KEYENCE

96M1780

**Super-High-Speed Digital
Machine Vision
Supporting Multi-Camera**

CV-3001 Series

User's Manual

A.C.E.
COLOR

Introduction

This manual describes the hardware of the CV-3001/3501 series high-speed universal machine vision system and its basic operation. Read this manual thoroughly to understand how the CV-3001/3501 series works to utilize the maximum performance of the system. Always keep this manual in a safe place for future reference.
Ensure that the manual is passed to the end user in case of transfer of the unit.

Symbols

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

⚠ DANGER
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 overlooked.

Reference
Indicates further information that may be useful to know.

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 ^{TM} mark and ® mark are omitted in this manual.

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 Keyence product fails, take full safety measures to prevent damage before using the system again.
- If the system is used beyond published specifications or if the system is modified, the functions and performance cannot be guaranteed.
- Please note that when the system is used in combination with other instruments, its functions and performance may be degraded.
- Do not use the system for protecting the human body.
- Do not subject this unit or connected devices to a sudden change of temperature, as condensation may occur.

Warnings

General

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

Operating environment and conditions

- To use the system properly and safely, avoid installing this unit in the following locations:
  - Locations that contain moisture or dust, or that are poorly ventilated.
  - Locations where the system is exposed to direct sunlight or temperature increases.
  - Locations where there are flammable or corrosive gases.
  - Locations where the unit may be directly subjected to vibration or impact.
  - Locations where water, oil or chemicals may splash onto the unit.
  - Locations where static electricity occurs.

  Doing so may cause fire, electric shock, or product malfunction.
- Keep this unit and cables away from high-tension cables or power lines. Otherwise, noise may cause malfunction or accidents.
- This unit and optional devices are precision components. Do not subject them to vibration or impact.

Measures to be taken when an abnormality occurs

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

- If water or debris enters the system
- If the system is dropped or the case is damaged
- If smoke or a burning smell emits from the system

Cautions

Usage

- Before making any connections/disconnections, be sure to turn off the power of this unit and connected devices. Failure to do so may result in malfunction of the system or connected devices.
- Do not turn the power off while you are programming. Otherwise, all or part of the program settings may be lost.
- Do not block the ventilation holes. Otherwise, the inside temperature may rise and malfunction may occur.
- Do not allow an excessive amount of sunlight or bright indoor light to enter the camera for a long period of time. Doing so may cause damage to the CCD inside the camera.

Notes

Maintenance

Do not clean with benzene, thinner, or alcohol.
Doing so may 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.

Cameras

The system can only use Keyence cameras specifically made for the product. Commercial cameras cannot be used.

Cautions About CE Marking

Keyence evaluates compliance with the requirements of the EU directive according to how products fulfill the following conditions. Keyence has confirmed that the system meets these requirements.

When using the system in EU nations, it should therefore be used while meeting the following conditions.

However, the following conditions do not guarantee that the customer's entire machinery installation is compliant with the EMC directive, nor do they guarantee compliance to the Low Voltage Directive.

The customer is responsible for determining the compliance of the overall machinery installation.

Cautions

Conditions for Compliance to EMC Directive (89/336/EEC)

- Compatible specification: EN61326 (Class A)
- Use cables shorter than 30 m to connect the controller unit and its external devices.

Differences Between CV-3501 and CV-3001

This user's manual covers the two types of models for the CV-3001 series second edition II , the CV-3501 and the CV-3001. The information in this manual explains the basics of the CV-3501, unless otherwise noted. The examples of screens in this manual also come from the CV-3501.

The following information represents the main differences between CV-3501 and CV-3001.

		CV-3501	CV-3001
	CV-035C	2 (4)	2
Color camera	CV-S035C	2 (4)	2
	CV-200C	2 (4)	—
	CV-S200C	2 (4)	—
	CV-035M	2 (4)	2
Monochrome camera	CV-S035M	2 (4)	2
	CV-200M	2 (4)	—
	CV-S200M	2 (4)	—
Number of possible camera connections		• The number inside the parentheses ( ) indicates connections when using the camera expansion unit CV-E300. • In addition to the standard mode (about 240,000 pixels) for CV-3001, CV-3501 can connect a megapixel camera to process images at 1 megapixel mode or 2 megapixel mode. Up to four cameras can be connected simultaneously when the camera expansion unit CV-E300 is used.	
Internal memory		Approx. 60 MB	Approx. 15 MB

For more details on the differences between the models, see "Main Specifications" (page 12-2).

Cautions about using program data created by the CV-3501 with the CV-3001
Program data for CV-3501 can only be used in CV-3001 if all of the following conditions are met.
• Only standard cameras (CV-035C/CV-S035C/CV-035M/CV-S035M) are used
• Window memory is 50% or less (the value can be checked in the [System Information] screen (page 7-16) under the Global menu).
Operations cannot be guaranteed in CV-3001 if the CV-3501 program data fails to meet the above conditions.

Changes to the Second Edition III

This user's manual covers the second edition III of CV-3501 and CV-3001.

The following information lists the changes to the second edition shipped before October 9, 2006.

Reference

You can check the CV's edition in the [System Information] screen under the Global menu (page 7-18) (only for the second edition and later editions).

Added new functions

The following functions have been added:

Inspection modes

- OCR measurement tool (page 4-247) has been added. This tool takes characters from inside the measurement area, compares it to a registered library of character pattern data, and outputs the recognized characters.
- The segment settings for trend edge position (page 4-172) and trend edge width (page 4-187) have been changed to accept decimal values. This allows the segment position to be adjusted in more detail. The settings can also be applied to all of the segments displayed in the measurement area.
- In the parameters for trend edge position (page 4-172), a sensitivity setting has been added when using the correction function for a line or circle. This can help stabilize the correction adjustment depending on the inspection conditions.

Image enhancement

A real-time subtraction filter (page 13-15) has been added that will compare the current image versus a processed image that has had an expand and shrink filter applied to it. This will eliminate the background information.

Processing and control functions

- With the addition of the OCR measurement tool, input and output commands have been added for library data and judged text (pages 4-274, 4-302).
- The command for writing into command memory has been changed so that batch data (up to 30 pieces) can be written into the memory all at once (page 9-28).
- The setting for sending a ERR output when there is a memory card error can be turned on or off (page 7-17).
- In addition to the normally closed mode for the terminal output, normally closed 2 mode has been added. This mode will switch only the Error, OR and OUT0 to OUT15 outputs to a normally closed type (page 7-2).

Support functions

- When using [Shift All Windows], the user can select whether to move the search window with the pattern window for a search in measurement mode (pattern search, pattern sort) (page 3-26).
- Inspection status can be selected as a type of measurement item for calculation results with measurements and active text on the custom screen. Also, if two or more pages are set for the custom screen, switching pages from the remote control console can now skip unset pages (page 6-37).
- The cursor can be moved in the character input panel by moving the [ENTER] button in any direction while holding down the [FNC] button on the remote control console (page 3-7).

Added memory

- The internal memory that is used for saving settings and other data has been increased from 45 MB to 60 MB (CV-3501 only).

Upgrades to communication software (CV-H3N)

Software is upgraded to Version 2.2 in order to handle functions added to CV.

► **Note**

- The second edition III is not compatible with CV-H3N version 2.1 or earlier software. However, CV-H3N version 2.2 is forward compatible and can be used with previous versions of the system. If CV-H3N version 2.1 or earlier is installed on the computer, use "Add/Remove Programs" on the Windows Control Panel to delete the old version of the software before installing version 2.2. For more details about CV-H3N, see the User's Manual (PDF) for CV-H3N.
- The newest USB driver version (1.0.0.1) is forward compatible and can be used with previous versions of the system. Reinstall the USB driver if the driver that was included with second edition II or earlier is installed. The USB driver included with the first edition cannot communicate with this version of the CV. Make sure to reinstall the driver. For more details about the USB driver, see "Installing a driver" (page 9-9).

