect stains on the target work piece.

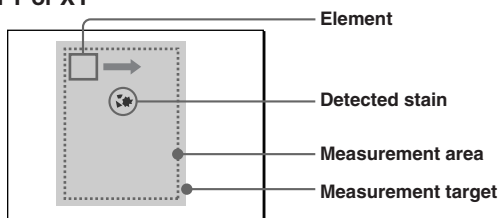
### Measurement image

In the stain measurement mode, the measurement element moves in the specified detection directions (X, Y, XY direction or in the direction of circumference) by the traveling distance of 1/4 of the size of the element. While moving, the average intensity within the element is measured.

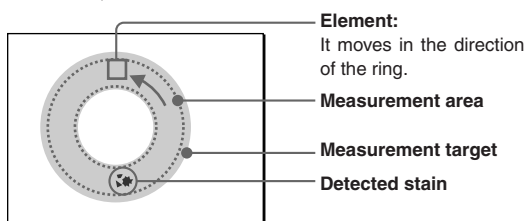


When the neighboring two elements have a significant intensity difference (more than the stain level), it is judged that there is a stain within the measurement window.

### Example when the detecting direction is either X or Y or XY



### Example when the detecting direction is counter-clockwise ↺



## Measurement result to be output

The measurement results that can be output in the stain measurement mode are shown below.

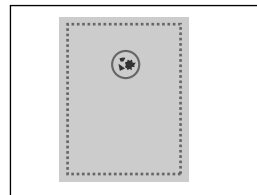
### When the measurement area is rectangle or a rotated rectangle

- **Level of stain:** The stain level is output. The level increases when a large stain is present and also when many small stains are present.
- **OK/NG:** If the amount of stain exceeds the upper limit, an [NG] message is displayed. If it is less than the upper limit, an [OK] message is displayed.

## Sample of measurement

### Example when a stain on the surface of a target is going to be detected:

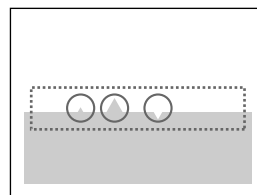
- Direction of detection: XY



Level of stain: 20

### Example when a crack and burr on the surface of a target is going to be detected:

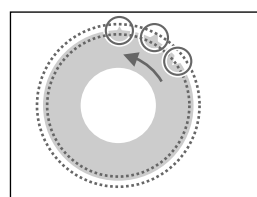
- Direction of detection: X



Level of stain: 55

### Example when a crack and burr on the round surface of a target is going to be detected:

- Direction of detection: Counter-clockwise direction ↺



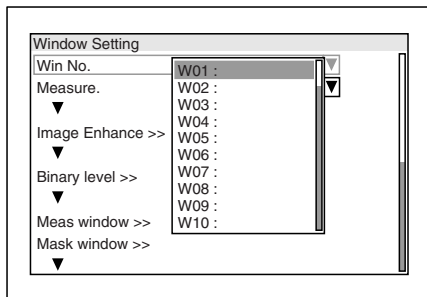
Level of stain: 35



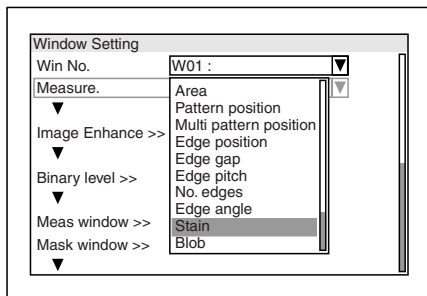
## 1. Selecting the Measurement Tool

Select the [Stain] measurement mode.

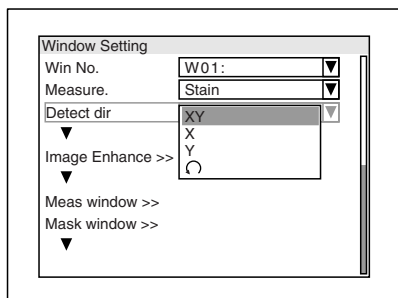
### 1 Select the measurement window. (page 4-20)



### 2 Select [Measure.] and then select [Stain].



### 3 Select [Detect dir.], and then select the direction of detecting stain.



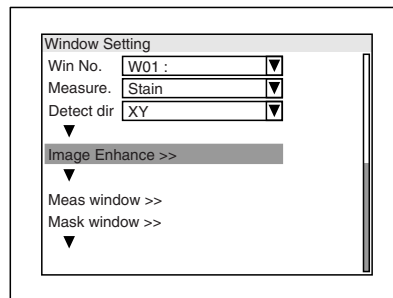
- **XY:** The intensity differences in the X-direction and Y-direction are detected.
- **X:** The intensity difference in the X-direction is detected.
- **Y:** The intensity difference in the Y-direction is detected.
- **Counter-clockwise ↺:** The intensity difference in the ring direction is detected.

#### ► Note

When Counter-clockwise ↺ is selected as the [Detect dir.], the measurement area (on page 4-75) is restricted to either ring or arc.

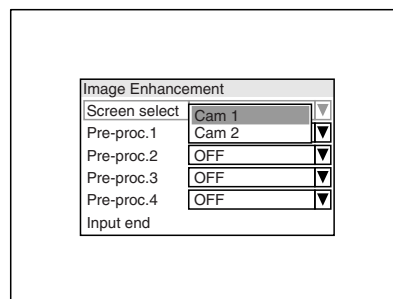
## 2. Selecting the Pre-processing Method of Images

### 1 Select [Image enhance].

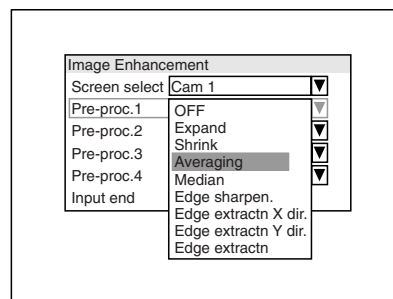


The [Image enhancement] menu appears.

### 2 Select the camera that you want to have an Image Enhancement.



### 3 Select the pre-processing number, then select Image Enhancement that you want to perform.



The contents of each process method are shown below.

**[OFF]** Pre-processing will not be executed.

**[Expand]** The white pixels are expanded and the black pixel noise is removed.

**[Shrink]** The white pixels are shrunk and the white pixel noise is removed.



**[Averaging]** Intensity is averaged to remove noise.

**[Median]** Noise is removed while the outline is maintained.

**[Edge sharpen.]**

Region where there is a change in intensity is enhanced.

**[Edge extractn X dir.]**

Region where there is a change in intensity in the horizontal (X) direction is extracted.

**[Edge extractn Y dir.]**

Region where there is a change in intensity in the vertical (Y) direction is extracted.

**[Edge extractn]**

Region where there is a change in intensity is extracted.

Refer to “Filter List” (page 15-2) for an example showing the Image Enhancements.

**Multiple Image Enhancements can be set.**

When multiple Image Enhancements are set, they are executed starting from the Pre-processing 1.

Example: Pre-processing 1 (shrink) → Pre-processing 2 (expand) → Pre-processing 3 (shrink) → Pre-processing 4 (expand)

**4 To set multiple Image Enhancements, repeat Steps 3 and 4.**

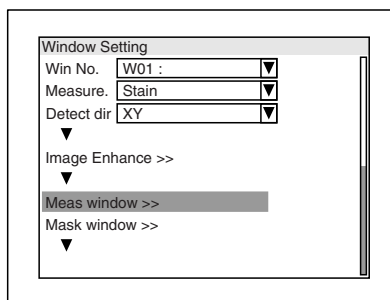
**5 After completing the setting, select [Input end].**

### 3. Setting the Measurement Window

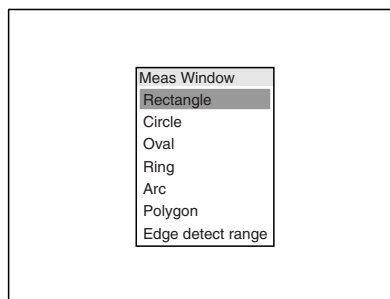
**Reference**

When the measurement window has a complicated shape, you can set the mask to hide the unwanted parts. For details, refer to “Hiding an unwanted area (mask window)”.

#### 1 Highlight [Meas window]



#### 2 Select the desired shape of the measurement window.



**Note**

When Counter-clockwise ↺ is selected as the [Detect dir.] (on page 4-74), the measurement window (on page 4-75) is restricted to either ring or arc.

#### 3 Draw the measurement window.

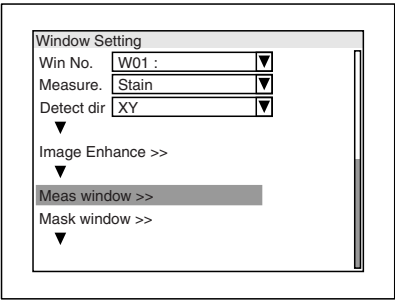
Refer to “Drawing a Measurement Window” (page 3-5) for more details.

#### 4 When drawing is complete, press the [ESCAPE] button of the remote control console.

Clearing the measurement area

You can clear the specified measurement area that has been set by the following procedure.

1 Highlight [Meas window].

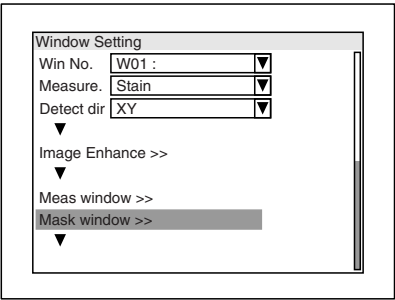


2 Press the [FNC] button on the remote control console and select [Clear].

Hiding an unwanted area (mask window)

You can set the area (mask window) that will not be measured inside the Meas window. This function is useful when the Meas window has the complicated shape and you want to hide the unwanted area.

Select "Mask window".



The "Mask window" menu appears.  
Refer to "Hiding the Measurement Window Partially (Mask Window)" (page 3-12) for the subsequent actual operations.

Note

When Counter-clockwise ↺ is selected as the [Detect dir.], the mask window cannot be set.

Clearing the entire area of the mask window

Move the cursor to the [Mask window]. Then press the [FNC] button of the remote control console on the setting screen of mask window. Then select [Clear].

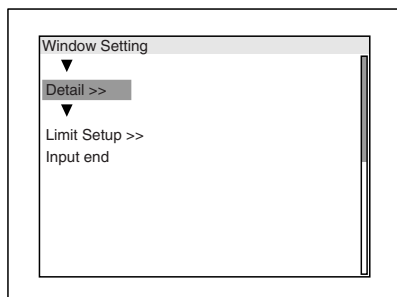
Clearing the shape of the mask window that has been set

Press the [FNC] button of the remote control console on the setting screen of mask window. Then select [Clear].



## 4. Specifying the Detailed Conditions

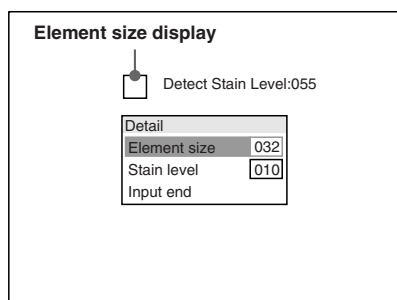
### 1 Select [Detail].



The [Detail] menu appears.

### 2 Implement the necessary setting.

When the setting is complete, select [Input end].



**Specify the size of the element that moves inside the Meas window.**

You can specify the size of the segment using [Element size] on the [Detail] menu. Specify the size of element in the range of 4 to 64 (pixels). (Default value: 12)

**Specify the stain level. This level is used for the judgment of stain.**

Specify the stain level using [Stain level] on the [Detail] menu. The stain level can be set in the range of 0 to 255. (Default value: 10)

If any difference of intensity is smaller than the difference that is specified here, the difference of intensity will not be detected as the stain. When you want to recognize a specific difference of intensity as a stain, adjust the stain level so that it is smaller than the detected stain level.

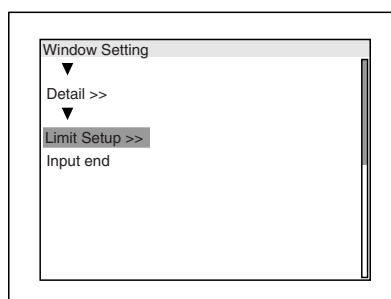
#### Reference

- If you press the [SCREEN] button of the remote control console to select the Processing screen 1 while the scar level is in the process of setting, size of the segment as a box and the detected stain level are displayed on screen. This function is convenient when you want to set the stain level while confirming the size of segment and stain level on the screen.
- You can press the [VIEW] button of the remote control console while setting of the stain level is in progress. When the [VIEW] button is pressed, the stains that are being detected can be confirmed on the background screen.

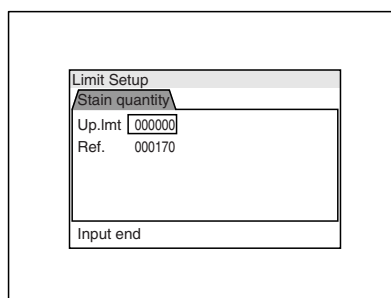
## 5. Setting the Limit Setup

You can set the upper limit value of the total amount of the detected stain. If the amount of stain exceeds the set upper limit, an [NG] message is displayed. If it is less than the upper limit, an [OK] message is displayed.

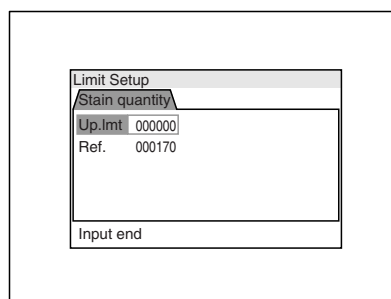
### 1 Select [Limit Setup].



### 2 Select [Stain quantity]



### 3 Select [Up. lmt] and then set the upper limit value of the stain quantity.



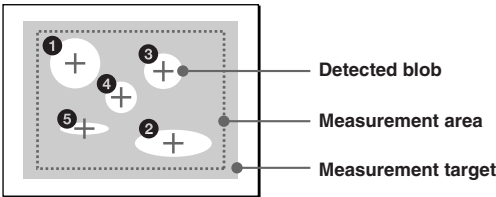
### 4 When the setting is complete, press the [ESCAPE] button. Then select [Input end].

What Is the [Blob] Measurement Mode?

A gathering of pixels having the same intensity (between 255 or 0) within the binary image is called [Blob]. In this measurement, the number of blobs, area, center of gravity coordinates, main axis angle, feret diameter, perimeter and roundness in the measurement area are determined. The characteristics to be measured can be chosen.

Measurement image

The blobs are measured and controlled by giving label to the blobs. They can be ordered based on size or scan direction.



Measurement result to be output

The measurement results that can be output in the Blob measurement mode are shown below.

- **Number of blobs:** Number of the detected blobs is output.
- **Area:** Area of a blob is output in units of number of pixels.
- **Center of gravity coordinates (X,Y):** Center of gravity position of blob is output in units of number of pixels.
- **Main axis angle:** The main axis angle (page 4-79) of blob is output.
- **Feret diameter:** Feret diameter (page 4-80) of blob is output in units of number of pixels.
- **Perimeter:** Perimeter (page 4-80) of blob is output in units of number of pixels.
- **Roundness:** How the blob detected in the measurement area is similar to a complete circle is output using a numerical value in the range of 0.000 to 1.000 (page 4-80). When the blob is a complete circle, 1.000 is output. As a blob loses similarity to the shape of complete circle, this value becomes closer to 0.0000.
- **OK/NG:** If the measurement value exceeds the specified tolerance (upper limit or lower limit), an [NG] message is displayed. If it is within the specified tolerance, an [OK] message is displayed.

Note

The maximum number of blobs that can be measured is 2,000. When any characteristics quantities other than the blob count are selected as the measurement item, the maximum number of blobs that can be measured is 64.

Sample of measurement

Example showing the result of the measurement when the measurement is made under the following conditions:

- Order of blobs: Y > X ascending order
- Blob designation: 3

Number of blobs: 5

Blob that is the target of measurement

Center of gravity position:  
X: 300,Y: 230

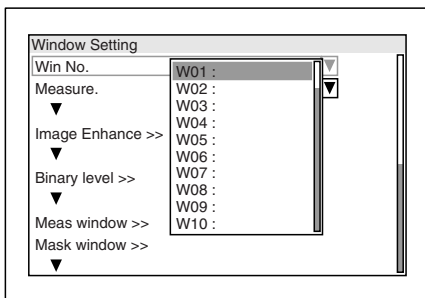
Area: 20.000

Roundness: 0.85

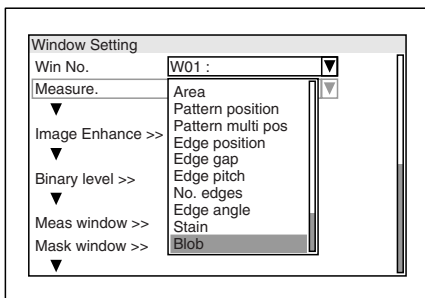
## 1. Selecting the Measurement Tool

Select the [Blob] measurement mode.