Compatibility of program data for the previous edition and second edition III

- The format for the program data is different than the previous versions, but forward compatibility is assured for the program data, so program files created with the previous editions can be read with the second edition III.
- Backwards compatibility is not assured for the program data, so program files created with the second edition III cannot be read by the previous editions.

When program files created with previous versions are loaded, the CV behaves differently depending on which version the file was created in.

- **Program files created with the second edition or second edition II**
  - The loaded program files can be executed, edited, and saved like normal, but the program file format needs to be converted since the second edition III uses additional functions (page 4-304). After converting the file format, the program file will not longer be readable with the second edition II or earlier.
  - When using second edition or second edition II program files with the second edition III, "(SE)" or "(SE2)" appears next to "Edit Settings".

When using second edition program files

When using second edition II program files

- **Program files created with the first edition**
  Loaded program files can be executed and edited like normal, but they are automatically converted to second edition III program file format when they are saved. Therefore, the saved program files will not longer be readable with the second edition II or earlier.

▶ **Note**

The previous overseas versions CV-3501(P), CV-3502(P), CV-3001(P), and CV-3002(P) use second edition II, and therefore they cannot read new program files from second edition III.

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Chapter 5   Run

Chapter 6   Applying Functions for the CV ([Utility]/[Display])

Chapter 7   Changing the Settings of the CV (Global)

Chapter 8   Saving and Loading the CV Data to/from the Memory Card

Chapter 9   Transmitting Data via the Communication Ports

Chapter 10 Controlling the System or Outputting Data Via PLC Link

Chapter

1

Package Contents

Introduction

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-3501/3001): x1

- Remote control console (OP-42342): x1
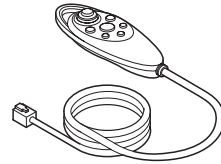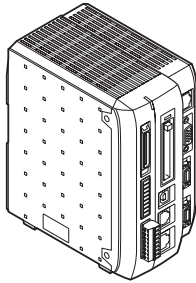
- User's Manual (this document): x1

Options

- CV-200C (2 megapixel color camera)
- CV-200M (2 megapixel monochrome camera)

- CV-035C (320,000 pixel color camera)
- CV-035M (320,000 pixel monochrome camera)
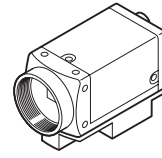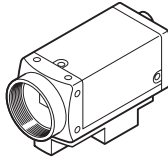
- CV-S035C (320,000 pixel micro color camera)
- CV-S035M (320,000 pixel micro monochrome camera)

- CV-S200C (2 megapixel micro color camera)
- CV-S200M (2 megapixel micro monochrome camera)
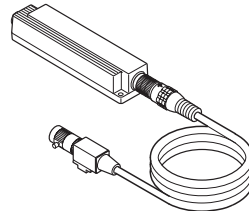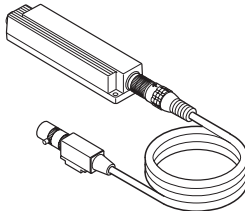
- CV-E300 (Camera expansion unit)
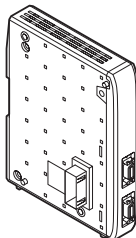
► **Note**

For more details on the options, see "Options" (page 12-15).

Identifying Controls and Connectors

Controller Unit
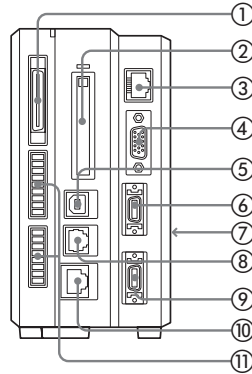
① **Parallel I/O connector**
Connects the parallel input/output signals (page 11-2).

② **Memory card slot**
For Compact Flash Memory card (page 8-2).

③ **Modular connector**
Connects the remote control console (page 2-15).

④ **VGA output terminal**
Connects to an external monitor (page 2-15).

⑤ **USB port**
Connects to the USB cable (page 9-8).

⑥ **Camera 2 connector**
Connects camera 2 (page 2-15).

⑦ **Expansion unit connector (Side, CV-3501 only)**
Use to connect the camera expansion unit CV-E300.

⑧ **RS-232C port**
Connects to the RS-232C communication cable (page 9-2).

⑨ **Camera 1 connector**
Connects camera 1 (page 2-15).

⑩ **Ethernet connector**
Connects to the Ethernet cable (page 9-3).

⑪ **Terminal Block I/O connector**
Connects the power supply (24 V DC) and the input/output signals (page 2-15, 11-4).

Remote Control Console

This section explains the common operations and functions of the 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).
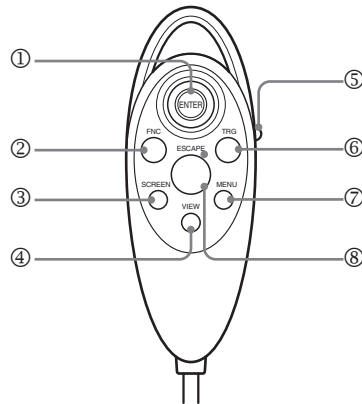
① **[ENTER] button**

Move the [ENTER] button up, down, right or left to move the selected item on the screen.
Press the button to confirm the setting on the screen.

② **[FNC] (FUNCTION) button**

Press the button to display the function menu (page 5-7).

③ **[SCREEN] button**

Press this button to toggle through the display templates in order (page 5-5). For example, pressing the button switches from the Raw screen to the Filtered screen 1, then to Filtered screen 2, etc.

④ **[VIEW] button**

Press to display the View Bar, zoom in or out on the screen, or to switch between options such as result values or display templates (3-9, page 5-3).

⑤ **Selector switch (PROG/RUN)**

Use this switch to change between Run mode and Program mode. Pressing this switch toggles between the two modes.

⑥ **[TRG] (TRIGGER) button**

Press the button to enter a trigger input and capture an image.

⑦ **[MENU] button**

Press this button to switch between help displays on the bottom of the screen.

⑧ **[ESCAPE] button**

Press this button to return to the previous screen or to resume the previous operation.

List of Remote Control Console Operations

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

1. Apply during power up

Contents	Buttons to use
Initialize all settings of the CV	ESCAPE+Turning on the power
Forcibly start the system in Program mode	FNC+ENTER UP+Turning on the power
Clear the password and disable the password setting (page 7-10)	FNC+ESCAPE+Turning on the power

► Note
- All of the registered images are also cleared when the CV is initialized.
- Never turn off the power while initialization of the system is in progress. It can cause an internal data error.

2. Operation when the power is on

Contents	Buttons to use
Save the current image on the screen to the CF memory card (Screen capture) (page 5-6, 7-7)	FNC+VIEW
Input a reset signal to the CV during Run mode (page 11-9)	FNC+ESCAPE
Convert program data created with second edition or second edition II into second edition III format and overwrite the file (page 4-304)	FNC+Save

Chapter

2

Standard System Configuration

**Installation
and
Connection**

Example of a standard system setup with two cameras

Controller Unit
(CV-3501/CV-3001)

Remote Control Console
(OP-42342)

Camera cable
CV-C3 (3 m)
(Optional)

DC24V Power supply
CA-U2 (Optional)

Monitor
CA-MP80
(Optional)

Lens
(Optional)

CAM1 CAM2
$\left(\begin{array}{c} \text{CV-200C*/CV-035C} \\ \text{CV-200M*/CV-035M} \end{array}\right)$ (Optional)

* Can only be connected to CV-3501.
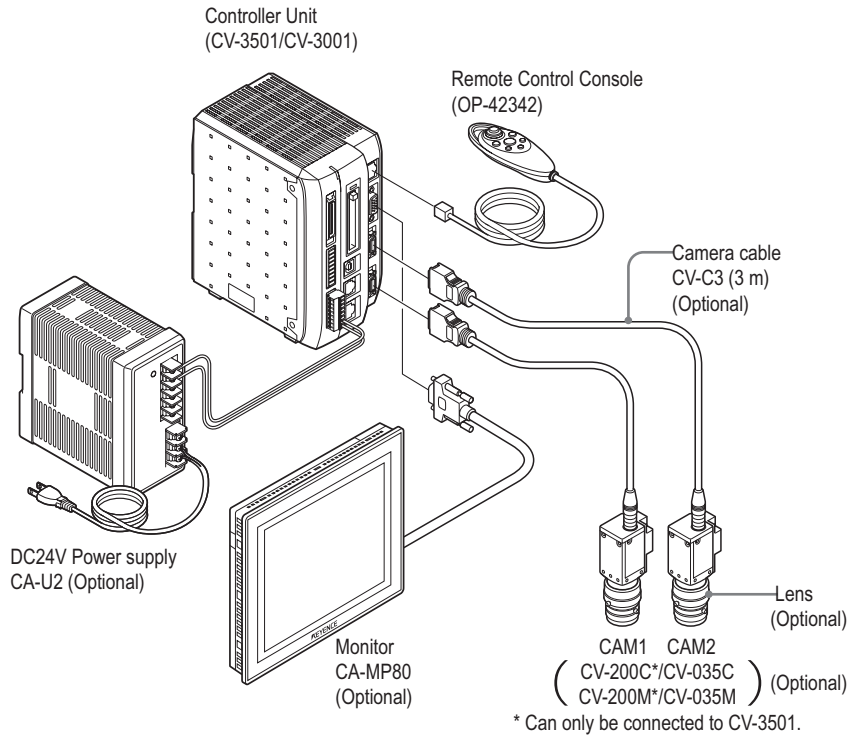
Example of a standard system setup with four cameras (CV-3501 only)

Controller Unit
CV-3501

Camera Expansion Unit
CV-E300 (Optional)

Remote Control Console
(OP-42342)

Camera cable
CV-C3 (3 m)
(Optional)

DC24V Power supply
CA-U2 (Optional)

Monitor
CA-MP80
(Optional)

Lens
(Optional)

CAM1   CAM2   CAM3   CAM4

(CV-200C/CV-035C
  CV-200M/CV-035M) (Optional)
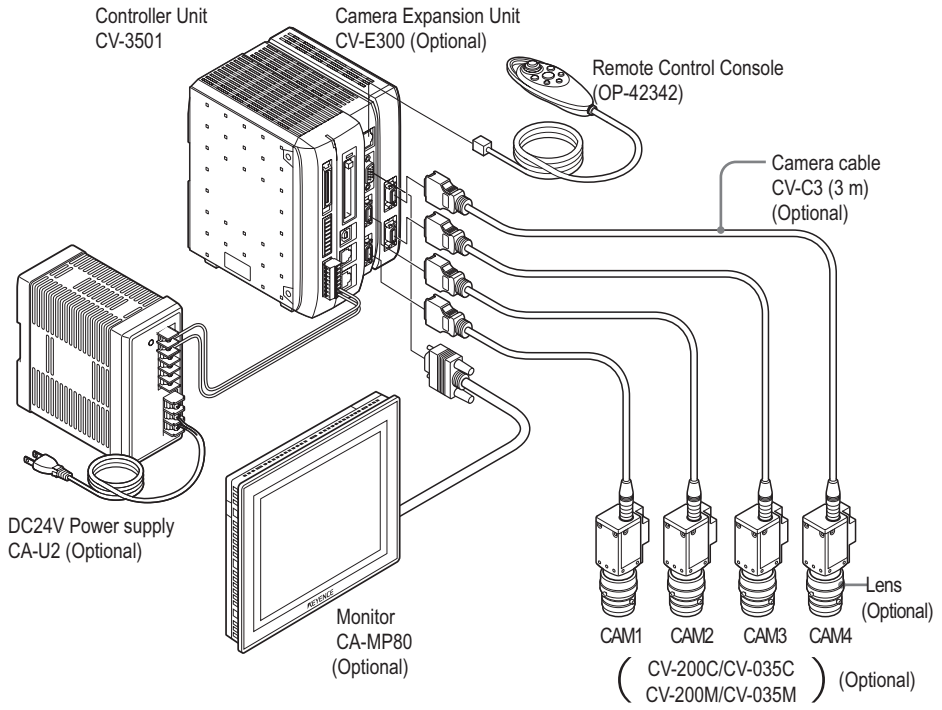
Installing the Controller Unit

Install the controller unit to DIN rail, or use the holes on the bottom of the controller to secure it with screws.

► Note

Do not install the CV in a location with lots of dust or water vapor. The CV does not have a mechanism to protect the CV from dust or water. Dust or water entering the controller can cause damage to the CV.

Caution on Direction of Controller Mounting

• Install the controller in the direction indicated by the circle as shown below. Do not install the controller in any other direction.
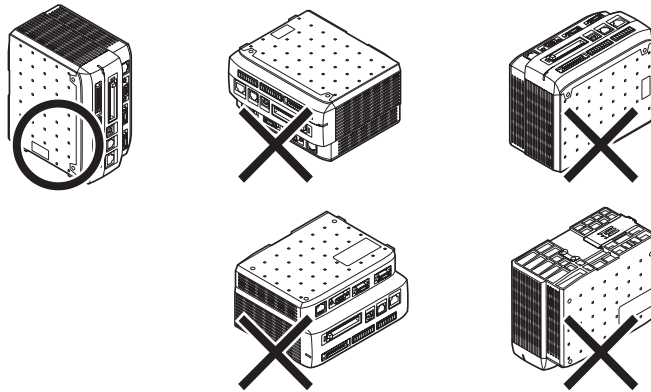
• For ventilation, keep the space free of objects for 50 mm or more above the controller and 30 mm or more for both sides.
Keep the space free of objects for 90 mm or more in the front of the connector panel to connect the cables safely.

50mm

30mm   30mm
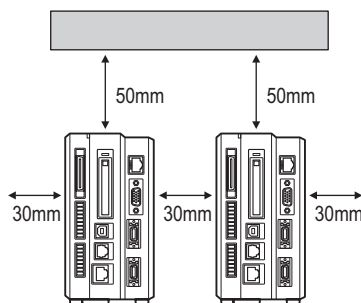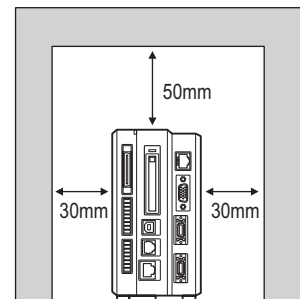
• When two or more controllers are installed side by side, keep the space free of objects for 30 mm or more between controllers, and 50 mm or more on top of both controllers.

50mm   50mm

30mm   30mm   30mm

Installation and Connection

> ► **Note**

- Do not block the ventilation openings on the top and bottom of the controller. If the vents are 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 the rating, use forced air-cooling or increase the free space around the system to improve ventilation until the operating ambient temperature drops below the rating.

Installing the Camera Expansion Unit (CV-3501 only)

Use the camera expansion unit CV-E300 (sold separately) to connect three or more cameras.
Remove the protective connector cover from the side of the controller and install the camera expansion unit as shown below.
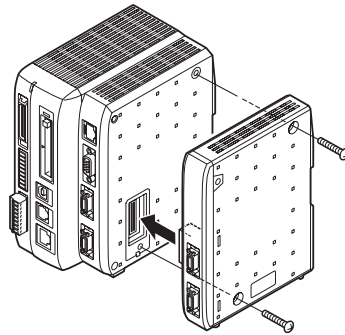
> ► **Note**

- Turn off the power to the controller when connecting or removing a camera expansion unit. Connecting or removing the camera expansion unit while the power is being supplied may damage the controller or peripheral devices.
- When a camera expansion unit is not connected, place the connector protection cover back on the controller. Using the controller with the connector exposed may cause damage to the CV-3501.

Installing the CV

Installing the Controller on a DIN Rail

The controller unit and the expansion unit are designed to be mounted on a DIN rail.

Tab
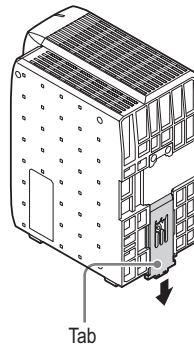
Pull out the tab on the bottom in the direction of the arrow to mount or dismount the controller.