### 1 Select the measurement window. (page 4-20)



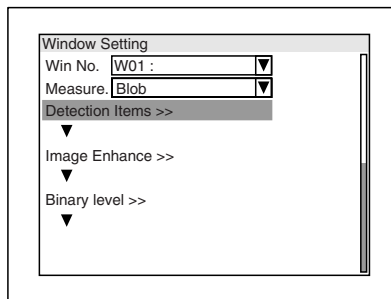
### 2 Select [Measure.] and then select [Blob].



## 2. Specifying the Measurement Items

Specify the blob items that you want to measure.

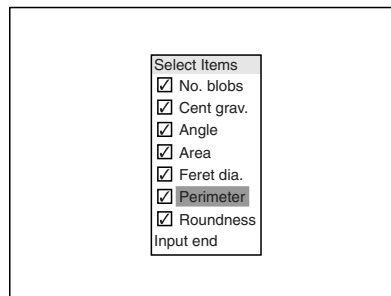
### 1 Select the [Detection items].



### 2 Select the items that you want to measure and click the respective check boxes.

#### Note

The maximum number of blobs that can be counted is 2,000. Measurement of characteristics quantities other than the blob count is limited to 64.



#### Number of blobs

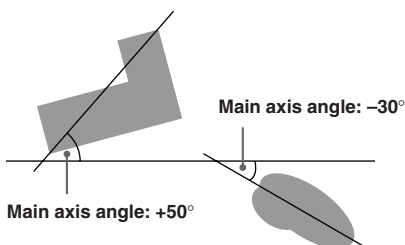
Counts the number of blobs.

#### Center of gravity position

Measures the center of gravity position of blob.

#### Main axis angle

Measures the angle of the blob main axis against the horizontal (X) axis of the image.

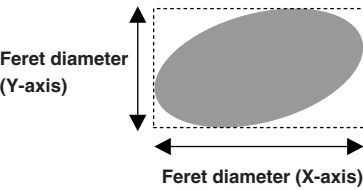


Area

Measures the area of blob.

Feret diameter

Lengths of the sides that are in parallel with the horizontal (X) axis and vertical (Y) axis of the circumscribed rectangle of the blob are measured in the X-Y direction.

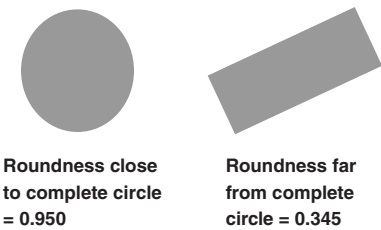


Perimeter

Length of profile of the blob is measured.

Roundness

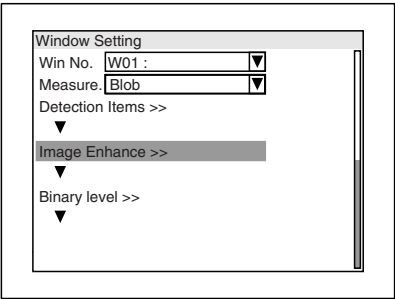
How the blob is similar to a complete circle is measured. When the blob is a complete circle, 1.000 is output as the maximum value. As a blob loses similarity to the shape of a complete circle, this value becomes closer to 0.0000.



3 When the setting is complete, select [Input end].

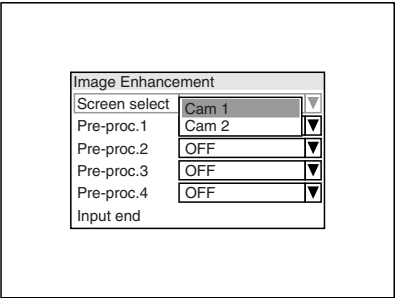
3. Selecting the Pre-processing Method of Images

1 Select [Image enhance].

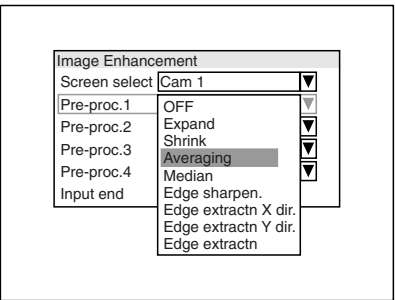


The [Image enhancement] menu appears.

2 Select the camera that you want to have an Image Enhancement.



3 Select the pre-processing number, then select Image Enhancement that you want to perform.



The contents of each process are shown below.

- |          |   |
|----------|---|
| [OFF]    | Pre-processing will not be executed.                                |
| [Expand] | The white pixels are expanded and the black pixel noise is removed. |
| [Shrink] | The white pixels are shrunk and the white pixel noise is removed.   |

**[Averaging]** Intensity is averaged to remove noise.

**[Median]** Noise is removed while the outline is maintained.

**[Edge sharpen.]**

Region where there is a change in intensity is enhanced.

**[Edge extractn X dir.]**

Region where there is a change in intensity in the horizontal (X) direction is extracted.

**[Edge extractn Y dir.]**

Region where there is a change in intensity in the vertical (Y) direction is extracted.

**[Edge extractn]**

Region where there is a change in intensity is extracted.

Refer to the "Filter List" (page 15-2) for an example showing the Image Enhancements.

#### Multiple Image Enhancements can be set.

When multiple Image Enhancements are set, they are executed starting from Pre-processing 1.

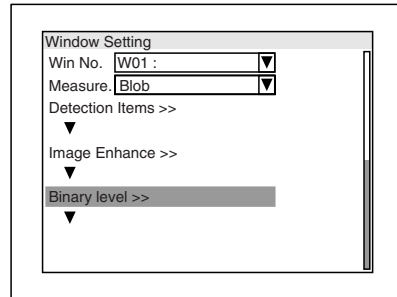
Example: Pre-processing 1 (shrink) → Pre-processing 2 (expand) → Pre-processing 3 (shrink) → Pre-processing 4 (expand)

- 4** To set multiple Image Enhancements, repeat Steps 3 and 4.
- 5** After completing the settings, select [Input end].

## 4. Setting the Binary Level

The captured image is converted to gray scale with a 256 steps. The threshold level for the binary conversion is set as follows.

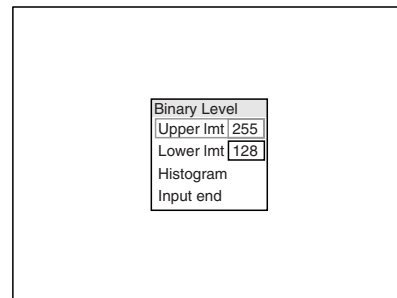
### 1 Select the [Binary level]



The [Binary Level] menu appears.

### 2 Select [Upper lmt] and then specify the upper limit value.

The upper limit value can be set at any level between "Lower limit value" and 255.



### 3 Select [Lower lmt] and then specify the lower limit value.

The lower limit value can be set between 0 and "Upper limit value".

### 4 After completing the settings, [Input end].

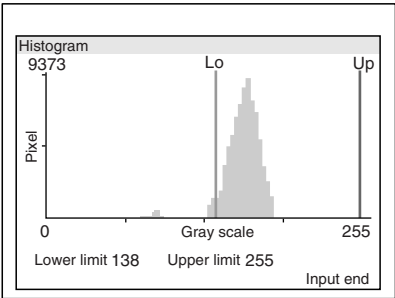
#### Reference

You can confirm the background screen of the [Binary Level] while the setting is in progress by pressing the VIEW button of the remote control console. If the menu is blocking an important part of the image, it can be made transparent or completely disappear by pressing the "VIEW" button on the remote control console.

### Setting the upper limit and lower limit of the [Binary Level] using histogram

Indicating the color distribution of the image on the screen using histogram of which the upper limit and lower limit.

- 1 Select [Histogram] in the [Binary Level] menu.  
The [Histogram] appears.
- 2 Press the [ENTER] button and select [Upper lmt]. Then specify the upper limit value by pressing the right and left arrow keys.



When you press the [VIEW] button of the remote control console, you can check the background screen.

#### Reference

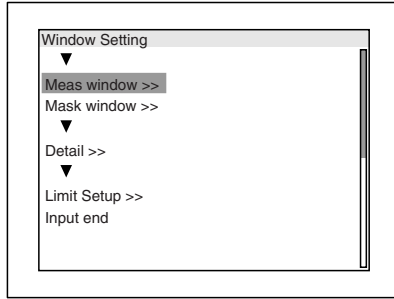
- When the measurement window is not set, distribution of the entire screen is displayed on histogram. When the measurement area is set, distribution information of only inside the measurement window is displayed on histogram.
- You can confirm the background screen of the histogram while the setting is in progress by pressing the [VIEW] button of the remote control console. If the menu is blocking an important part of the image, it can be made transparent or completely disappear by pressing the "VIEW" button on the remote control console.

- 3 Press the [ENTER] button and select [Lower lmt]. Then specify the lower limit value by pressing the right and left arrow keys.
- 4 When the setting is complete, select [Input end].

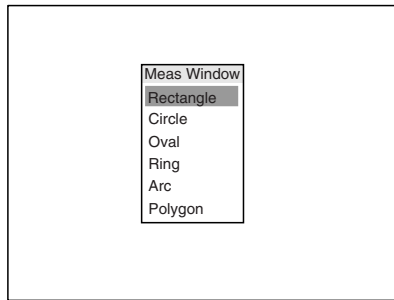
### 5. Setting the Measurement Window

You can specify the area the camera uses for measurement.

- 1 Highlight [Meas window].



- 2 Select the desired shape of the measurement window.



- 3 Draw the measurement window.

Refer to "Drawing a Measurement Window" (page 3-5) for more details.

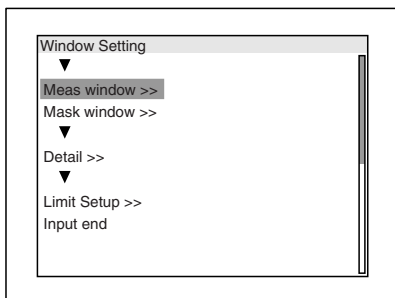
- 4 When drawing is complete, press the [ESCAPE] key of the remote control console.



## Clearing the measurement area

You can clear the specified measurement area that has been set by the following procedure.

### 1 Highlight [Meas window].

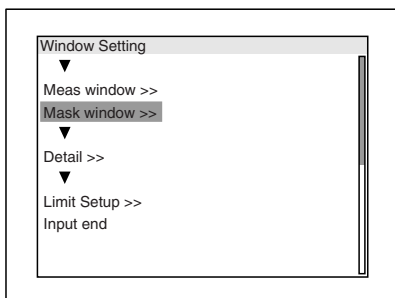


### 2 Press the [FNC] button on the remote control console and select [Clear].

## Hiding the unwanted area (mask window)

You can set the area (mask window) that will not be measured inside the measurement window. This function is useful when the measurement window has the complicated shape and you want to hide the unwanted area.

### Highlight [Mask window].



The [Mask Window] menu appears.

Refer to “Hiding the Measurement Window Partially (Mask Window)” (page 3-12) for the subsequent actual operations.

### When you want to clear the entire area of the mask window

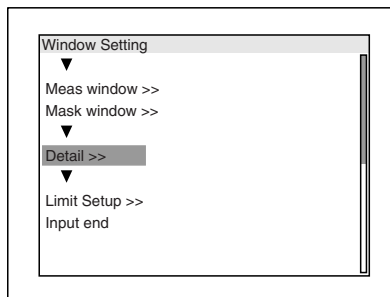
Move the cursor to the [Mask Window]. Then press the [FNC] button of the remote control console on the setting screen of mask area. Then select [Clear].

### When you want to clear the shape of the mask window that has been set

Press the [FNC] button of the remote control console on the setting screen of mask window. Then select [Clear].

## 6. Specifying the Detailed Conditions

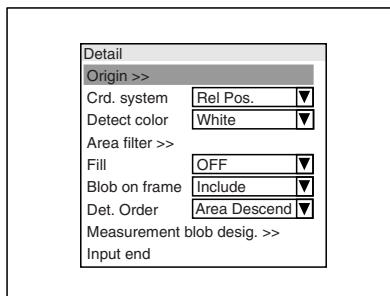
### 1 Select [Detail].



The [Detail] menu appears.

### 2 Implement the necessary setting.

When the setting is complete, select [Input end].



### Changing the reference position of origin

Setting the [Origin] on the [Details] menu.

As the [Origin Selection] menu appears, implement the necessary settings as follows.

- **Designate Origin point** (Default value): The origin point is set at the top left of the screen by default. However, you can freely specify the origin point by first selecting [Origin Pt.Select]. Move the [+] cursor to the position where you want to set the origin point and then press the [ESCAPE] button. The coordinates of the set position are displayed in the [Origin Value X = ] and [Origin Value Y = ] columns.
- **Registered position**: The position of the “Detection point” in the pattern area is used as the origin point. The present origin point is displayed in the [Origin Value X = ] and [Origin Value Y = ] columns.

#### Reference

- The [Reg.Scrn.Pos] can be set only when [Cent grav.] is selected as the measurement item.
- When you want to measure the amount of error (deviation) using the position where image is registered as the reference position, select [Reg.Scrn.Pos].



### Selecting the coordinate axis after position is corrected

Select the coordinate axis using the [Crd. System] on the [Detail] screen as follows.

When the position correction (page 4-104) is not executed, setting of this item will have no effect on measurement.

- **[Rel Pos] (default setting):** If position of source window has moved, amount of the error is reflected on the measurement.
- **[Abs Pos]:** The distance from the [Origin] is measured.

### Selecting the color that will be used for detection of a blob

Use the [Detect color] on the [Detail] menu.

- **White:** The blobs having white color will be the target of measurement.
- **Black:** The blobs having black color will be the target of measurement.

### Specifying the upper limit and lower limit values of the areas that will be detected as blobs.

Use the [Area filter] on the [Detail] menu.

The [Area filter] menu appears. Make the necessary settings. The blobs that are larger than the specified upper limit value or the blobs that are smaller than the specified lower limit value are not detected as a blob. The default setting values are 245760 for the upper limit value and 100 for the lower limit value.

### Specifying whether inside of the blob should be filled with the detect color or not

You can specify this using [Fill] on the [Detail] menu. If the inside of a blob contains an area having different color than the detect color, the measurement of area, center of gravity point, or main axis angle could possibly be affected.

In order to prevent this, the inside of the blobs can be filled by the detect color as follows.

- **OFF (default setting):** Filling the inside of blobs is not executed.
- **ON:** Inside is filled with detecting color.



FILL OFF



FILL ON

### Specifying whether the blobs existing on top of the frame lines of the measurement area shall be included as a detection target or not

You can specify it using the [Blob on frame] on the [Detail] menu.

- **Include (default setting):** The blobs existing on top of the frame lines of the measurement area are included in the detection target.
- **Exclude:** The blobs existing on top of the frame lines of the measurement area are not included in the detection target.

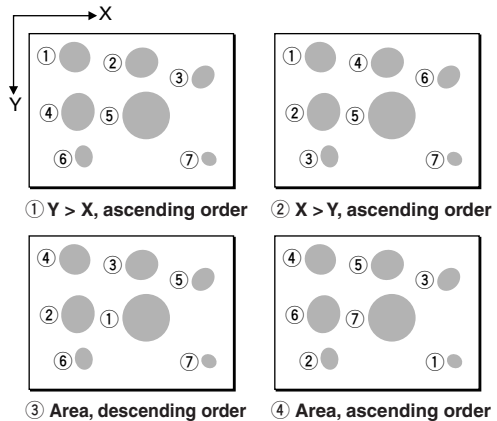
#### Note

Include or Exclude of the [Blob on frame] can only be specified when rectangle has been set as the measurement area. If any other measurement area is selected, the [Blob on frame] will be processed as Include all the time.

### Selecting the conditions of putting the blob number to the blobs

You can select the above conditions using the [Det. order] on the [Detail] menu.

You can select the conditions of putting the blob number to the blobs from the following four methods. (Default setting: Area, descending order)



### Specifying the blobs that will become target of judgment

You can specify the target blobs using the [Desig. Measured blob] on the [Detail] menu.

The [Measured Blob Designation] menu appears. Implement the necessary settings. (By default, [measurement desig.] is set to [Select (1 to 64)] and [Blob desig.] is set to [01].)

- **When you want to judge all blobs,** select [All] in the [measurement desig.].
- **When you want to judge only the specified blobs,** select [Select (1 to 64)] in the [measurement desig.] and select [Blob desig.] and lastly specify the blob number that you want to select as the target of judgment. Only the blobs that are specified here become the target of judgment.