Mounting to the Bottom of the Controller

M4 screws
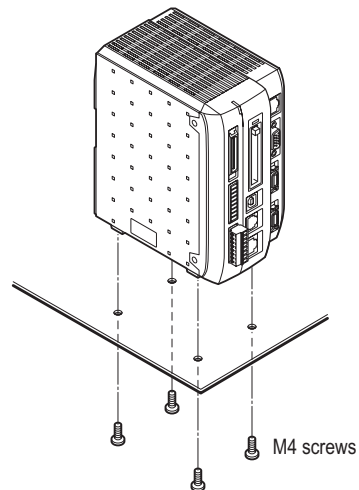
► **Note**

Mount the controller in a stable location that is free from vibration.

Installing the Camera

⚠ **Electrical 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 malfunctions or internal damage. For secure insulation, be sure to use the resin mounting bracket and screws 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 another means.

1 Install the lens on the camera.

Select an appropriate lens according to the size of the object or distance between the object and the camera (next page).
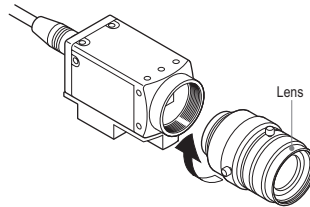
Lens

▶ **Note**

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

2 Install the camera using the screw holes provided on the resin mount.

There are three types of screw holes. Use the holes that are suitable for the mounting setup.

▶ **Note**

- When installing the camera, use a tightening torque of 0.5 Nm and a maximum tension of 30 N.
- Focus and aperture adjustment (Page 2-19) 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 loosen. Keyence recommends using a locking paint in these situations.
- Mounting the provided resin mount in a direction other than on the bottom of the camera can cause gaps between the mount and the camera. If the installation needs to be very precise, try to fix the mount to the bottom of the camera.

Reference

Keyence recommends creating a mount that leaves room to adjust the position of the camera. This will make slight adjustments easier.

Warning on space for installation of the camera

When installing the camera, keep the space free of objects for 30 mm or more above the camera and 15 mm or more on both sides.

30mm
15mm   15mm
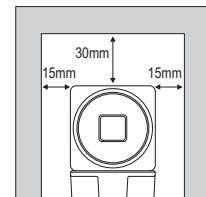
Selecting the Lens

Select the lens according to the size of the target (FOV (Field of view): Y) and distance between the camera and the object (working distance). Select the suitable lens referring to the field of view chart.

FOV (Field of view)
: Y

WD
(working distance)

Target

Installation and Connection
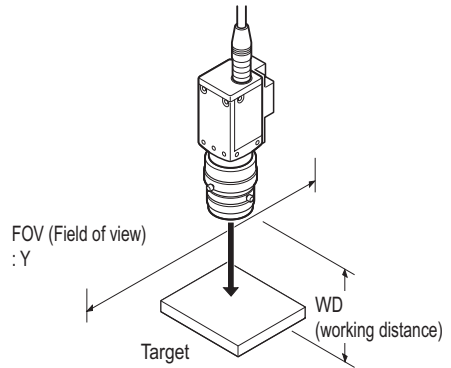
Confirm the Working Distance from the Field of View Chart

- The numbers in the field of view chart represent the thickness required for the close-up ring. Install the close-up ring between the lens and the camera when required.
- The asterisk (*) symbol in the field of view chart indicates the type of lens.

▶ **Note**

The numerical numbers shown in the field of view chart are typical values. The values must be fine tuned when installing the camera.

Using a Megapixel Camera (CV-200C/CV-200M)

When using the CA-LH16 with a required field of view of 40 mm and CV-200C in 2 megapixel mode, the chart shows that the working distance should be set to 100 mm and the 1.5 mm close-up ring should be used.

High-resolution lens (CA-LH*): Using 1600 x 1200 pixels (2 megapixel mode)
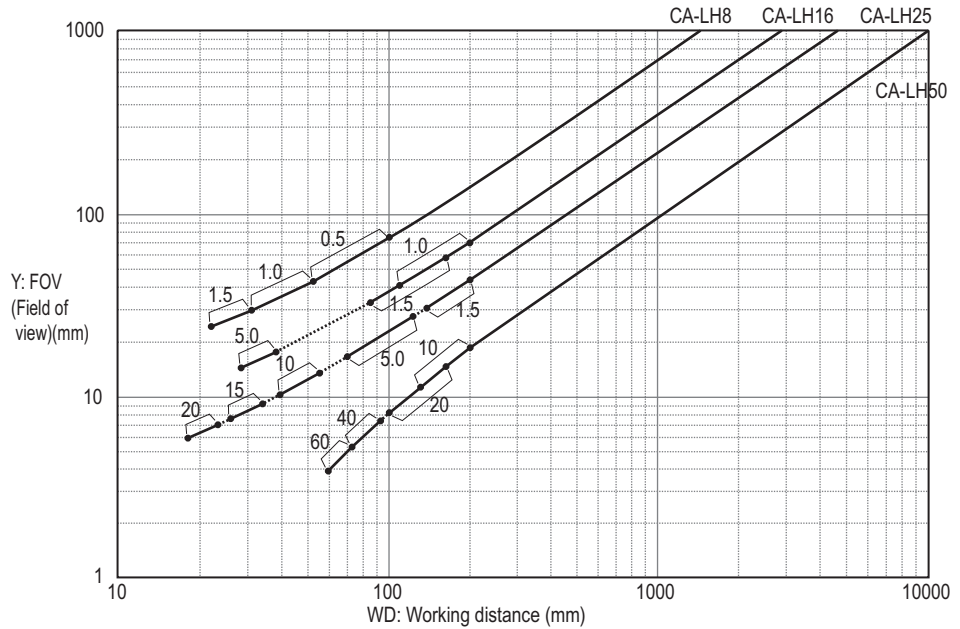
High-resolution lens (CA-LH*): Using 1024 x 960 pixels (1 megapixel mode)
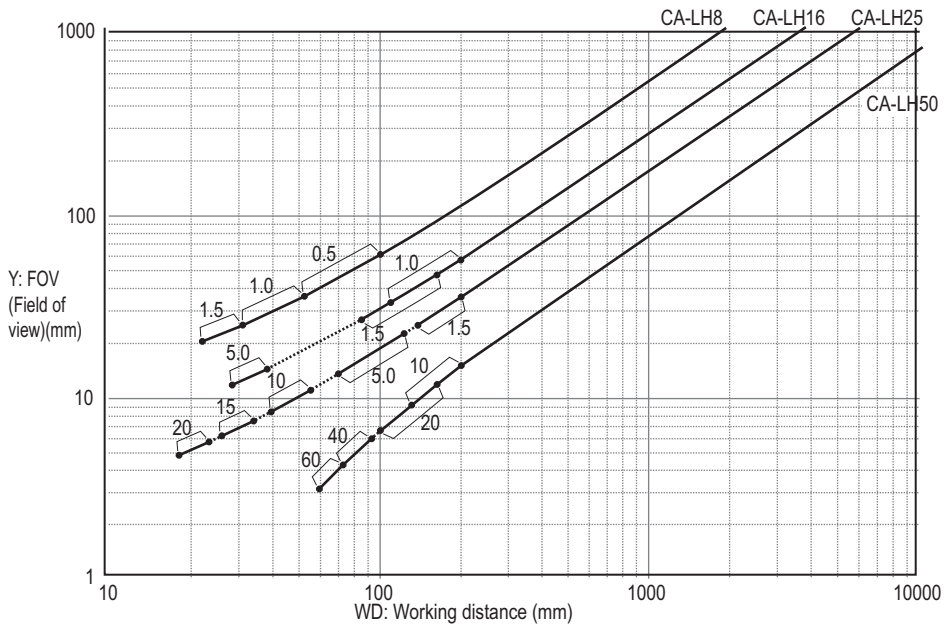
The following graph shows the performance when using a standard lens.