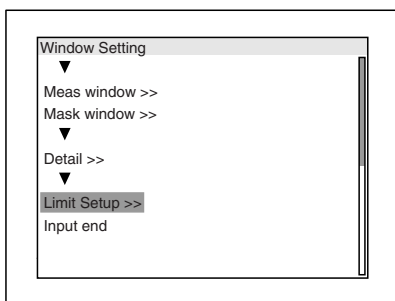


## 7. Setting the Limit Setup

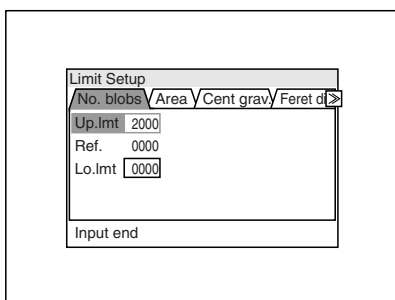
You can set the tolerance (upper limit value and lower limit value) for the measurement value.

If the measurement value exceeds the specified tolerance (upper limit or lower limit), an [NG] message is displayed. If it is within the specified tolerance, an [OK] message is displayed.

### 1 Select [Limit Setup].



### 2 Move the [ENTER] button to the right or left to select an item on which you want to specify tolerance.



### 3 Press the [ENTER] button to specify the lower limit value and the upper limit value of tolerance.

Contents of the Limit setup and units of tolerance are different depending on the shape of the measurement area.

- **No. blobs:** The number of blobs
- **Area:** Number of pixels
- **Cent grav.:** Number of pixels
- **Feret dia.:** Number of pixels
- **Angle:** Angle
- **Perimeter:** Number of pixels
- **Roundness:** Number in the range of 0.000 to 1.000  
(1.000 = complete circle)

### 4 When you want to specify tolerance of other measurement values, press the [ESCAPE] button and repeat steps 2 and 3 as described above.

### 5 When setting is complete, press the [ESCAPE] button of the console and select [Input end].

# Trend Edge Position

4



Specifying the Units (Windows) for Inspections and Measurements

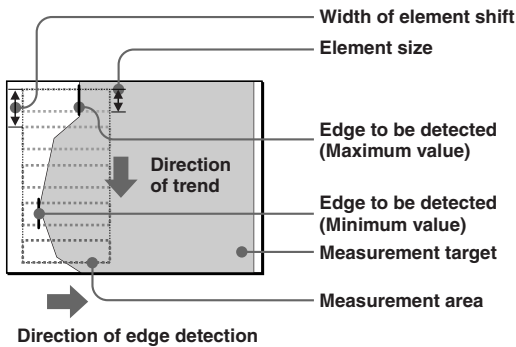
## What Is the [Trend Edge Position] Measurement Mode?

Within a specified measurement area, an element of specific size is moved within the area to detect edges. The average value, maximum value and minimum value of the edge position are measured by the trend edge position.

### Measurement image

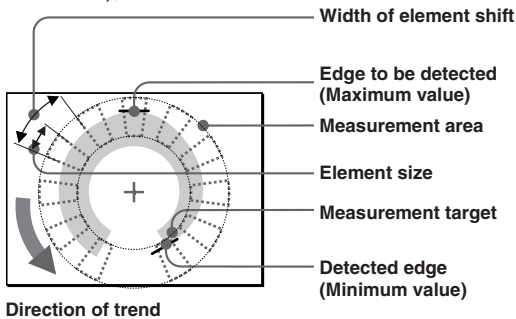
**Example: When the measurement window is a rectangle or a rotated rectangle**

- In the case when the detecting direction “→” and direction of trend is “↓”,



**Example: When the measurement window is a ring or an arc**

- In the case when the detecting direction is ↺ (counter-clockwise),



## Measurement result to be output

The measurement results that can be output in the edge position measurement mode are shown below.

**When the measurement window is a rectangle or rotated rectangle**

- Edge position:** The maximum value, minimum value and average value are output.
- Number of edges:** The maximum number, minimum number and average number of the detected edges within the element are output.
- OK/NG:** If the measurement value exceeds the specified tolerance (upper limit or lower limit), an [NG] message is displayed. If it is within the specified tolerance, an [OK] message is displayed.

**When the measurement window is a ring or an arc**

- Radius gap:** The maximum value, minimum value and average value of the distance from the center to the edge in the radial direction are output.
- Number of edges:** The maximum number, minimum number and average number of the detected edges within the element are output.
- OK/NG:** If the measurement value exceeds the specified tolerance (upper limit or lower limit), an [NG] message is displayed. If it is within the specified tolerance, an [OK] message is displayed.

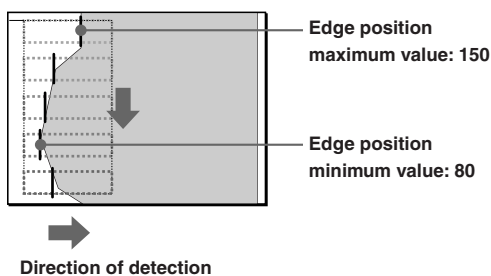


## Sample of measurement

### When the measurement window is a rectangle or rotated rectangle

Example showing the result of the measurement when the measurement is made under the following conditions:

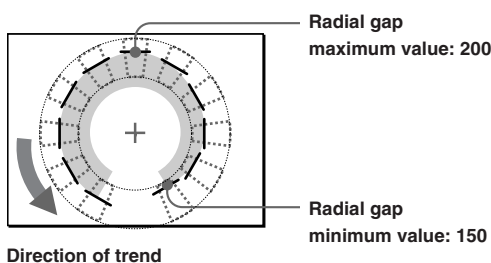
- Direction of trend: ↓
- Direction of detection: →
- Edge direction: Both



### When the measurement window is a ring or an arc

Example showing the result of the measurement when the measurement is made under the following conditions:

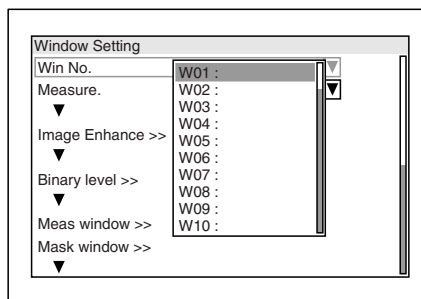
- Direction of trend: ↻ (counter-clockwise direction)
- Direction of detection: ↻ (radial direction)
- Edge direction: Both



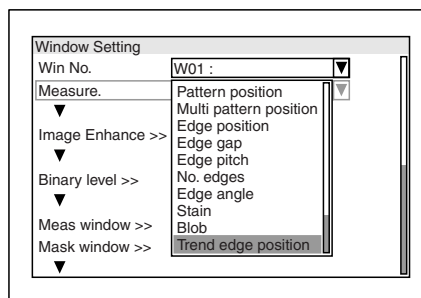
## 1. Selecting the Measurement Tool

Select the [Trend edge position] measurement mode.

### 1 Select the measurement window (page 4-20).

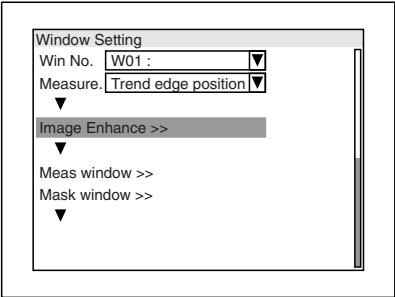


### 2 Select [Measure.] and then select [Trend edge position].



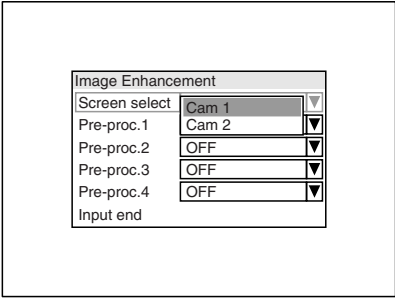
## 2. Selecting the Pre-processing Method of Images

### 1 Select [Image enhance].

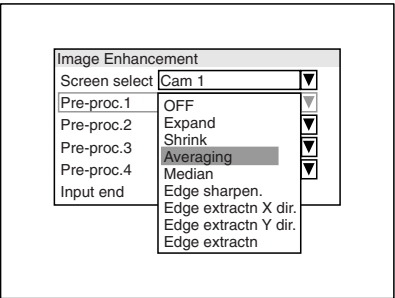


The [Image enhancement] menu appears.

### 2 Select the camera that you want to have an Image Enhancement.



### 3 Select the pre-processing number. Then select Image Enhancement that you want to perform.



Contents of each process are shown below.

OFF	Pre-processing will not be implemented.
Expand	The white pixels are enlarged and the black pixel noise is removed.

Shrink	The white pixels are shrunk and the white pixel noise is removed.
Averaging	Intensity is averaged to remove noise.
Median	Noise is removed while outline is maintained.
Edge sharpen	Region where there is a change in intensity is enhanced.

Edge extractn X dir.	Region where there is a change in intensity in the horizontal (X) direction is extracted.
----------------------	---

Edge extractn Y dir.	Region where there is a change in intensity in the vertical (Y) direction is extracted.
----------------------	---

Edge extractn	Region where there is a change in intensity is extracted.
---------------	---

Refer to the "Filter List" (page 15-2) for an example showing the Image Enhancements.

#### Multiple Image Enhancements can be set.

When multiple Image Enhancements are set, they are executed starting from Pre-processing 1.

Example: Pre-processing 1 (shrink) → Pre-processing 2 (expand) → Pre-processing 3 (shrink) → Pre-processing 4 (expand)

### 4 To set multiple Image Enhancements, repeat Steps 3 and 4.

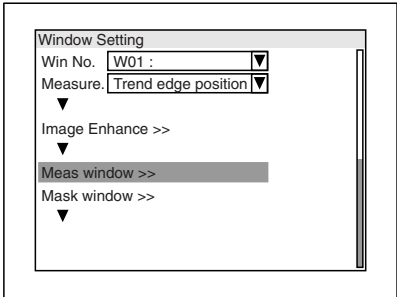
### 5 After completing the settings, select [Input end].

### 3. Setting the Measurement Area

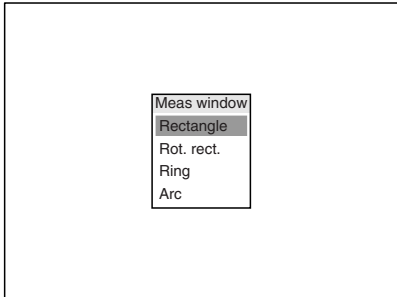
#### Reference

If the measurement area has a complicated shape, you can set the mask to hide the unwanted parts. For details, refer to “Hiding an unwanted area (mask window)”.

#### 1 Highlight [Meas window]



#### 2 Select the desired shape of the measurement area.



#### 3 Draw the measurement window.

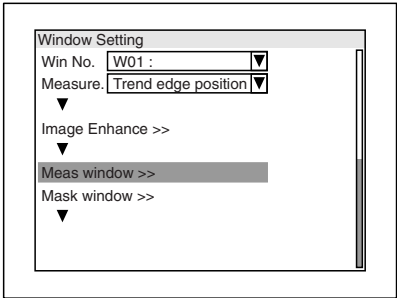
Refer to “Drawing a Measurement Window” (page 3-5) for more details.

#### 4 After completing the drawing, press the [ES-CAPE] key of the remote control console.

### Clearing the measurement area

You can clear the specified measurement area that has been set by the following procedure.

#### 1 Hight light [Meas window].

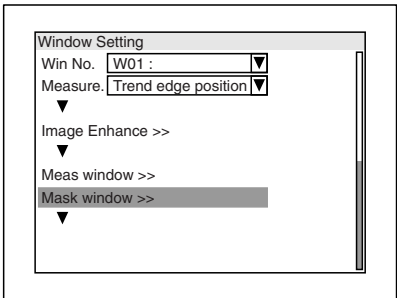


#### 2 Press the [FNC] button on the console and select [Clear].

### Hiding an unwanted area (mask window)

You can set an area (mask window) that will not be measured inside the Meas window. This function is useful when the Meas window has the complicated shape and you want to hide an unwanted area.

#### Select [Mask window].



The [Mask Window] menu appears.  
Refer to “Hiding the Measurement Window Partially (Mask Window)” (page 3-12) for the subsequent actual operations.

### Clearing the entire area of the mask window

Move the cursor to the [Mask window]. Then press the [FNC] button of the console on the setting screen of mask window. Then select [Clear].

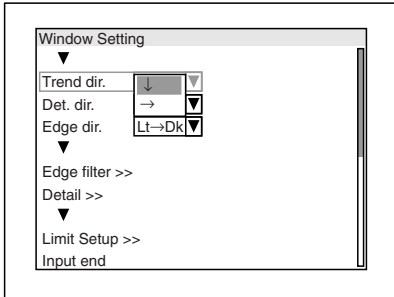
### Clearing the shape of the mask area that has been set

Press the [FNC] button on the remote control console on the setting screen of mask window. Then select [Clear].



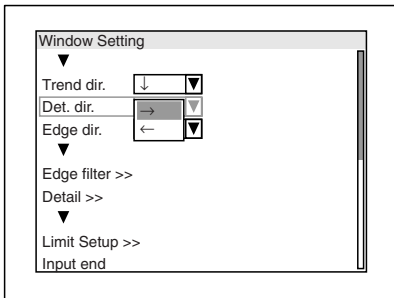
## 4. Setting the Detecting Direction / Edge Direction

### 1 Select [Trend dir.], and then select the direction segment movement.



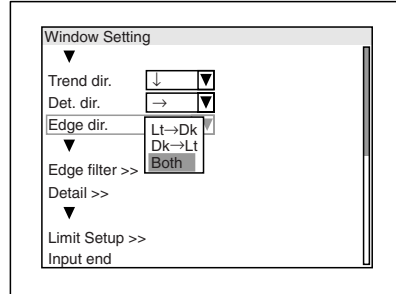
- **When the measurement area is a rectangle:** →, ↓
- **When the measurement area is a rotated rectangle:** ↓ (From the top to bottom only)  
When setting the measurement area, be careful that the direction that can be set for this shape of measurement area is top to bottom only.
- **When the measurement area is a ring or an arc:**  
↻ (counter-clockwise) only

### 2 Select [Det. dir.] and then select the edge direction to be detected.



- **When the measurement area is a rectangle:** The direction that is perpendicular to the trend direction selected by step 1 is set.
- **When the measurement area is a rotated rectangle:** → only
- **When the measurement area is a ring or an arc:**  
↻ (Radial direction from outer circumference toward center point), ↻ (Direction toward outer circumference from center point toward the outer circumference)

### 3 Select [Edge dir.] and then select the direction of edge to be detected.



- **Lt → Dk:** Detects the transition for light to dark.
- **Dk → Lt:** Detects the transition from dark to light.
- **Both** (default): Detects transitions from both light to dark and dark to light.

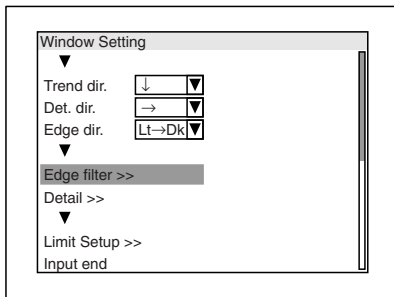
## 5. Setting the Edge Detecting Conditions

### Reference

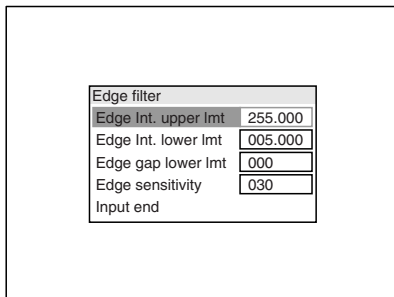
Edges are detected based on where transition in the 0-255 gray scale occur. Edge strength is the size of the transition (ex. Gray (50) to white (250) = Edge strength of 200). The [Edge int. upper lmt] and [Edge int. lower lmt] can be set to include or exclude edges based on the edge strength.

For details, refer to "What is the Edge?" (page 15-3).

### 1 Select [Edge Filter].



### 2 Specify the necessary conditions.

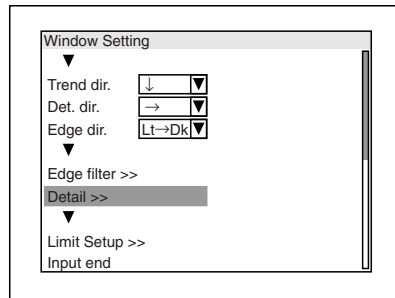


- **[Edge Int. Upper lmt]:** Specify the upper limit of edge strength that can be detected. (Default: 255)
- **[Edge Int. Lower lmt]:** Specify the lower limit of edge strength that can be detected. (Default: 5)
- **[Edge gap lower lmt] (in pixel):** Specify the minimum distance between the edges pixels to help filter out noise (Default: 0).
- **[Edge sensitivity] (in %):** Specify the threshold value for recognizing edges (Default: 30).

### 3 After completing the settings, select [Input end].

## 6. Specifying the Detailed Conditions

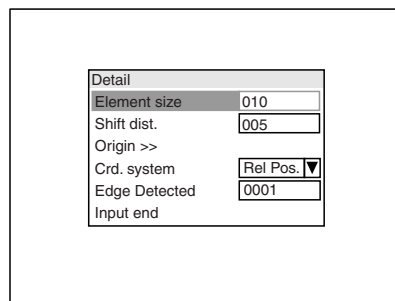
### 1 Select [Detail].