Standard lens (CV-L*): Using 1600 x 1200 pixels (2 megapixel mode)
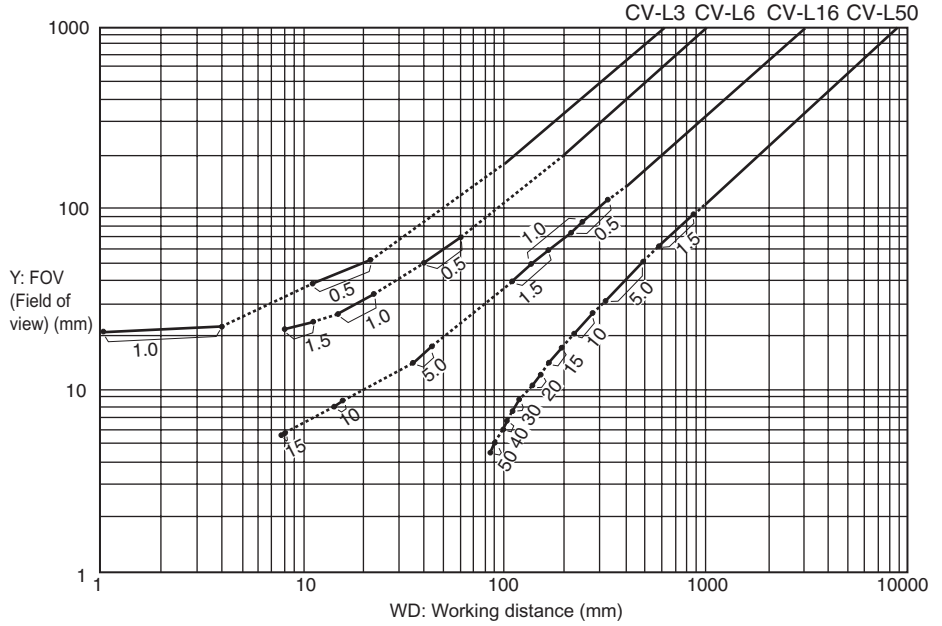
Standard lens (CV-L*): Using 1024 x 960 pixels (1 megapixel mode)
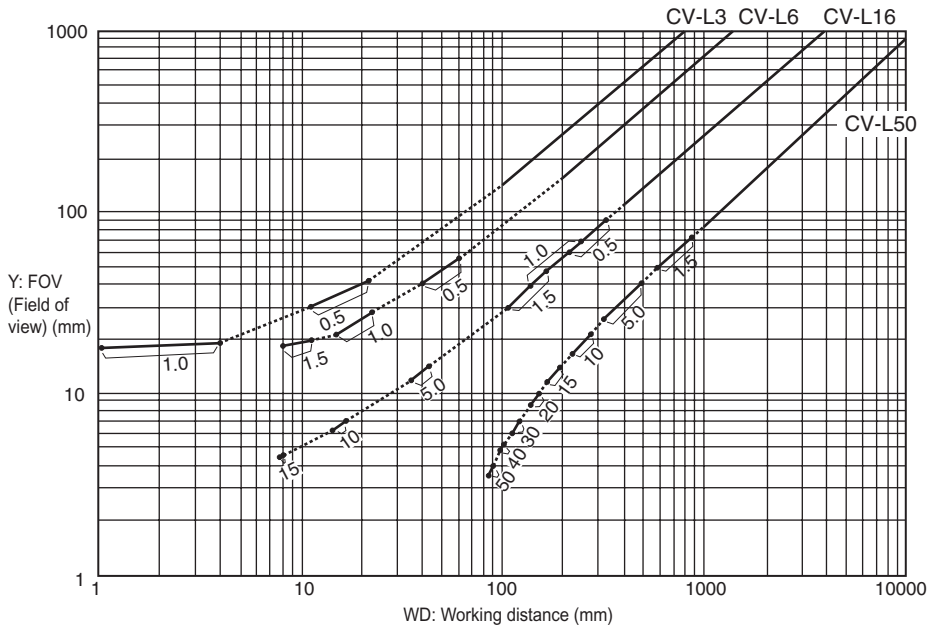
Using a Double Speed Camera (CV-035C/CV-035M)

Using a Standard Lens (CV-L*)
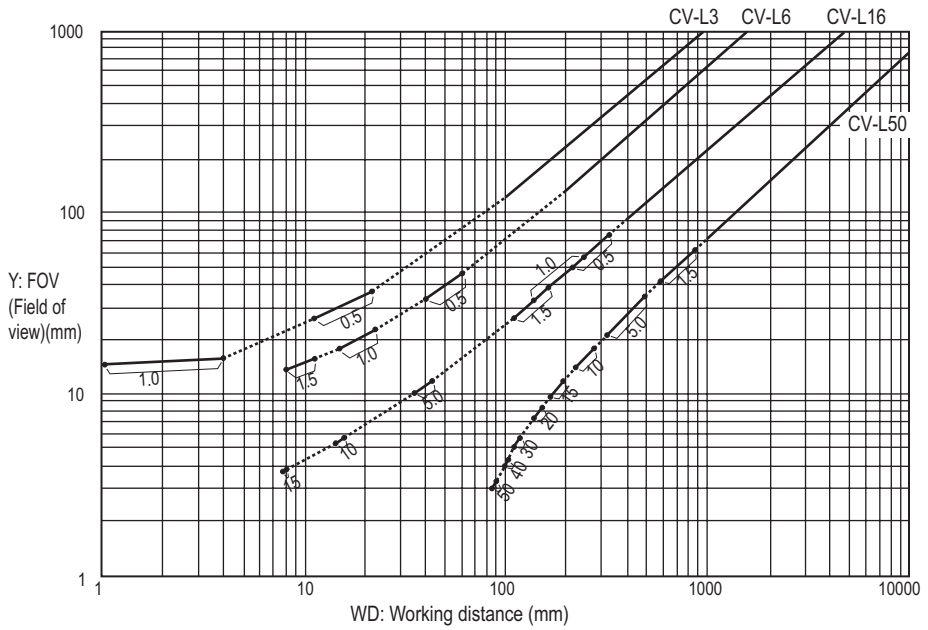
Using a High Accuracy Lens (CV-LH*)
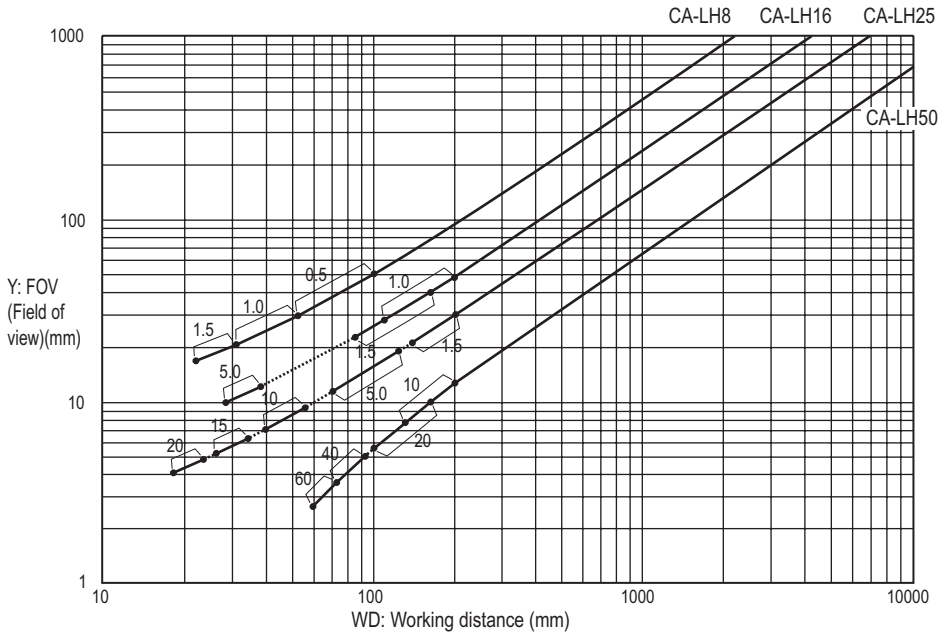
Using a Micro Double Speed Camera (CV-S035C/CV-S035M)
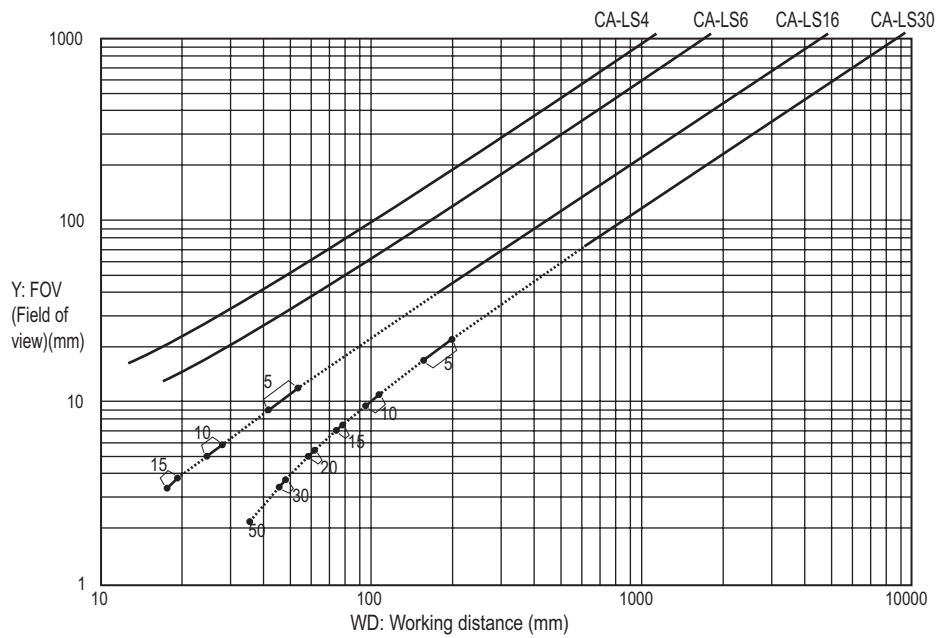
► **Note**