The [Detail] menu appears.

### 2 Implement the necessary setting.

When the setting is complete, select [Input end].



### Specify the size of the element.

You can specify the position using [Ref. anglr] on the [Detail] menu.

- **When the measurement area is a rectangle or a rotated rectangle,** you can specify the size of element in the range of 1 to 256 (pixels). However, an element that is larger than the meas window cannot be set.
- **When the measurement area is a ring or an arc,** you can specify the size of element in the range of 0.01° to 25.60° (angle).

### Specify the amount of movement of the element

You can specify it using [Shift dist] on the [Detail] menu.

- **When the measurement area is a rectangle or a rotated rectangle,** you can specify it in the range of 1 to 256 (pixels). However, an element that is larger than the measurement area cannot be set.
- **When the measurement area is a ring or an arc,** you can specify the size of element in the range of 0.01° to 25.60° (angle).



### Changing the Reference Position of Origin (Only when the measurement window is a rectangle.)

You can change the reference position of origin using [Origin] on the [Detail] menu.

You can make the necessary setting as shown below on the [Origin Selection] menu.

- **Desg.Orig.Pt.** (Default value): The origin point is set at the top left of the screen by default. However, you can freely specify the origin point by first selecting [Origin Pt.Select]. Move the [+] cursor to the position where you want to set the origin point and then press the [ESCAPE] button. The coordinates of the set position are displayed in the [Origin Value X = ] and [Origin Value Y = ] columns.
- **Reg.Scrn.Pt.:** The position of the "Detection point" in the pattern area is used as the origin point. The present origin point is displayed in the [Origin Value X =] and [Origin Value Y =] columns.

#### Reference

When you want to measure the amount of error (deviation) using the position where image is registered as the reference position, select [Reg.Scrn.Pos.].

### Selecting the coordinate axis after position is corrected

Select the coordinate axis using the [Crd. system] on the [Detail] menu as follows.

When the position correction (page 4-104) is not executed, setting of this item will have no effect on measurement.

- **[Rel Pos.] (default setting):** If position of source window has moved, amount of the error is reflected on the measurement.
- **[Abs Pos.]:** The distance from [Origin] set is measured.

### Among the detected multiple edges, specify the edge number to be the target of measurement.

You can specify it using the [No.Edge Det] on the [Detail] screen.

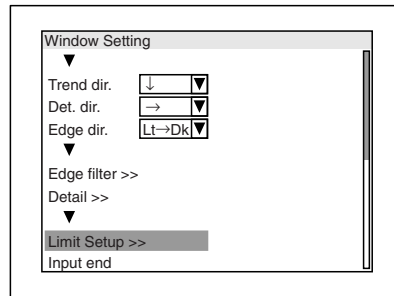
The edge numbers are given in the specified order of detecting direction.

## 7. Setting the Judgment Conditions

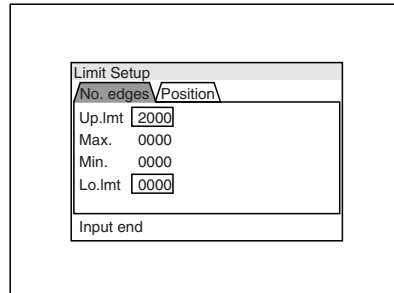
You can set the tolerance (upper limit value and lower limit value) for the measurement value.

If the measurement value exceeds the specified tolerance (upper limit and lower limit), an [NG] message is displayed. If it is within the specified tolerance, an [OK] message is displayed.

### 1 Select [Limit Setup].



### 2 Move the [ENTER] button to the right or left to select an item on which you want to specify tolerance.



### 3 Press the [ENTER] button to specify the lower limit value and the upper limit value of tolerance.

Contents of the judging conditions and units of tolerance are different depending on the shape of the measurement window.

- **No. edges:** The number of edges
- **Position:** The number of pixels (only when the measurement area is a rectangle or a rotated rectangle)
- **Rad. gap:** Angle (only when the measurement area is a ring or an arc.)

### 4 When you want to specify tolerance of other measurement values, press the [ESCAPE] button and repeat steps 2 and 3 as described above.

### 5 When setting is complete, press the [ESCAPE] button of the console and select [Input end].





# Trend Edge Gap

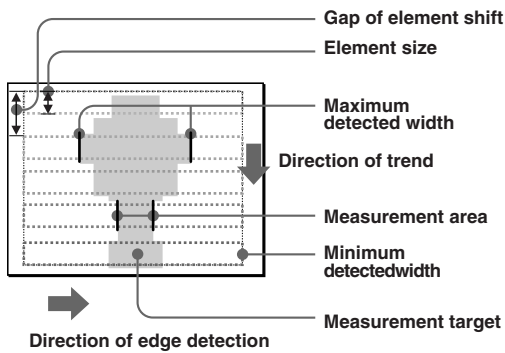
## What Is the [Trend edge gap] Measurement Mode?

Within a specified measurement area, an element of specific size is moved within the area to detect the width of outer or inner diameter and the number of edges. The average, maximum and minimum can be measured.

### Measurement image

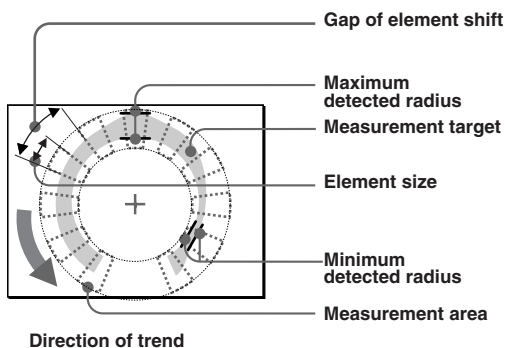
**Example: When the measurement area is a rectangle or a rotated rectangle**

- For cases in which the detecting direction is “→” and the direction of trend is “↓”,



**Example: When the measurement area is a ring or an arc**

- For cases in which the detecting direction is ↺ (counter-clockwise),



## Measurement result to be output

The measurement results that can be output in the trend edge gap measurement mode are shown below.

**When the measurement area is a rectangle or a rotated rectangle**

- No.edges** : The maximum number, minimum number, and average number of detected edges are output.
- Gap** : The maximum value, minimum value, and average value of the distance (outside or inside dimensions) between the edges are output.
- OK/NG** : If the measurement value exceeds the specified tolerance (upper or lower limits), a [NG] message is displayed. If it is within the specified tolerance, a [OK] message is displayed.

**When a measurement area is a ring or an arc**

- No.edges** : The maximum number, minimum number, and average number of detected edges are output.
- Rad. gap** : The maximum value, minimum value, and average value of the distance (outside or inside dimensions) between the edges in the radial direction are output.
- OK/NG** : If the measurement value exceeds the specified tolerance (upper or lower limits), a [NG] message is displayed. If it is within the specified tolerance, a [OK] message is displayed.

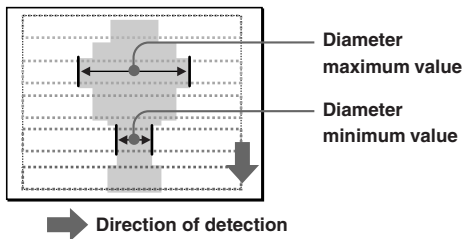


## Sample of measurement

### When the measurement area is a rectangle or rotated rectangle

Example showing the result of the measurement when the measurement is made under the following conditions:

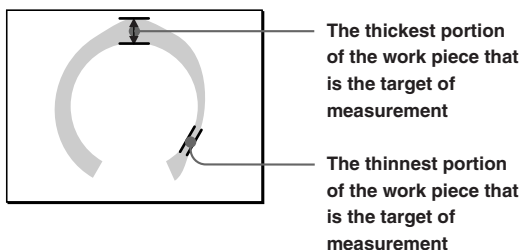
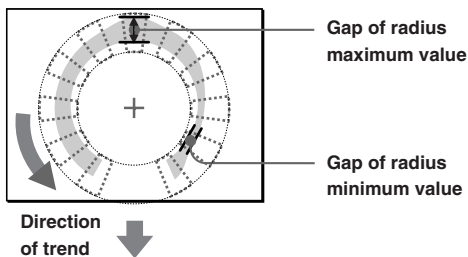
- Specify the detecting width: Outer diameter
- Direction of trend: ↓
- Direction of detection: →
- Edge direction: Both



### When the measurement area is a ring or an arc

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

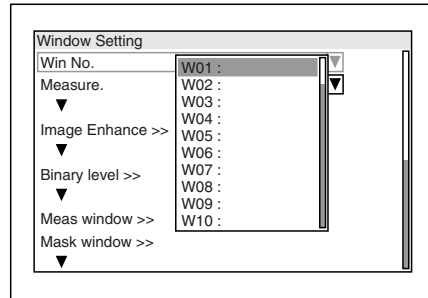
- Specify the detecting gap: Outer diameter
- Direction of trend: ↻ (counter-clockwise direction)
- Direction of detection: ↗ (direction toward outer circumference)
- Edge direction: Both



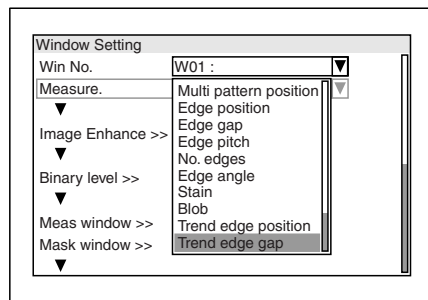
## 1. Selecting the Measurement Tool

Select the [Trend edge gap] measurement mode.

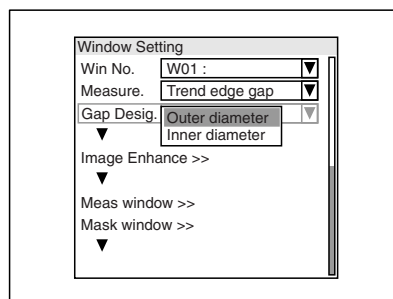
### 1 Select the measurement window. (page 4-20)



### 2 Select [Measure.] and then select [Trend edge gap].

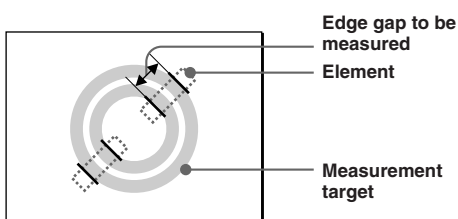
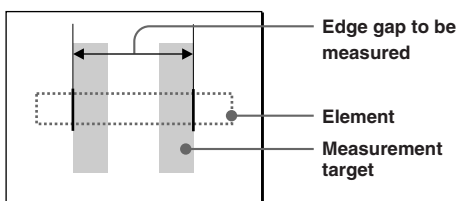


### 3 Select [Gap Desig.] and then select the type of edge gap to be used for detection.

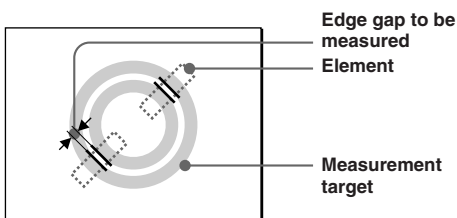
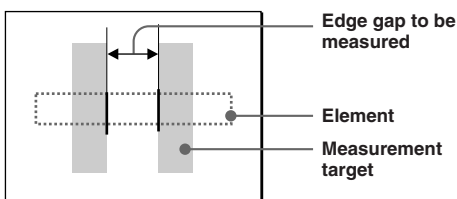




- **Outer diameter** (default setting): The distance between the outermost edges inside the window is measured.

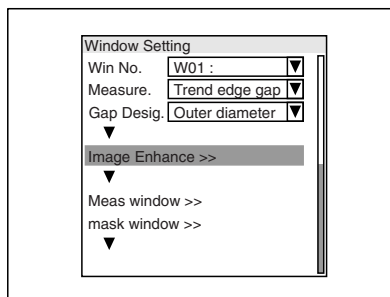


- **Outer diameter**: The distance between the inner-most edges inside the window is measured.



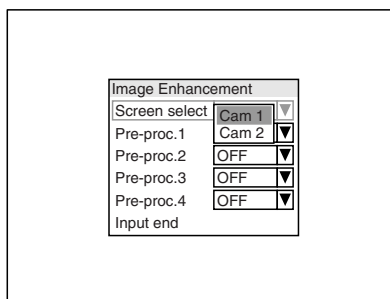
## 2. Selecting the Pre-processing Method of Images

### 1 Select [Image enhance].

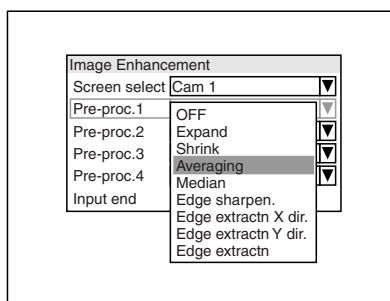


The [Image enhancement] menu appears.

### 2 Select the camera that you want to have an Image Enhancement.



### 3 Select the pre-processing number, then select Image Enhancement that you want to perform.



The contents of each process are shown below.

<b>OFF</b>	Pre-processing will not be executed.
<b>Expand</b>	The white pixels are expanded and the black pixel noise is removed.
<b>Shrink</b>	The white pixels are shrunk and the white pixel noise is removed.



<b>Averaging</b>	Intensity is averaged to remove noise.
<b>Median</b>	Noise is removed while the outline is maintained.
<b>Edge sharpen</b>	Region where there is a change in intensity is enhanced.
<b>Edge extractn X dir.</b>	Region where there is a change in intensity in the horizontal (X) direction is extracted.
<b>Edge extractn Y dir.</b>	Region where there is a change in intensity in the vertical (Y) direction is extracted.
<b>Edge extractn</b>	Region where there is a change in intensity is extracted.

Refer to the “Filter List” (page 15-2) for an example showing the Image Enhancements.

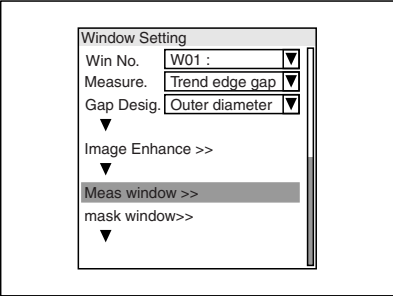
**Multiple Image Enhancements can be set.**  
When multiple Image Enhancements are set, they are executed starting from Pre-processing 1.  
Example: Pre-processing 1 (shrink) → Pre-processing 2 (expand) → Pre-processing 3 (shrink) → Pre-processing 4 (expand)

- 4 To set multiple Image Enhancements, repeat Steps 3 and 4.
- 5 After completing the settings, select [Input end].

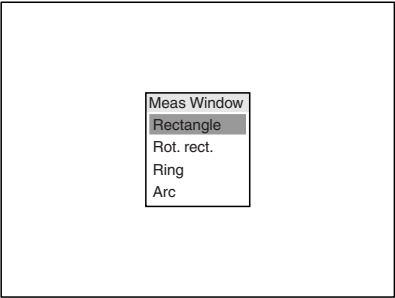
3. Setting the Measurement Area

**Reference**  
If the measurement area has a complicated shape, you can set the mask to hide the unwanted parts. For details, refer to “Hiding an unwanted area (mask window)” .

1 Highlight [Meas window].



2 Select the desired shape of the measurement area.



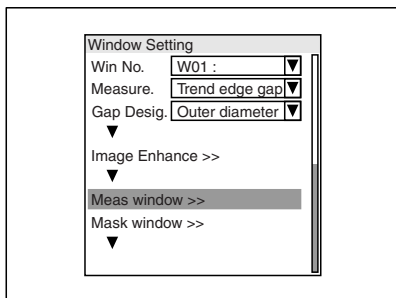
- 3 Draw the measurement area.  
Refer to “Drawing a Measurement Window” (page 3-5) for details.
- 4 After completing the Drawing, press the [ESCAPE] button on the remote control console.



## Clearing the measurement area

You can clear the specified measurement area that has been set by following the procedure below.

### 1 Highlight [Meas window].

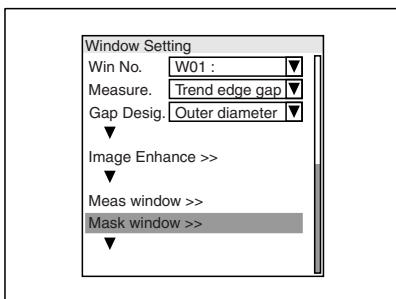


### 2 Press the [FNC] button on the console and select [Clear].

## Hiding an unwanted area (mask window)

You can set an area (mask window) that will not be measured inside the measurement area. This function is useful when the measurement area has a complicated shape and you want to hide an unwanted parts.

### Select [Mask window].



The [Mask Window] menu appears.

Refer to "Hiding the Measurement Window Partially (Mask Window)" (page 3-12) for the subsequent operations.

### Clearing the entire area of the mask window

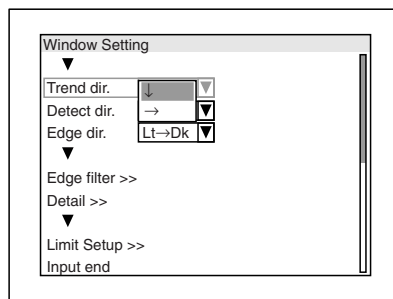
Move the cursor to the [Mask window]. Press the [FNC] button on the console on the setting screen of the mask window, then select [Clear].

### Clearing the shape of the mask window that has been set

Press the [FNC] button on the remote control console on the setting screen of the mask window, then select [Clear].

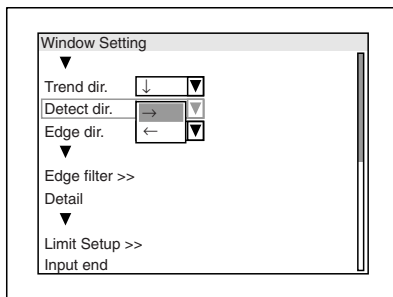
## 4. Setting the Detecting Direction / Edge Direction

### 1 Select [Trend dir.] and then select the direction element movement.



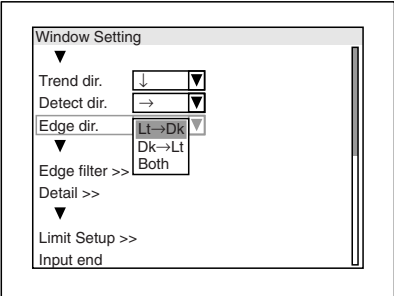
- When the measurement area is a rectangle: →, ↓
- When the measurement area is a rotated rectangle: ↓ (From the top to bottom only)  
When setting the measurement area, be careful that the direction that can be set for this shape is from top to bottom only.
- When the measurement area is a ring or an arc: ↺ (counterclockwise) only

### 2 Select [Detect dir.] and then select the edge direction to be detected.



- When the measurement area is a rectangle: The direction that is perpendicular to the trend direction selected by step 1 is set.
- When the measurement area is a rotated rectangle: "→" only
- When the measurement area is a ring or an arc: ↻ (Radial direction from outer circumference toward center point), ↻ (Direction toward outer circumference from center point)

3 Select [Edge dir.] and then select the direction of edge to be detected.



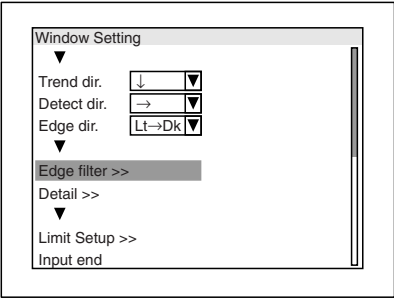
- **Lt → Dk:** Detects the transition for light to dark.
- **Dk → Lt:** Detects the transition from dark to light.
- **Both** (default): Detects transitions from both light to dark and dark to light.

5. Setting the Detecting Conditions

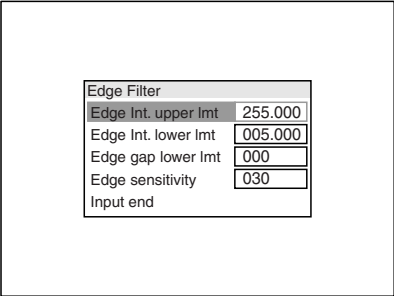
Reference

Edges are detected based on where transition in the 0-255 gray scale occur. Edge strength is the size of the transition (ex.Gray (50) to white (250) = Edge strength of 200). The [Edge int. upper lmt] and [Edge int. lower lmt] can be set to include or exclude edges based on the edge strength. For details, refer to “What is an Edge?” (page 15-3).

1 Select [Edge filter].



2 Specify the necessary conditions.



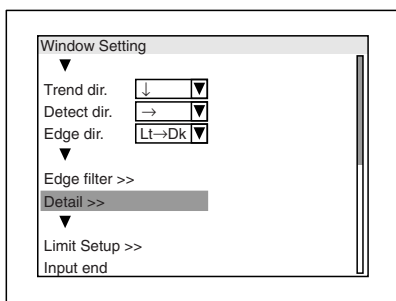
- **[Edge Int. upper lmt]:** Specify the upper limit of edge strength that can be detected (Default: 255).
- **[Edge Int. lower lmt]:** Specify the lower limit of edge strength that can be detected (Default: 5).
- **[Edge gap lower lmt] (in pixel):** Specify the minimum distance between the edges pixels to help filter out noise (Default: 0).
- **[Edge sensitivity] (in %):** Specify the threshold value for recognizing edges (Default: 30).

3 After completing the settings, select [Input end].



## 6. Specifying the Detailed Conditions

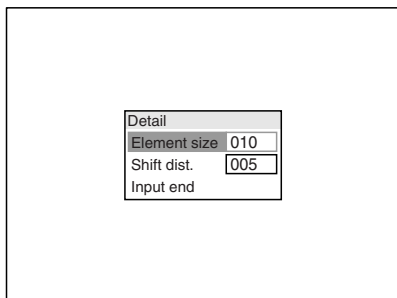
### 1 Select [Detail].



The [Detail] menu appears.

### 2 Make the necessary settings.

After completing the settings, select [Input end].



#### Specify the size of the element

You can specify it using [Element size] on the [Detail] screen.

- **When the measurement area is a rectangle or a rotated rectangle**, you can specify the size of element in the range of 1 to 256 (pixels). However, an element that is larger than the measurement area cannot be set.
- **When the measurement area is a ring or an arc**: you can specify the size of an element in the range of 0.01° to 25.60° (angle).

#### Specify the amount of movement of the element

You can specify it using [Shift dist.] on the [Details] screen.

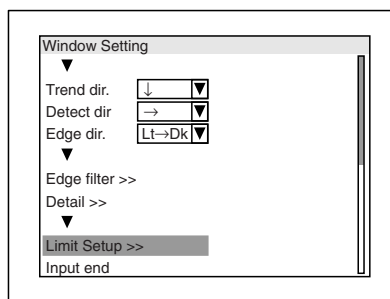
- **When the measurement area is a rectangle or a rotated rectangle** : you can specify the amount of movement in the range of 1 to 256 (pixels). However, an element that is larger than the measurement area cannot be set.
- **When the measurement area is a ring or an arc**: you can specify the size of element in the range of 0.01° to 25.60° (angle).

## 7. Setting the Limit Setup

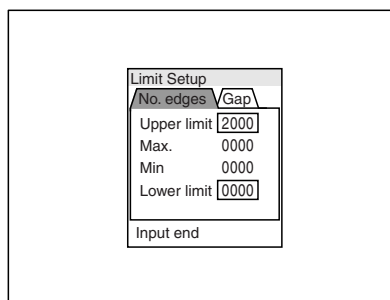
You can set the tolerance (upper and lower limits) for the measurement value.

If the measurement value exceeds the specified tolerance, a [NG] message is displayed. If it is within the specified tolerance, a [OK] message is displayed.

### 1 Select [Limit Setup].



### 2 Move the [ENTER] button to the right or left to select an item for which you want to specify the tolerance.



### 3 Press the [ENTER] button to specify the lower and upper limit values of the tolerance.

The contents of the judging conditions and units of tolerance are different depending on the shape of the measurement area.

- **No. edge**: The number of edges
- **Gap**: The number of pixels (only when the measurement area is a rectangle or rotated rectangle)
- **Rad.gap**: Angle (only when the measurement area is a ring or an arc.)

### 4 To specify the tolerance of other measurement values, press the [ESCAPE] button and repeat Steps 2 and 3 as described above.

### 5 After completing the settings, press the [ESCAPE] button on the remote control console and select [Input end].

# Intensity Inspection

4



Specifying the Units (Windows) for Inspections and Measurements

## What is the [Intensity] Measurement Mode?

You can measure the maximum, minimum and average values of intensities within a measurement area as well as the deviation in average intensity from inspection to inspection.

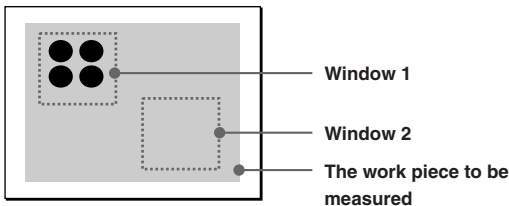
If you have measured the average intensity of the target and that of the background, you can inspect the presence/absence of parts by comparing their intensity differential.

### Note

To obtain the intensity differential, the calculation feature is used.

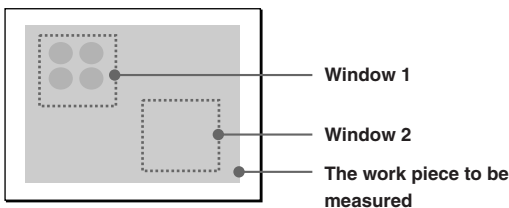
## Measurement image

### Example: When the intensity differential is large



- Average intensity of window 1: 50
- Average intensity of window 2: 200
- Intensity differential: 150

### Example: When the intensity differential is small



- Average intensity of window 1: 150
- Average intensity of window 2: 200
- Intensity differential: 50

## Measurement results

The measurement results that can be output in the [Intensity] inspection measurement mode are shown below.

### When the measurement area is a rectangle or a rotated rectangle

- **Average intensity:** The average intensity in the measurement area is output on a scale of 0 to 255.
- **Maximum intensity:** The maximum intensity (the brightest part) in the measurement area is output.
- **Minimum intensity:** The minimum intensity (the darkest part) in the measurement area is output.
- **Intensity deviation:** The intensity deviation in the measurement area is output. This deviation represents the variation level in the intensity of each pixel.
- **OK/NG:** If the measurement value exceeds the specified tolerance (upper and lower limits), a [NG] message is displayed. If it is within the specified tolerance, a [OK] message is displayed.

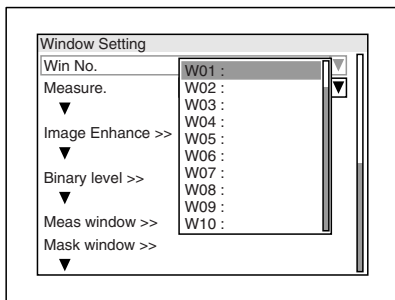




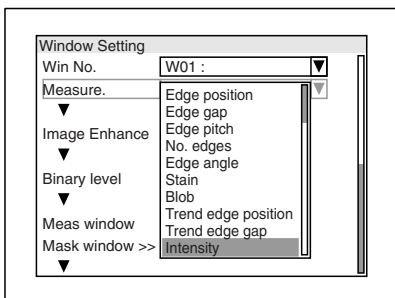
## 1. Selecting the Measurement Method

Select the [Intensity] measurement mode.

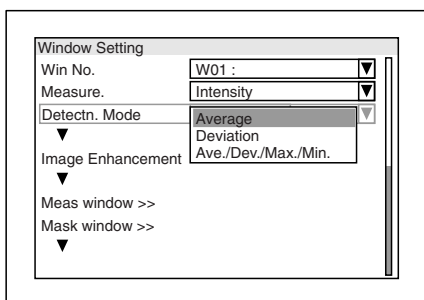
### 1 Select the measurement window. (page 4-20)



### 2 Select [Measure.] and then select [Intensity].



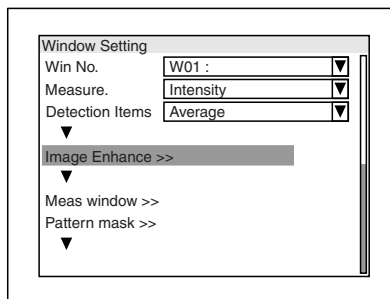
### 3 Select [Detectn. Mode] and then select the intensity measurement items.



- **Average:** Measures the average value for intensity.
- **Deviation:** Measures the deviation of intensity.
- **Ave./dev./max./min.:** Measures the average intensity, the deviation, the maximum and the minimum density.

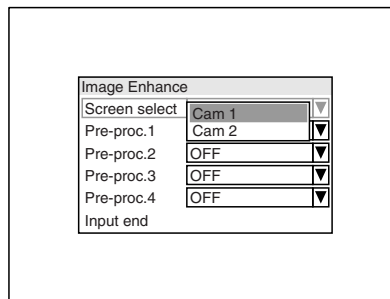
## 2. Selecting the Pre-processing Method of images

### 1 Select [Image enhance].

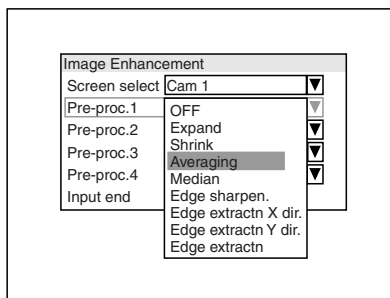


The [Image enhancement] menu appears.

### 2 Select the camera that you want to have an Image Enhancement.



### 3 Select the pre-processing number, then select Image Enhancement that you want to perform.



The contents of each process are shown below.

<b>OFF</b>	Pre-processing will not be executed.
<b>Expand</b>	The white pixels are expanded and the black pixel noise is removed.
<b>Shrink</b>	The white pixels are shrunk and the white pixel noise is removed.

- Averaging** Intensity is averaged to remove noise.
- Median** Noise is removed while the outline is maintained.
- Edge sharpen**  
Region where there is a change in intensity is enhanced.
- Edge extractn X dir.**  
Region where there is a change in intensity in the horizontal (X) direction is extracted.
- Edge extractn Y dir.**  
Region where there is a change in intensity in the vertical (Y) direction is extracted.
- Edge extractn**  
Region where there is a change in intensity is extracted.

Refer to the “Filter List” (page 15-2) for an example showing the Image Enhancements.

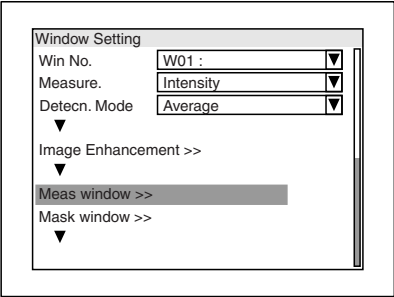
**Multiple Image Enhancements can be set.**  
When multiple Image Enhancements are set, they are executed starting from Pre-processing 1.  
Example: Pre-processing 1 (shrink) → Pre-processing 2 (expand) → Pre-processing 3 (shrink) → Pre-processing 4 (expand)

- 4 To set multiple Image Enhancements, repeat Steps 3 and 4.**
- 5 After completing the settings, select [Input end].**

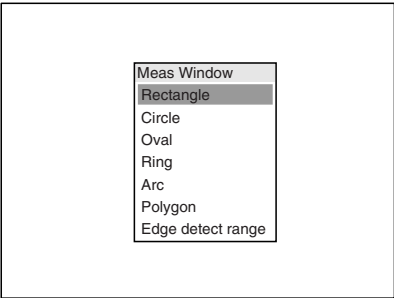
3. Setting the Measurement Area

**Reference**  
If the measurement area has a complicated shape, you can set the mask to hide the unwanted parts. For details, refer to “Hiding an unwanted area (mask window)” .

1 Highlight [Meas window].



2 Select the desired shape of the measurement area.

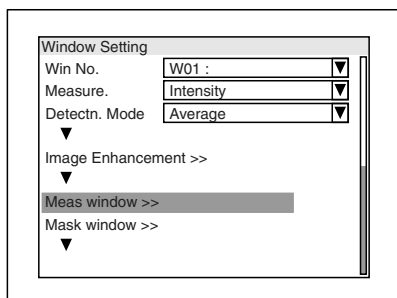


- 3 Draw the measurement area.**  
Refer to “Drawing a Measurement Window” (page 3-5) for details.
- 4 After completing the Drawing, press the [ES-CAPE] button on the remote control console.**

## Clearing the measurement area

You can clear the specified measurement area that has been set by following the procedure below.

### 1 Highlight [Meas window].

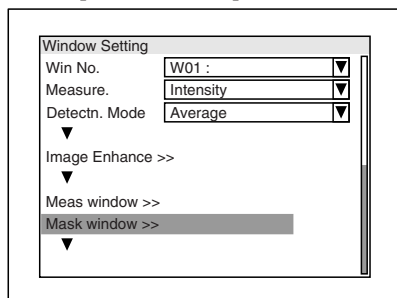


### 2 Press the [FNC] button on the console and select [Clear].

## Hiding an unwanted area (mask window)

You can set an area (mask window) that will not be measured inside the measurement area. This function is useful when the measurement area has a complicated shape and you want to hide an unwanted parts.

### Select [Mask window].



The [Mask Window] menu appears.

Refer to "Hiding the Measurement Window Partially (Mask Window)" (page 3-12) for the subsequent operations.

### Clearing the entire area of the mask window

Move the cursor to the [Mask window]. Press the [FNC] button on the console on the setting screen of the mask window, then select [Clear].