- The numerical numbers shown in the field of view chart are typical values. Adjust the values when installing the camera.
- For more information on installing and adjusting micro cameras, see the instruction manual that comes with the camera.
- When attaching the side view attachment OP-51503, subtract the internal optical length of 15.3 mm from the working distance.

Using a Micro Megapixel Camera (CV-S200C/CV-S200M)

Using 1600 x 1200 pixels (2 megapixel mode)
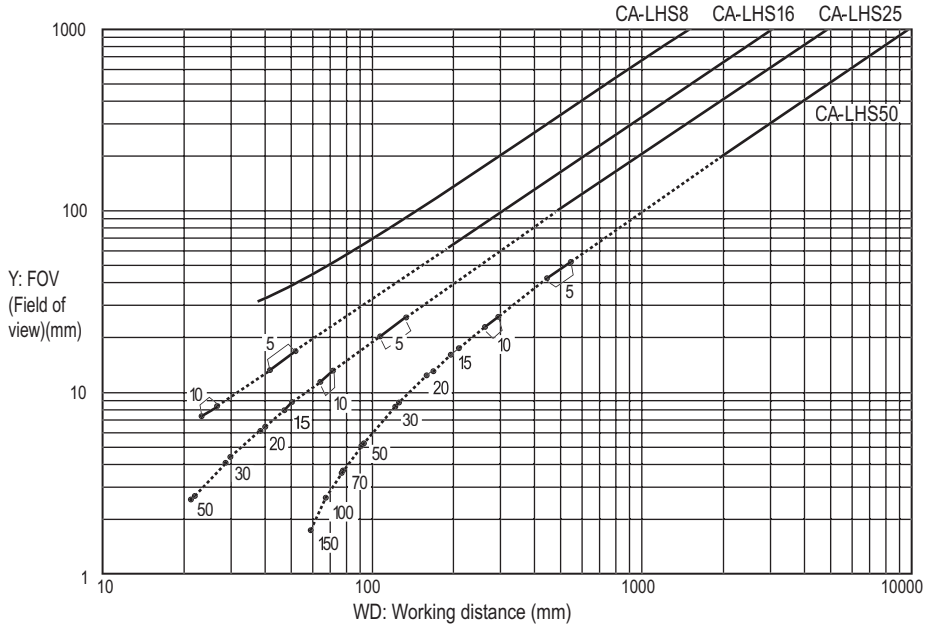
Using 1024 x 960 pixels (1 megapixel mode)
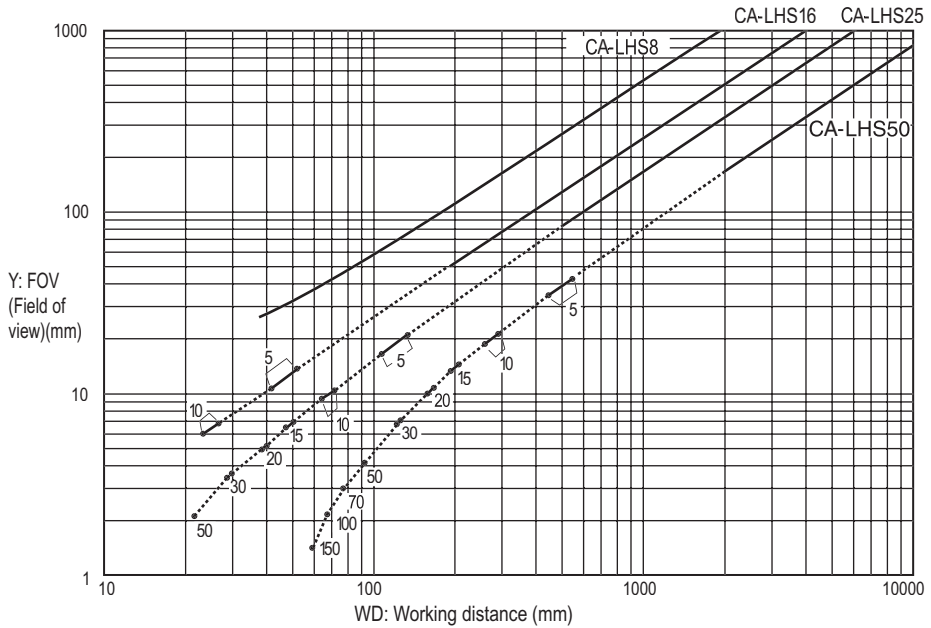
▶ **Note**

- The numerical numbers shown in the field of view chart are typical values. Adjust the values when installing the camera.
- For more information on installing and adjusting micro cameras, see the instruction manual that comes with the camera.
- When attaching the side view attachment OP-66833, subtract the internal optical length of 25.8 mm from the working distance.

Information on Optional Lenses

Contact your local Keyence office if you need lenses that are not shown here.

For CV-200C/200M/035C/035M

Standard lens

Model	Focal distance	F-value	Filter size
CV-L3	3.5mm	F1.6	43.0 mm P0.75
CV-L6	6mm	F1.4	30.5 mm P0.5
CV-L16	16 mm	F1.6	27.0 mm P0.5
CV-LC16	16 mm	F1.4	27.0 mm P0.5
CV-L50	50 mm	F1.8	30.5 mm P0.5

High-resolution lens

Model	Focal distance	F-value	Filter size
CA-LH8	8mm	F1.4	27.0 mm P0.5
CA-LH16	16mm	F1.4	25.5mm P0.5
CA-LH25	25mm	F1.4	27.0 mm P0.5
CA-LH50	50 mm	F2.8	27.0 mm P0.5

Macro lens

Model	Shape	Optical	WD (When standard magnification is used)
CA-LM0510	Straight	x0.5 to x1	111 mm (x0.5) to 78mm (x1.0)
CA-LM2	Straight	x2	66.9mm
CA-LM4	Straight	x4	70.3mm
CA-LM6	Straight	x6	64.4 mm
CA-LM8	Straight	x8	64.5 mm

► **Note**

The area around the captured image might darken if the process area (Page 4-11) is changed to be positioned at the edge of the CCD while using the macro lens.