### Clearing the shape of the mask window that has been set

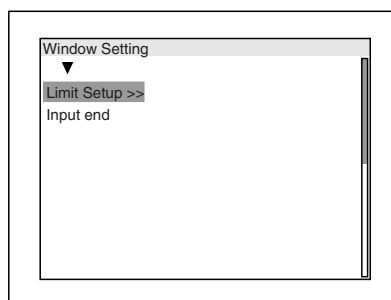
Press the [FNC] button on the remote control console on the setting screen of the mask window, then select [Clear].

## 4. Specifying the Judging Conditions

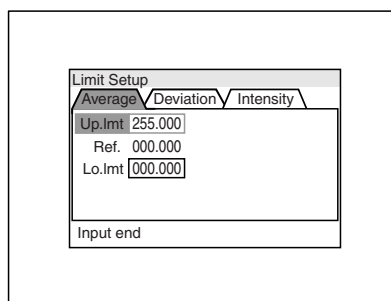
You can specify the tolerance (upper and lower limits) for the measurement values.

If the measurement value exceeds the specified tolerance, a [NG] message is displayed. If it is within the specified tolerance, a [OK] message is displayed.

### 1 Select [Limit Setup].



### 2 Select the item for which you want to set the tolerance by moving the [ENTER] button to the right and left.



### 3 Press the [ENTER] button to specify the upper and lower limits of the tolerance.

The limit setup varies depending on the measurement items.

- **Average:** The level of brightness (0 - 255)
- **Deviation:** The level of brightness (0 - 128)
- **Intensity:** The maximum and minimum level of brightness (0 - 255)

### 4 To set the tolerance for other measurement values, press the [ESCAPE] button and repeat Steps 2 and 3.

### 5 After completing the settings, select [Input end].

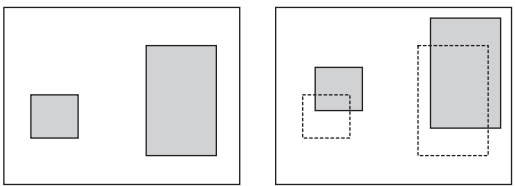


# 4-5 Making Position Adjustments ([Position Adjustment])

- 4-1 Program No. p.4-2
- 4-2 Camera p.4-5
- 4-3 Image Registration p.4-16
- 4-4 Window/Inspection tools p.4-18
- 4-5 Position Adjustment p.4-104**
- 4-6 Calculation p.4-109
- 4-7 Output Settings p.4-119
- 4-8 Save p.4-125

## Overview of Position Adjustments

For cases in which the measurement areas are fixed, even a slight misalignment of the target being inspected will make it difficult to obtain correct measurements.



Example of reference images      Example of misaligned images

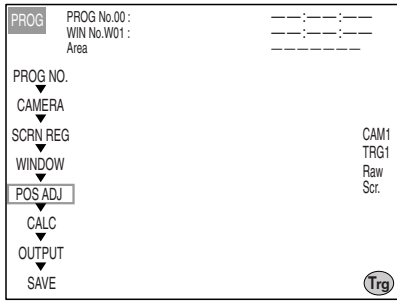
In order that correct measurements can be made, you can specify an adjustment window and have the adjustment window's misalignment information automatically update the new position data to the measurement areas in other windows. This capability is referred to as the position adjustment function.

With the CV-2100, not only can you specify a single adjustment window and use it for position adjustments for all other windows (batch adjustments), but you can also specify multiple adjustment windows and use them one at a time for position adjustments for each individual window (individual adjustments).

### Displaying the [Position Adjustment] menu

To make position adjustment settings, display the [Position Adjustment] screen by performing the following steps.

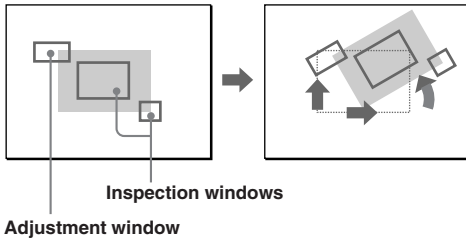
- 1 Perform the setting procedure as described in “4-1 Program No.” (page 4-2) and “4-4 Window” (page 4-18).
- 2 Select [POS ADJ].



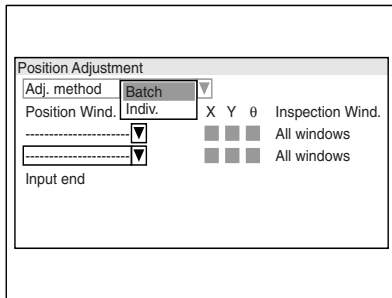
The [Position Adjustment] menu appears.

# Making Position Adjustments for All Windows Collectively ([Batch])

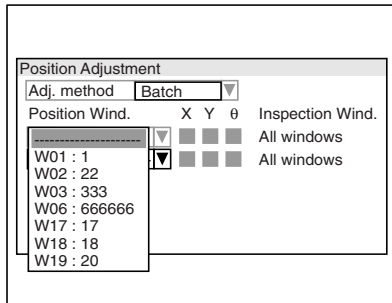
In this mode of adjustment, you specify a single adjustment window and perform position adjustments for all other windows at once.



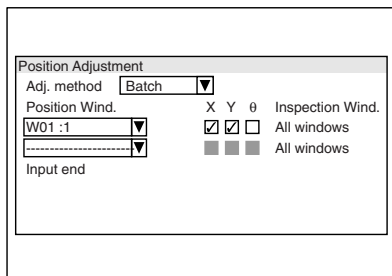
- 1 Select [Adj.Method] on the [Position Adjustment] menu and select [Batch].



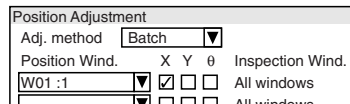
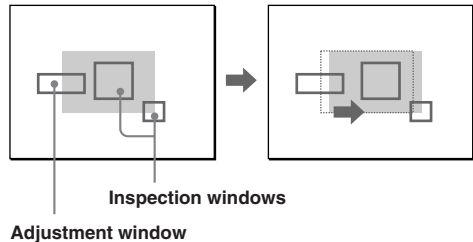
- 2 Select [Position Wind.] and then select a window to serve as an adjustment window (position window) for position adjustment.



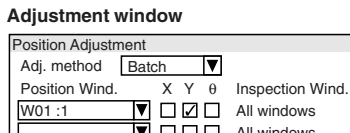
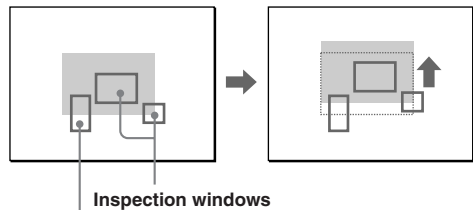
- 3 Select the items for which you want to perform adjustment and checkmark the box for each item.



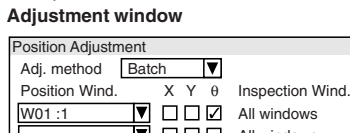
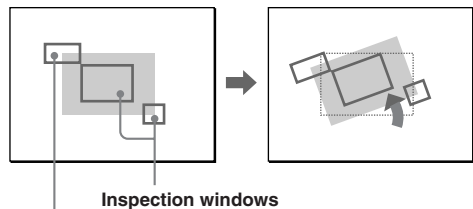
- X: Makes a position adjustment in the horizontal (X) direction.



- Y: Makes a position adjustment in the vertical (Y) direction.



- θ: Makes an adjustment for a rotated angle (θ).



- 4 After specifying all of the settings, select [Input end].

## Reference

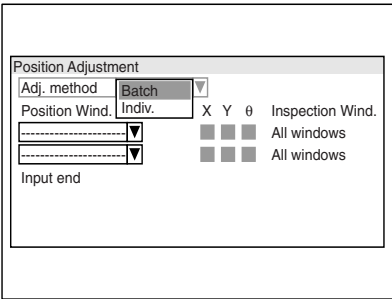
If you checkmark two or more items in the above-mentioned Step 3, correction of misalignment for the X, Y, and  $\theta$  components becomes possible.

# Making Position Adjustments for Each Window (Individual)

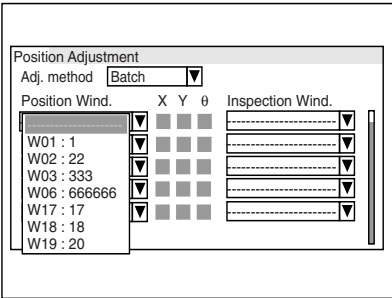
Use the individual position adjustment function for making a position adjustment for a specific window using an adjustment (position) window you have specified, bringing the window in agreement with the position window's displacement.

Refer to “Hints for position adjustment” (page 4-107) for examples of using this function.

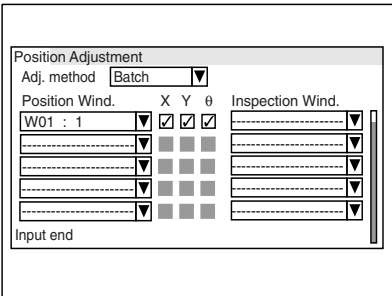
- 1 Select [Adj. Method] on the [Position Adjustment] menu, and select [Indiv.]



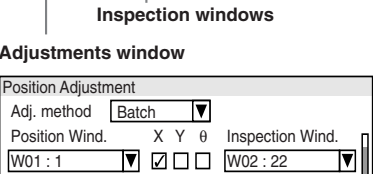
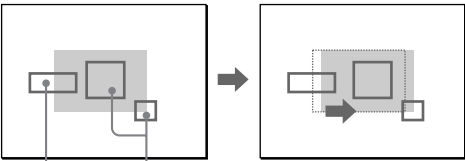
- 2 Select [Position Wind.] and then select a window to serve as an adjustment window for position adjustment.



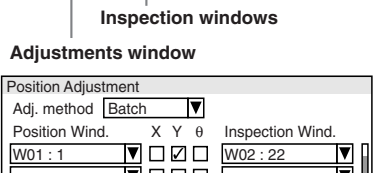
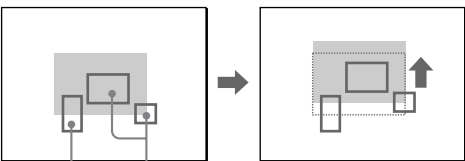
- 3 Select the items for which you want to perform adjustments and checkmark the box for each item.



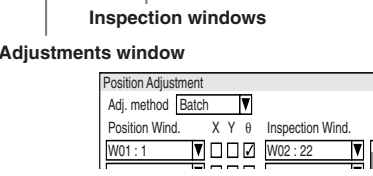
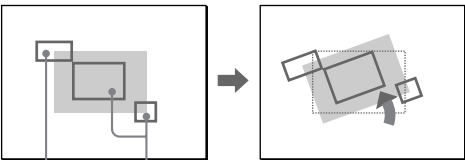
- **X**: Makes a position adjustment in the horizontal (X) direction.



- **Y**: Makes a position adjustment in the vertical (Y) direction.



- **θ**: Makes an adjustment for a rotated angle ( $\theta$ ).





- 4** Select [Inspection Wind.] and select the window (inspection window) for which you want to make position adjustments with respect to the adjustment window.

- 5** Repeat steps 2 through 4 for as many position adjustment that are required for the inspection.
- 6** After specifying all of the settings, select [Input end].

## Hints for position adjustment

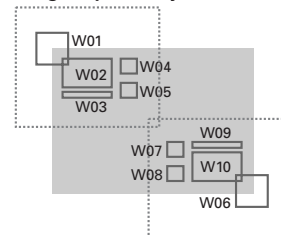
Although problems in ordinary measurement cases may be solved with batch position adjustment, individual position adjustment is useful in cases such as the following.

### When using two cameras

Set adjustment windows at two opposite ends, respectively, and use each of the adjustment windows for correcting the window in the closer vicinity.

The following figure shows an example of having two cameras connected to measure a large target.

Range captured by camera 1



Range captured by camera 2

In such a case, if you make position adjustments collectively (batch adjustment) using Window W01 as the adjustment window, and if an angular misalignment develops, the displacements for the range captured by Camera 2 become too large, thus making correct measurement impossible.

For this reason, it is desirable to set the position to W01 for the range captured by Camera 1 and W02 for the range captured by Camera 2 and make the position adjustments on a one-by-one basis.

**Position adjustments for the range captured by Camera 1 (adjustment: W01)**

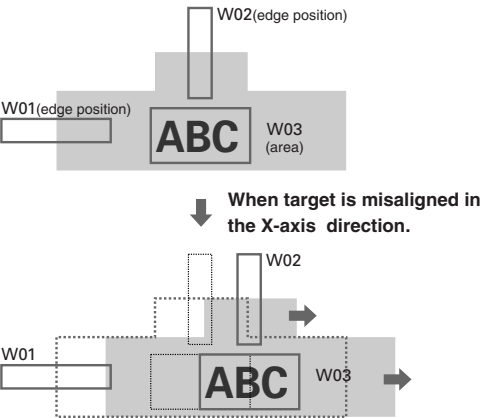
Adjustments are made for all of X, Y, and  $\theta$ .

**Position adjustments for the range captured by Camera 2 (adjustment: W06)**

Adjustments are made for all of X, Y, and  $\theta$ .

When giving high priority to displacement in the X-axis direction

This example is for cases where work as shown in the following figure is to be measured and position adjustment for W03 is performed using different adjustment windows for the X and Y directions. First, the adjustment is made for the X-direction position using W01, and then for the Y-direction position using W02.



In such cases, the following adjustments procedure becomes necessary:

- First make W01 the adjustment window for both W02 and W03(X-axis correction).
- Next make W02 the adjustment window for W03 (Y-axis correction).

In other words, based on the misalignment information obtained by measurements on W01, misalignments in the X-axis direction are adjusted for W02 and W03 first, then the misalignment of W03 in the Y-axis direction is adjusted based on W02.

Position Adjustment				
Adj. method		Batch		
Position Wind.	X	Y	θ	Inspection Wind.
W01	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	W02
W01	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	W03
W02	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	W03
.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Input end				

In this case, specifying the settings as shown below would make position adjustments possible.

Position Adjustment				
Adj. method		Batch		
Position Wind.	X	Y	θ	Inspection Wind.
W01	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	W02
W02	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	W03
.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Input end				





## 4-6 Calculating the Measurement Results (Calculation)

### 4-1 Program No. p.4-2

### 4-2 Camera p.4-5

### 4-3 Image Registration p.4-16

### 4-4 Window/Inspection tools p.4-18

### 4-5 Position Adjustment p.4-104

### 4-6 Calculation p.4-109

### 4-7 Output Settings p.4-119

### 4-8 Save p.4-125

## Overview of the Calculation Settings

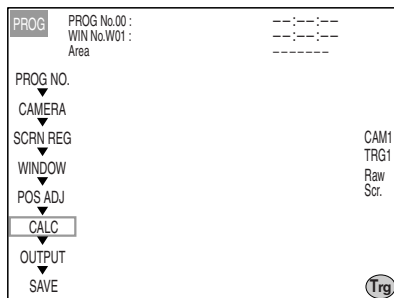
You can specify an arithmetic expression to make an evaluation of [OK] or [NG] based on the overall consideration for evaluation and measurement values. There are two features for calculation: the calculation that uses the measurement data with various operators and the status calculation to make a final evaluation of either [OK] or [NG].

For both types of calculations, multiple calculation results can be substituted for another arithmetic expression so that complex evaluations based on different evaluation results and measurement values can be covered.

### Displaying the [Calculations] menu

Calculation setting is performed in the [Calculations] menu.

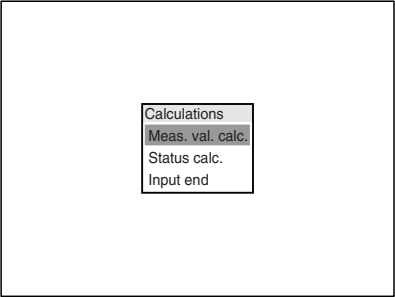
- 1** Specify the settings of “4-1 Program No.” (page 4-2) to “4-5 Position Adjustment” (page 4-104).
- 2** Select [CALC].



The [Calculations] menu appears.

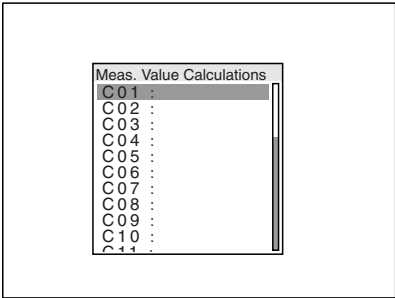
# Calculating the Measurement Value (Measured Value Calculation)

- 1** Select [Meas val. calc.] on the [Calculations] menu.



- 2** Specify the [Meas.Value calculations] to register the arithmetic expression for calculating the measurement values.