Installation and Connection

For CV-S035C/S035M

Standard lens

Model	Focal Distance	F-value
CA-LS4	4mm	F2.0
CA-LS6	6mm	F2.0
CA-LS16	16 mm	F2.0
CA-LS30	30mm	F3.4

For CV-S200C/S200M

High-resolution lens

Model	Focal Distance	F-value
CA-LHS8	8mm	F2.0
CA-LHS16	16mm	F2.0
CA-LHS25	25mm	F2.0
CA-LHS50	50 mm	F3.8

Using the Close-up Rings

You can install a close-up ring between the camera 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-51612, optional).

• For CV-S035C/S035M, use 5 mm (OP-51500) or 10 mm (OP-51501).
• For CV-S200C/S200M, use 5 mm (OP-66830) or 10 mm (OP-66831).
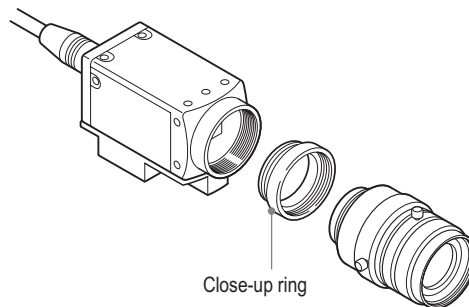
Close-up ring

If a single ring does match the number on the chart (ex. 1.5 mm), combine multiple rings.

► Note

If you use the 0.5 mm or 1.0 mm close-up rings with other close-up rings, the lens may be loosened by vibration due to insufficient tightening strength. Use of locking paint is recommended in such a case.

Connecting Cables

► **Note**

- Do not supply power to the controller before connecting the camera cable or the terminal block. If you connect the camera cable or the terminal block while the power is being supplied, it may damage the camera or peripheral devices.
- Camera cables CV-C17, CV-C17L, and CV-C12R can only be connected to CV-035C or CV-035M. Do not connect these cables to the other camera types as this may cause incorrect operation. For more details about the combinations of cameras and cables, see "Camera Cable" (Page 12-14).

1 **Connect the camera to the camera connector of the controller unit using one of the optional camera cables.**
If connecting only a single camera, attach it to the camera 1 connector.

To camera 2 connector

To camera 1 connector

CAM1   CAM2
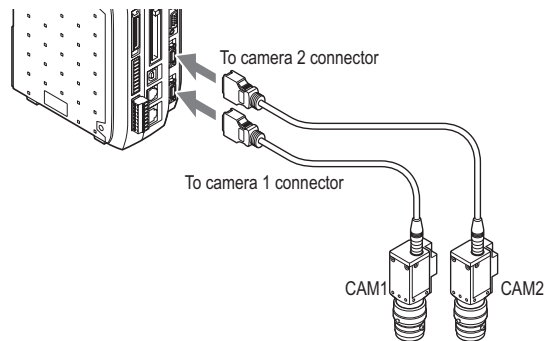
2 **Connect the remote control console to the modular connector of the controller unit.**

To modular connector
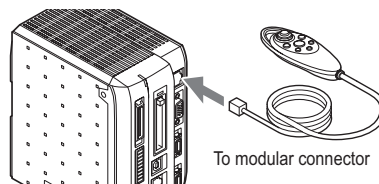
3 **Connect the monitor to the video output terminal of the controller unit.**

To VGA video
output termina
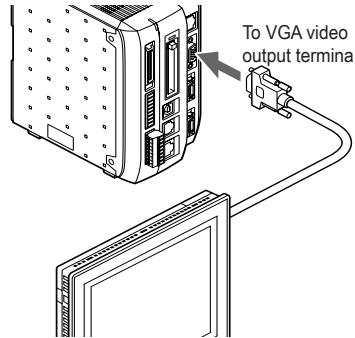
► **Note**

When using a commercial VGA monitor that is not SVGA (800 x 600 pixels) size, the displayed image quality may degrade and the screen may not appear correctly depending on the specifications of the monitor. (Recommended monitor: CA-MP80)

4 **Connect the 24 V DC power supply to terminals No. 7 and 8 on the terminal block.**

► **Note**

- Use a flat head screwdriver to connect the power supply to the terminals.
- Use a torque of 0.25 Nm or less to tighten the screws.
- Use the electrical wires AWG14 to AWG22.
- Make sure to connect the frame ground terminal for the 24 V DC power source to a type D ground.
- Do not supply power until installation is completed.

1) **Remove the terminal block from the controller unit.**

①
⑦
⑧

Terminal block
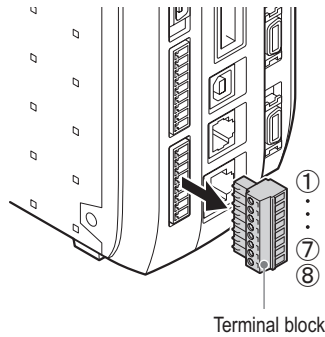
2) **Loosen the screws on the terminals with the flat head screwdriver.**

Flat head screwdriver
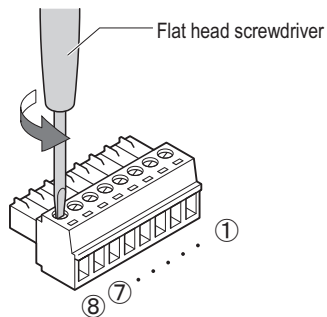
3) **After stripping the insulating sheath by about 7 mm, insert the lead wires to terminal No. 7 (24 V DC) and No. 8 (0 V), and then tighten the screws.**

Insert the lead wire after the insulating sheath has been stripped.
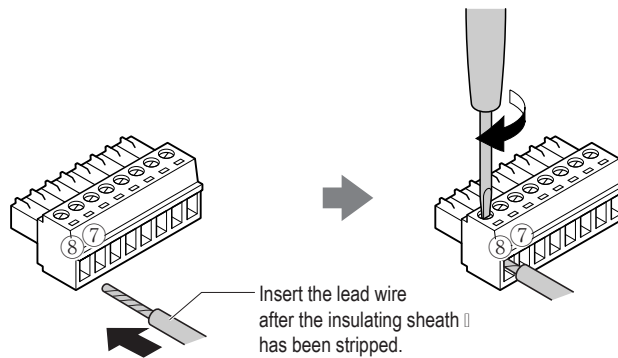
4) **After connecting all the necessary cables or wires, securely insert the I/O terminal block into the I/O connector as far as it can go.**
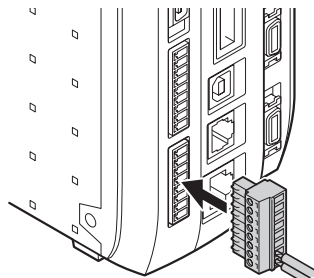
Camera & Lens Adjustment

Check that a screen is displayed on the monitor

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

After the opening screen appears on the monitor, the initial screen for the program mode should appear.

When nothing appears on the monitor

Check the following:

• Are the power input terminals connected correctly?

  – Is 24 V DC (2 A) used for the power supply？

  – Are the power input terminals connected in reverse polarity by mistake？

• Is the monitor cable connected correctly?

• Is the power of the monitor turned on?

Reference

You can change the opening screen. See "To change the opening screen displayed during startup" (Page 5-2) for more details.

2 **Press the [TRG] button to capture the image in front of the camera and display it on the screen.**

The Raw screen displays the view seen through the camera as is.
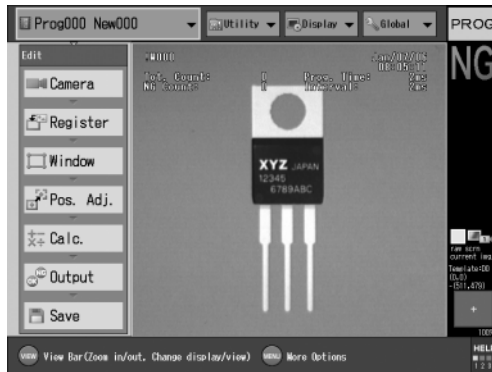
- If you use two cameras, the view through camera 1 is displayed.
- To display the view through camera 2, see Page 4-7.