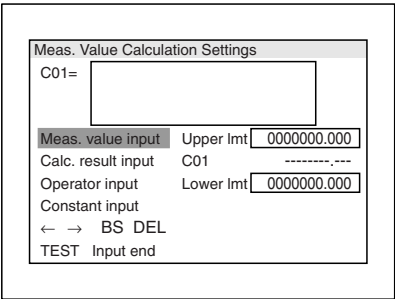
With this system, the calculation is made in the unit of [calculation window]. The calculation window is expressed as [Cxx], (where xx is the 2-digit number). Up to 32 windows can be set.



The [Meas.Value Calculation Settings] menu appears.

**Reference**  
The calculation windows that are already set are displayed with an “\*” (asterisk) attached.

- 3** Enter the an arithmetic expression.



If you enter an arithmetic expression, the result of the calculation is displayed in the field of the calculation window No. shown on the right part of the screen.

## Entering a measurement value input

Select this when you enter the specified measurement value.

The screen to select the measurement window and the screen to select the measurement items to be used are displayed. Select the desired measurement window, measurement value, judgment value, and specified value that you want to use for arithmetic expression.

**Reference**  
When using the judgment value in the arithmetic expression, “1” stands for OK, and “0” for NG.

## Entering a “Calculation result input”

Select this when you want to use the calculation result of other calculation window as an arithmetic expression.

A list of calculation numbers for selection is displayed on the screen. Select the calculation window that you want to use.

## Entering the “Operator input”

Select this when you enter the symbols of operation. Following calculations are supported in this system.

+, -, *, /	Four rules of arithmetic (addition, subtraction, multiplication and division)
Abs (P)	Absolute value of P Example: abs (-128) = 128
Mod (P0, P1)	Remainder of the P1 into P0 Example: Mod (29, 7) = 1 (29 = 7 x 4 + 1 )
Sin (P)	Sine value of P(°)
Cos (P)	Cosine value of P(°)
Atan (P)	Arctangent vale of P(°) Example: Atan(1) = 45
Dist (Q1, Q2)	The distance between Q1 and Q2 (in pixels). For Q1 and Q2, use the values calculated from the center of gravity of the blobs.

### Angl (Q1, Q2)

The angle that is made by a horizontal line and the line segment from Q1 to Q2. The angle is calculated with Q1 as a center. The angle value is positive if the angle is counterclockwise from the horizontal line.



### Sqr (P)

P squared  
Example: Sqr (2) = 4

### Sqrt (P)

Square root of P  
Example: Sqrt (256) = 16

### Max (P0, P1)

The larger value of P0 and P1  
Example: Max (8, 9) = 9

### Min (P0, P1)

The smaller value of P0 and P1  
Example: Min (17, 7) = 7

### Entering the constant input

Select this if you enter a numeric constant.

#### When you correct the arithmetic expression:

- You can delete the previous character by pressing the <BS> key and delete the character prompted by the cursor by pressing the <Del> key.
- To move the position to be corrected, use the arrow keys to move the cursor in the arithmetic expression.

**4** Set the [Upper limit] and the [Lower limit] as required.

**5** When the setting is complete, select [Input end].

### To confirm the result of the arithmetic expression that has been entered:

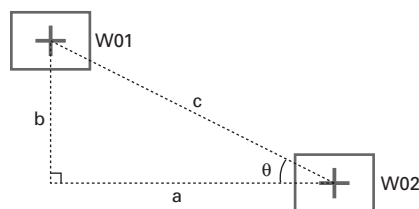
Enter the arithmetic expression and select [TEST] in the [Meas.Value Calculation Settings] menu.

The calculation is made and the result is displayed between the upper limit and the lower limit of the judgment. If the judgment value is [OK], [1] is displayed, whereas if [NG], [0] is displayed.

## Example of Calculation

Under the following conditions, the length of a, b, c, and an angle  $\theta$  are to be calculated.

- W01: Pattern search
- W02: Pattern search



### 1. An example of the arithmetic expression to calculate the length a.

$C01 = W02.X.MS - W01.X.MS$

#### Reference

If the absolute value is to be calculated, the following arithmetic expression is used.

$C01 = \text{Abs} (W02.X.MS - W01.X.MS)$

### 2. An example of the arithmetic expression to calculate the length b

$C02 = W02.Y.MS - W01.Y.MS$

#### Reference

If the absolute value is to be calculated, the following arithmetic expression is used.

$C02 = \text{Abs} (W02.Y.MS - W01.Y.MS)$

### 3. An example of the arithmetic expression to calculate the length c.

$C03 = \text{Dist} (W01.XY.MS, W02.XY.MS)$

### 4. An example of the arithmetic expression to calculate the angle $\theta$

$C04 = \text{Abs} (\text{Angl}(W01.XY.MS, W02.XY.MS))$

Since the angle W02 is calculated based on a horizontal line parallel to the X axis passing through the detected points of W01, the angle  $\theta$  will be the negative value. In the above example, Abs is used to obtain the positive value.

#### Reference

If the angle is calculated with W02 as the center, specify W02 as a first argument. In this case, the angle  $\theta$  can be obtained by subtracting the calculated value from the  $180^\circ$ .

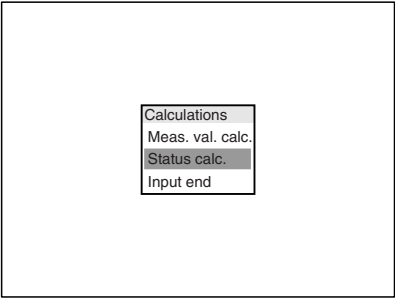
Example:  $C04 = 180 - \text{Angl} (W02.XY.MS, W01.XY.MS)$

The following arithmetic expression is used when applying the arctangent function.

$C04 = \text{Atan} ((W02.Y.MS - W01.Y.MS)/(W02.X.MS - W01.X.MS))$

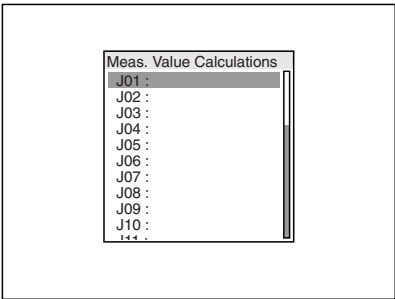
# Calculating the Evaluation Results (Status Calculations)

1 Select [Status calc.] on the [Calculations] menu.



2 Specify [Meas. Value Calculations] to register the arithmetic expression for calculating the evaluation value.

With this system, the status calculation is made in the [Status calculation window]. The status calculation window is expressed as [Jxx] (where xx is a two-digit number). Up to 32 windows can be set.

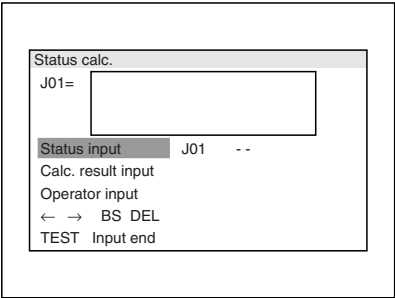


The [Status calc.] menu appears.

Reference

The status calculation windows that are already set are displayed with an asterisk “\*” mark.

3 Enter the arithmetic expression.



If you enter an arithmetic expression, the result of the calculation is displayed in the field of the status calculation window shown on the right part of the screen.

Entering a “status input”

Select this to enter the specified evaluation value. The screen to select the measurement window and the screen to select the measurement items to be used are displayed. Select the measurement window, measurement value, evaluation value, and specified value that you want to use for the arithmetic expression.

Entering a status calculation result

Select this for using the calculation results of another status calculation windows as an arithmetic expression.

A list of calculation numbers for selection is displayed on the screen. Select the status calculation window that you want to use

Entering the operator(s) and function(s)

Select this for entering the symbols of the operation. The following calculations are supported by this system.

AND	Logical multiplication Example: If any window from J01 to J03 is NG, J04 should be NG. J04 = J01.JG AND J02. JG AND J03. JG
OR	Logical add Example: If one window from J01 to J03 is OK, J04 should be OK. → J04 = J01.JG OR J02.JG OR J03.JG
NOT	Reverse Example: If J01 is reversed → NOT J01.JG
XOR	Exclusive OR

When you correct the arithmetic expression:

- You can delete the previous character by pressing the <BS> key and delete the character prompted by the cursor by pressing the <Del> key.
- To move the position to be corrected, use the arrow keys to move the cursor within the arithmetic expression.

4 After completing the settings, select [Input end].

To confirm the result of the arithmetic expression that has been entered:

Enter the arithmetic expression and select [TEST] on the [Status calc.] screen. The calculation is made and the result is displayed. If the evaluation value is [OK], [1] is displayed, whereas if the evaluation is [NG], [0] is displayed.



## Measured value calculation symbol table

### Reference

- **Set value (ST):** The value obtain from the registering images.
- **Measurement value (MS):** Measurement result.
- **Absolute measurement value (AB):** A measurement value before specifying the origin or calibrating. This value is based on the origin positioned at the top left of the screen.
- **Coordinates (XY):** Indicates the coordinates. Used as arguments for Dist ( ) or Angle ( ).
- **Center of coordinates (CXY):** The center coordinate of the measurement window.

### Areas

Content	Measurement options	Symbol	Type options	Symbol	Remark
Evaluation value	Evaluation value	JG			
Area value	Area	AR	Set value Measurement value Evaluation value	ST MS JG	

### Pattern search

Content	Measurement options	Symbol	Type options	Symbol	Remark
Evaluation value	Evaluation value	JG			
Position	Position X	X	Set value	ST	
			Measurement value	MS	
			Absolute measurement value	AB	
			Evaluation value	JG	
	Position Y	Y	Set value	ST	
			Measurement value	MS	
			Absolute measurement value	AB	
			Evaluation value	JG	
	Position	XY	Set value Measurement value Absolute measurement value	ST MS AB	
Angle	Angle		Set value	ST	
			Measurement value	MS	
			Absolute measurement value	AB	
			Evaluation value	JG	
Correlation value	Correlation value	C	Set value	ST	
			Measurement value	MS	
			Evaluation value	JG	



## Multiple pattern search

Content	Measurement options	Symbol	Type options	Symbol	Remark
Evaluation value	Evaluation value	JG			
Number	Number	N	Set Value Measurement value Evaluation value	ST MS JG	
Position	Position X	X	Set Value	ST	The specified blob is the target.
			Measurement value	MS	
			Absolute measurement value	AB	
			Evaluation value	JG	
	Position Y	Y	Set Value	ST	
			Measurement value	MS	
			Absolute measurement value	AB	
			Evaluation value	JG	
	Position	XY	Evaluation value Measurement value Absolute measurement value	ST MS AB	
Angle	Angle	T	Set value Measurement value Absolute measurement value Evaluation value	ST MS AB JG	The specified blob is the target.
Correlation value	Correlation value	C	Set value Measurement value Evaluation value	ST MS JG	

## Edge position

Content	Measurement options	Symbol	Type options	Symbol	Remark
Evaluation value	Evaluation value	JG			
Number of edges	Number of edges	N	Set value Measurement value Evaluation value	ST MS JG	
Edge detection position	Position X	X	Set value	ST	Valid only when the shape of the measurement area is a rectangle.
			Measurement value	MS	
			Absolute measurement value	AB	
			Evaluation value	JG	
	Position Y	Y	Set value	ST	
			Measurement value	MS	
			Absolute measurement value	AB	
			Evaluation value	JG	
	Position	XY	Set value	ST	
			Measurement value	MS	
			Evaluation value	JG	
	Position	P	Set value Measurement value Evaluation value	ST MS JG	Valid only when the shape of the measurement area is a rotated rectangle.
Angle	Angle		Set value Measurement value Evaluation value	ST MS JG	Valid only when the shape of the measurement area is a ring or an arc.
Center coordinate	Center coordinate X	CX	Absolute measurement value	AB	
	Center coordinate Y	CY	Absolute measurement value	AB	
	Center coordinate	CXY	Absolute measurement value	AB	
Average diameter	Diameter	R	Measurement value	MS	



## Edge gap

Content	Measurement options	Symbol	Type options	Symbol	Remark
Evaluation value	Evaluation value	JG			
Number of edges	Number of edges	N	Set value Measurement value Evaluation value	ST MS JG	
Edge detection gap (rectangle)	Gap	W	Set value Measurement value Evaluation value	ST MS JG	Valid only when the shape of the measurement area is a rectangle or a rotated rectangle.
Edge detection angle gap (arc)	Angle Gap	WT	Setting value Measurement value Evaluation value	ST MS JG	Valid only when the shape of the measurement area is a ring or a circular arc.

## Edge pitch

Content	Measurement options	Symbol	Type options	Symbol	Remark
Evaluation value	Evaluation value	JG			
Number of pitches	Number of pitches	N	Set value Measurement value Evaluation value	ST MS JG	
Maximum gap pitch at the center	Maximum distance	WH	Set value Measurement value	ST MS	Valid only when the shape of the measurement area is a rectangle.
Minimum gap pitch at the center	Minimum distance	WL	Set value Measurement value	ST MS	
Average gap pitch at the center	Average gap gap	WA W	Set value Measurement value Evaluation value	ST MS JG	
Maximum gap pitch angle at the center	Maximum angle gap	WTH	Set value Measurement value	ST MS	Valid only when the shape of the measurement area is a ring or a circular arc.
Minimum gap pitch angle at the center	Minimum angle gap	WTL	Set value Measurement value	ST MS	
Average gap pitch angle	Average angle gap Average angle	WTA WT	Set value Measurement value Evaluation value	ST MS JG	
Center coordinate	Center coordinate X Center coordinate Y Center coordinate	CX CY CXY	Absolute measurement value Absolute measurement value Absolute measurement value	AB AB AB	
Diameter	Diameter	R	Measurement value	MS	

## Number of edges

Content	Measurement options	Symbol	Type options	Symbol	Remark
Evaluation value	Evaluation value	JG			
Number of edges	Number of edges	N	Set value Measurement value Evaluation value	ST MS JG	



## Edge angle

Content	Measurement options	Symbol	Type options	Symbol	Remark
Evaluation value	Evaluation value	JG			
Edge angle	Angle	T	Set value Measurement value Absolute measurement value Evaluation value	ST MS AB JG	
Edge position <sup>1)</sup>	Position X1	X1	Set value Absolute measurement value	ST AB	
	Position Y1	Y1	Set value Absolute measurement value	ST AB	
	Position 1	XY1	Set value Absolute measurement value	ST AB	
	Position X2	X2	Set value Absolute measurement value	ST AB	
	Position Y2	Y2	Set value Absolute measurement value	ST AB	
	Position 2	XY2	Set value Absolute measurement value	ST AB	
Center coordinate <sup>2)</sup>	Center coordinate X	CX	Absolute measurement value	AB	
	Center coordinate Y	CY	Absolute measurement value	AB	
	Center coordinate	CXY	Absolute measurement value	AB	

1) Position X1 Position Y1 and Position 1 are detection results for the first segment. Position X2, Position Y2 and Position 2 are detection results for the second segment.

2) Center coordinate: This is the center point between position 1 and position 2.

## Stain

Content	Measurement options	Symbol	Type options	Symbol	Remark
Evaluation value	Evaluation value	JG			
Number of stains	Stain quantity	SL	Set value Measurement value Evaluation value	ST MS JG	

## Blob

Content	Measurement options	Symbol	Type options	Symbol	Remark
Evaluation value	Evaluation value	JG			
Number of counts	Number of blobs	N	Set value Measurement value Judgment value	ST MS JG	
Area	Area	AR	Set value Measurement value Evaluation value	ST MS JG	Valid only when the detected items are selected.
Center of gravity	Center of gravity X	X	Set value Measurement value Absolute measurement value	ST MS AB	
	Center of gravity Y	Y	Evaluation value Set value Measurement value Absolute measurement value	JG ST MS AB	
	Center of gravity XY	XY	Evaluation value Set value Measurement value Absolute measurement value	JG ST MS AB	





Feret diameter	Feret diameter X	FX	Set value	ST	Valid only when the detected items are selected.
			Measurement value	MS	
			Evaluation value	JG	
	Feret diameter Y	FY	Set value	ST	
			Measurement value	MS	
			Evaluation value	JG	
Main axis angle	Main axis angle	T	Set value	ST	
			Measurement value	MS	
			Absolute measurement value	AB	
			Evaluation value	JG	
Perimeter	Perimeter	CL	Set value	ST	
			Measurement value	MS	
			Evaluation value	JG	
Roundness	Roundness	CD	Set value	ST	
			Measurement value	MS	
			Evaluation value	JG	

### Trend edge position

Content	Measurement options	Symbol	Type options	Symbol	Remark
Evaluation value	Evaluation value	JG			
Maximum number of edges	Maximum number of edges	NH	Set value	ST	Valid only when the shapes of the measurement areas is a rectangle or a rotated rectangle.
			Measurement value	MS	
Minimum number of edges	Minimum number of edges	NL	Set value	ST	
			Measurement value	MS	
Average number of edges	Average number of edges	NA	Set value	ST	
			Measurement value	MS	
			Evaluation value	JG	
The position of the maximum number of edge detection	Maximum number for the edge detection	PH	Set value	ST	
			Measurement value	MS	
The position of the minimum number of edge detection	Minimum number for the edge detection	PL	Set value	ST	
			Measurement value	MS	
The position of the average number of edge detection	Average number for the edge detection	PA	Set value	ST	
			Measurement value	MS	
	Position	P	Absolute measurement value	AB	
			Evaluation value	JG	
Maximum diameter for edge detection	Maximum diameter width	RWH	Set value	ST	Valid only when the shape of the measurement area is a ring or an arc.
			Measurement value	MS	
Minimum diameter for edge detection	Minimum diameter width	RWL	Set value	ST	
			Measurement value	MS	
Average diameter for edge detection	Average diameter width	RWA	Set value	ST	
			Measurement value	MS	
			Evaluation value	JG	
Center coordinate	Center coordinate X	CX	Absolute evaluation value	AB	
	Center coordinate Y	CY	Absolute evaluation value	AB	
	Center coordinate	CXY	Absolute evaluation value	AB	
The angles for maximum/minimum value of detection diameter	The maximum diameter angle	RH	Absolute evaluation value	AB	
	The minimum diameter angle	RL	Absolute evaluation value	AB	



## Trend edge gap

Content	Measurement options	Symbol	Type options	Symbol	Remark
Evaluation value	Evaluation value	JG			
Maximum number of edges	Maximum number of edges	NH	Set value Measurement value	ST MS	
Minimum number of edges	Minimum number of edges	NL	Set value Measurement value	ST MS	
Average number of edges	Average number of edges Number of edges	NA N	Set value Measurement value Evaluation value	ST MS JG	
Maximum gap for edge detection	Maximum gap	WH	Set value Measurement value	ST MS	Valid only when the shape of the measurement area is a rectangle or a rotated rectangle.
Minimum gap for edge detection	Minimum gap	WL	Set value Measurement value	ST MS	
Average gap for edge detection	Average gap	WA	Set value Measurement value	ST MS	
	gap	W	Evaluation value	JG	
Maximum radius of the edge detection gap	Maximum radius gap	RWH	Set value Measurement value	ST MS	Valid only when the shape of the measurement area is a ring or an arc.
Minimum radius of the edge detection gap	Minimum radius gap	RWL	Set value Measurement value	ST MS	
Average radius of the edge detection gap	Average radius gap	RWA	Set value Measurement value	ST MS	
	Diameter width	RW	Evaluation value	JG	

## Intensity

Content	Measurement options	Symbol	Type options	Symbol	Remark
Evaluation value	Evaluation value	JG			
Average pixel value	Average intensity	DA	Set value Measurement value Evaluation value	ST MS JG	Valid only when the measurement item is average or the average/deviation/maximum/minimum.
Maximum pixel value	Maximum intensity	DH	Set value Measurement value	ST MS	Valid only when the measurement item is average or the average/deviation/maximum/minimum.
Minimum pixel value	Minimum intensity	DL	Set value Measurement value Evaluation value	ST MS JG	
	Intensity value	D			
Standard deviation	Intensity deviation	DD	Set value Measurement value Evaluation value	ST MS JG	Valid only when the measurement item is average or the average/deviation/maximum/minimum.



## 4-7 Specify Output Settings

### 4-1 Program No. p.4-2

### 4-2 Camera p.4-5

### 4-3 Image Registration p.4-16

### 4-4 Window p.4-18

### 4-5 Position Adjustment p.4-104

### 4-6 Calculation p.4-109

### 4-7 Output Settings p.4-119

### 4-8 Save p.4-125

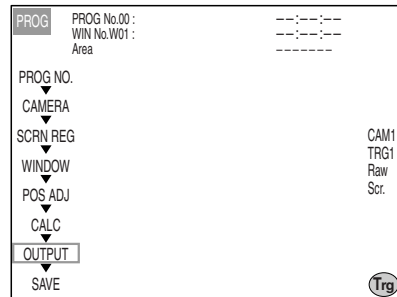
## Overview of Output Settings

The judgement results and the measurement values can be output via a parallel I/O connector. In addition to saving the measurement value, you can also save the screen image in the compact flash memory at the time of an NG occurrence, or output it to the external device that is connected via an RS-232C or Ethernet.

### Display the [Output setting] menu

**1** Perform the settings of “4-1 Program No.” (page 4-2) to “Calculation” (page 4-109).

**2** Select [OUTPUT].



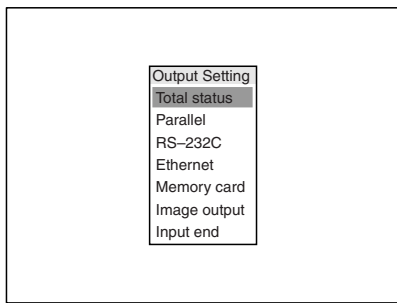
The [Output setting] menu appears.

# Selecting a Window Evaluation Value for Overall Evaluation(Overall Evaluation OR)

Specify a window evaluation value to be used as an overall evaluation. You can specify not only a measurement value (OK/NG evaluation) of a measurement window but also status calculations and measured value calculations.

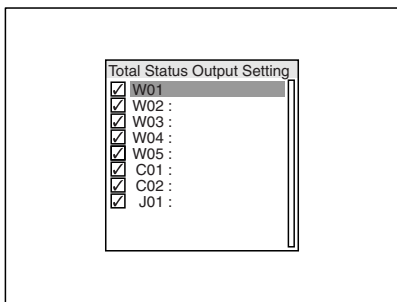
The OK/NG evaluation of the window specified here is the overall evaluation of a target inspection.

**1 Select [Total status] on the [Output Setting] menu.**



The [Total Status Output Setting] menu appears.

**2 Select a window that you want to use as an overall evaluation and check the checkbox next to it.**



A logical add (OR output) of the checked windows is used for the overall evaluation.

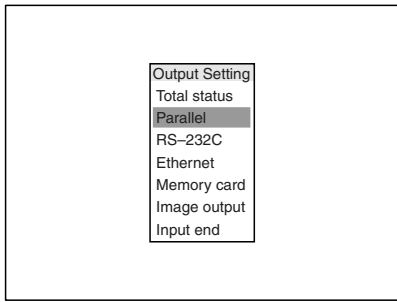
**3 After completing the settings, select [Input end].**

# Changing the Output Settings of the Parallel I/O

## (Terminal Output)

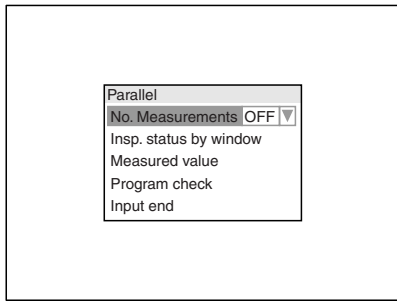
You can specify the output contents when outputting the number of measurements, measurement results, or measurement value from the parallel I/O connector.

**1 Select [Parallel] on the[Output Setting] menu.**



The [Parallel] menu appears.

**2 Change the settings as required.**  
The default setting is that no data is output.



### No. measurements

- **ON:** Outputs the number of measurements
- **OFF:** Does not output the number of measurements

### Insp. status by window

The [Insp. status by window] menu is displayed. Check the window for which you want to output the evaluation value.

### Measurement value

The [Measurement value output] menu is displayed. Check the window for which you want to output the measurement value, and then check the types of measurement values that you want to output.

### Program check

A confirmation screen appears that describes the output contents based on the current settings. Refer to "Output Settings Specification Format" (page 10-29) for more information.

**3 After completing the settings, select [Input end].**

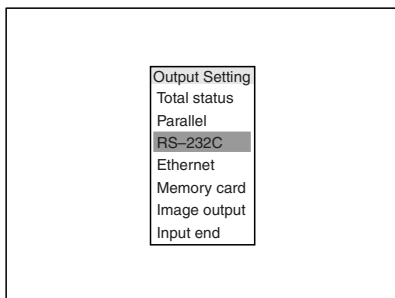


# Changing the Output Settings for RS-232C

## (RS-232C)

You can specify the data of evaluation results or measurement results that are output from the RS-232C connector. The default setting is no output from the RS-232 connector. Change the setting according to the required data.

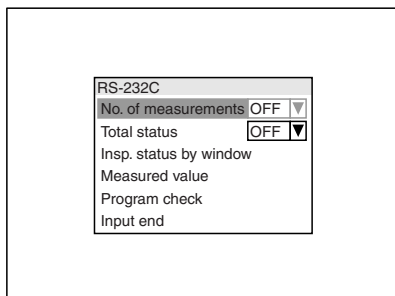
### 1 Select [RS-232C] on the [Output Setting] menu.



The [RS-232C] menu appears.

### 2 Change the settings as required.

The default setting is that no data is output.



#### No. measurements

- **ON:** Outputs the number of measurements
- **OFF:** Does not output the number of measurements

#### Total status

- **ON:** Outputs the overall judgment (OK: 1, NG: 0)
- **OFF** (default): Does not output the overall evaluation

#### Insp. status by window

The [Insp. status by window] menu is displayed. Check the window for which you want to output the evaluation value.

#### Measured value

The [Measured value output] menu is displayed. Check the window for which you want to output the measurement value, and then check the types of measurement value that you want to output.

#### Program check

A confirmation screen appears that describes the output contents based on the current settings. Refer to "Output Settings Specification Format" (page 10-29) for more information.

### 3 After completing the settings, select [Input end].

#### Reference

The output content of the overall evaluation and the evaluation value is [1] for OK, and [0] for NG.

# Changing the Output Setting for Ethernet

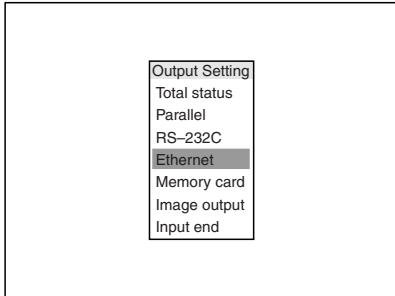
4



Specifying the Units (Windows) for Inspections and Measurements

You can specify the data types of evaluation results or measurement results that are output from the Ethernet connector of this machine. The default setting is no output from the Ethernet connector. Change the setting according to the required data.

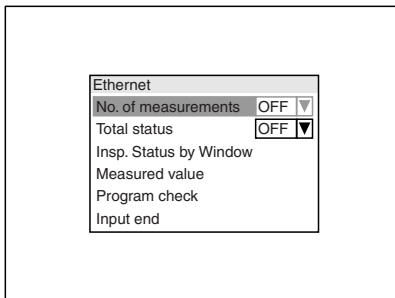
## 1 Select [Ethernet] from the [Output Setting] menu.



The [Ethernet] menu appears.

## 2 Change the settings as required.

The default setting is that no data is output.



### No. measurements

- **ON:** Outputs the number of measurements
- **OFF** (default): Does not output the number of measurements

### Total Status

- **ON:** Outputs the overall evaluation (OK: 1, NG: 0)
- **OFF** (default): Does not output the overall evaluation

### Insp. status by window

The [Insp. status by window] menu is displayed. Check the window for which you want to output the evaluation value.

### Measured value

The [Measured value output] menu is displayed. Check the window for which you want to output the measurement value, and then check the types of measurement value that you want to output.

### Program check

A confirmation screen appears that describes the output contents based on the current settings. Refer to “Output Settings Specification Format” (page 10-29) for more information.

## 3 After completing the settings, select [Input end].

### Note

If the output buffer of this machine is in a state of overflow, the measurement data (i.e. measurement values and evaluation values) may only be partially output.

### Reference

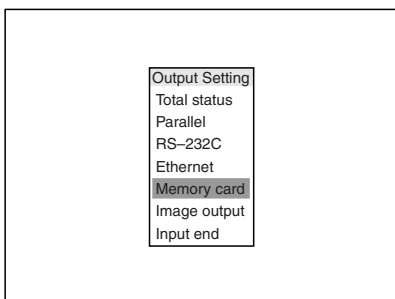
The output content of the overall evaluation and the evaluation value is [1] for OK, and [0] for NG.



# Changing the Output Setting to the Compact Flash Memory (Memory Card)

You can specify the data types of evaluation results or measurement results that are saved in the compact flash memory inserted in the compact flash memory slot. The default setting is no output to the memory card. Change the setting according to the required data.

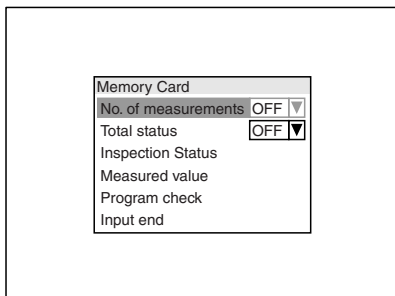
## 1 Select [Memory card] on the [Output Setting] menu.



The [Memory Card] menu appears.

## 2 Change the settings as required.

The default setting is that no data is output.



### No. measurements

- **ON:** Outputs the number of measurements
- **OFF** (default): Does not output the number of measurements

### Total Status

- **ON:** Outputs the overall evaluation (OK: 1, NG: 0)
- **OFF** (default): Does not output the overall evaluation

### Inspection Status

The [Insp. status by window] menu is displayed. Check the window for which you want to output the evaluation value.

### Measured value

The [Measured value output] menu is displayed. Check the window for which you want to output the measurement value, and then check the types of measurement value that you want to output.

### Program check

A confirmation screen appears that describes the output contents based on the current settings. Refer to [Output Settings Specification Format] (page 10-29) for more information.

## 3 After completing the settings, select [Input end].

### Note

If the output buffer of this machine is in a state of overflow, the measurement data (i.e. measurement values and evaluation values) may only be partially output.

### Reference

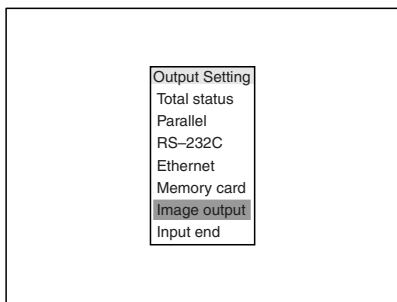
The output content of the overall evaluation and the evaluation value is [1] for OK, and [0] for NG.

# Changing the Output Setting of the Images

## (Image Output)

You can output the screen images that were used for measurement to the external devices via the RS-232 connector or the Ethernet connector, or save them in the compact flash memory. The default setting is no output of the screen images. Change the setting according to the required data.

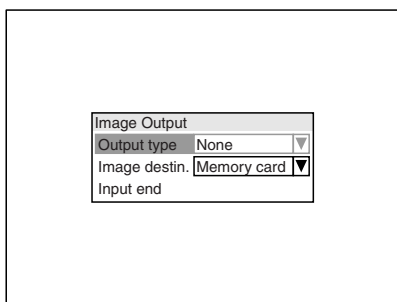
**1 Select [Image output] on the [Output Setting] menu.**



The [Image Output] menu appears.

**2 Changes the settings as required.**

The default setting is that no data is output.



### Output type

- **None** (default): Does not output image data.
- **NG images**: Outputs the image data to the output specified in the [image destin.] each time an NG occurs.
- **All images**: Outputs the image data to the output specified in the [image destin.] each time the trigger is entered.

### Image destin.

- **Memory card** (default): Outputs the image data to the compact flash memory inserted to the compact flash memory slot.
- **Ethernet**: Outputs the image data from the Ethernet connector.
- **RS-232C**: Outputs the image data from the RS-232 connector.

**3 After completing the settings, select [Input end].**

### Note

If the next output image is generated while the previous image is being output, the data being output is partially skipped.



## 4-8 Saving the Settings (Save)

### 4-1 Program No. p.4-2

### 4-2 Camera p.4-5

### 4-3 Image Registration p.4-16

### 4-4 Window p.4-18

### 4-5 Position Adjustment p.4-104

### 4-6 Calculation p.4-109

### 4-7 Output Settings p.4-119

### 4-8 Save p.4-125

## Saving the Settings

You can save the settings specified on the [Program] screen as follows.

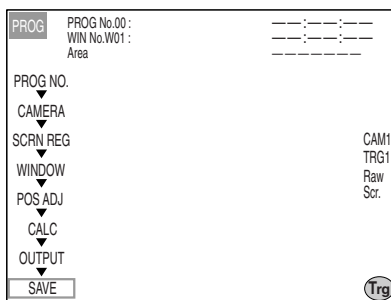
#### ► Note

Do not turn off the power of the machine while you are saving the settings. Doing so may cause abnormalities to the internal data.

### 1 Select the [PROG NO.] whose settings you want to save.

Refer to the page 4-3 for details.

### 2 Select [SAVE] and press the [ENTER] button.



All the settings (camera settings, registered image, window settings, position correction settings, calculation settings, etc.) specified for the Program No. that is selected in Step 1, as well as the settings specified on the settings menu (page 6-1), are saved in the internal memory of this system.

### 3 Select [Yes] and press the [ENTER] button to save the settings.