Reference

During program mode, press and hold the [TRG] button on the remote control console to continuously refresh the data and image on the screen. Press the [TRG] button once more to stop refreshing.

If the Raw screen is not displayed

Check the following:

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

Adjusting Aperture and Focus

For CV-200C/200M/035C/035M

While monitoring the screen, turn the aperture iris and the focus ring to adjust the aperture and focus.

Lock screw of the focus ring

Lock screw of the aperture iris
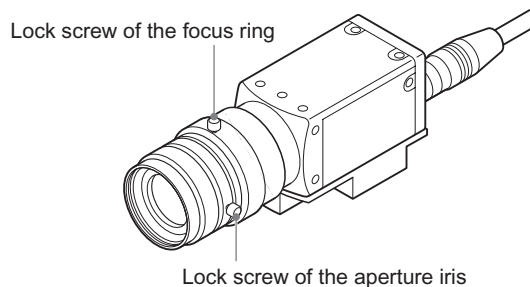
- Adjusting the aperture: Loosen the locking screw on the aperture ring to make the target and the surroundings distinguishable. (Brighten and darken the image)
- Adjusting the focus: Loosen the locking screw on the focus ring to sharpen the outline of the target image.

When the iris and focus adjustments are complete, tighten the locking screws so that the iris ring and the focus ring do not move.

For CV-S035C/S035M/S200C/S200M

While monitoring the screen, turn the aperture locking screws A and B and the lens setting ring to adjust the aperture and focus.

Aperture locking screw A

Lens setting ring

Aperture locking screw B
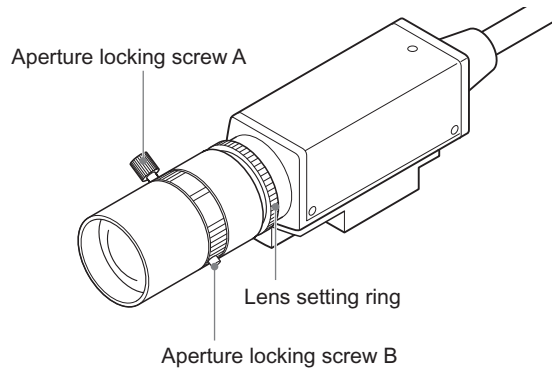
1 **Completely screw the lens setting ring inwards.**
At the same time, install the lens as far inwards as it can go.

2 **Adjust the distance between the camera and the target, then loosen the lens until the image is focused.**

3 **Fix the lens with the lens setting ring at the position where the image is in focus.**

4 **Loosening the aperture locking screws A and B to adjust for the best possible brightness of the image.**
The image becomes brighter when turned towards the OPEN side, and darker when turned towards the CLOSE side.

5 **After brightness is adjusted, fix the aperture with the aperture locking screws A and B.**

Selection and Installation of Illumination

Use a lighting system to ensure stable inspection

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

- Locations where the CV 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 representative for details.

Typical Lighting Systems

Direct illumination

Illuminates broadly and evenly by a lighting system such as a ring light. This type of lighting is suitable for surface inspection.

LED illumination system
Direct-ring light (CA-DR)
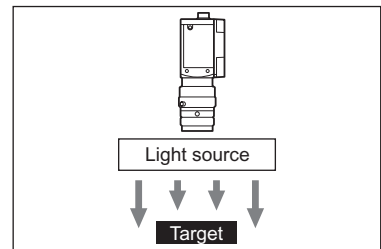
Backlight illumination

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 (CA-DS)
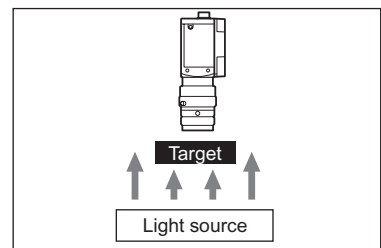
Indirect illumination

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

LED illumination system
Bar light (CA-DB)
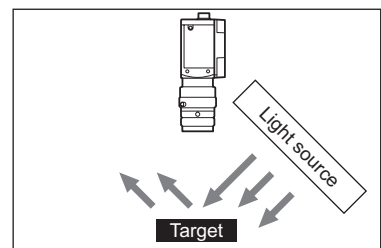
Coaxial illumination

Illuminates from the same axis as the lens.
This type of lighting makes the target's flat surfaces brighter and angled surfaces darker. This is suitable for surface inspection or position and size measurement of a flat surface.

LED illumination system
Coaxial light (CA-DX)
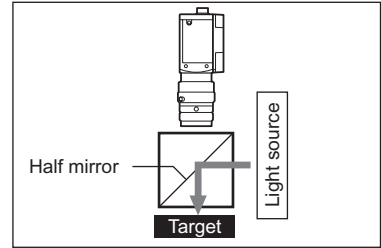
Low-angle illumination

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

LED illumination system
Low-angle light (CA-DL)
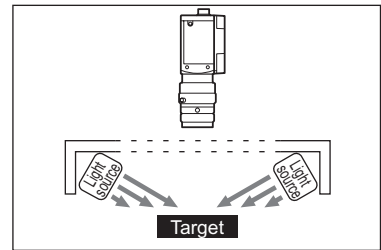
Dome illumination

Illuminates evenly from all around 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.

LED illumination system
Dome light (CA-DD)
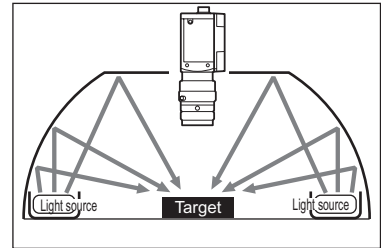
Basic Programming of the CV

The basic operation of the CV is conducted through the supplied console by selecting the items displayed on the screen or by entering the required setting value.

This section describes the general operations of the CV as follows:

- Operational Flow of the CV (Page 3-2)
- How to View the Screen (Page 3-4)
- How to Use the Remote Control Console
    - Selecting Items (Page 3-5)
    - Inputting Values (Page 3-6)
    - Inputting Characters (Page 3-7)
    - Zooming IN/OUT on the Displayed Image (Page 3-9)
    - Using the Help Menu (Menu Bar/Help Bar) (Page 3-11)
    - Using the Function Menu (Page 3-12)
- Drawing a Measurement Window (Page 3-13)

Operational Flow of the CV

The following flowchart indicates the flow of inspection and measurement setup on the CV.

Preparing for measurement (Chapter 2)
· Connect the camera and the monitor to the CV
· Prepare the suitable lens and illumination for the target.

Example of the Program screen

Specifying camera setting and register an image (Chapter 4)
· Register a reference image and select the camera settings suitable for the target (i.e. shutter speed).

Camera   Register

Creating an inspection window (Chapter 4)
· Specify an inspection tool
· Specify the measurement window position, measurement result calculation and output method.

Window   Pos. Adj.
Calc.

Advanced Program Options (Chapter 6)
· A program No. is assigned to a group of measurement conditions.
· Display settings can be registered for each program No. as necessary.

Display

Trial Run (Chapter 6)
· Check whether the intended judgment can be performed with the specified measurement conditions.
· Retest the saved image to check the judgment result.

Utility

Overall system settings (Chapter 7)
· Configure system settings that are common to all program Nos. (i.e. input/output options).
· You can set a password to prevent tampering.

Global

Enter into Operations mode (RUN MODE) (Chapter 5)
· The CV enters into the Operations mode and starts inspection operation.

Outputting the measurement result (Chapter 4)
· Measurement results or NG images can be output to a memory card during inspection operation.
· Measurement results or NG images can also be output via ports on the CV.

Output

When using a computer connected by RS-232C/When connecting to PLC in "no protocol" mode

In addition to the steps on the previous page, the following operations are required.

1 **Change the RS-232C communication settings on the CV.**
See Page 7-3.

2 **Connect the computer/PLC.**
See Page 9-3 (for the specifications of the RS-232C port for CV-3001/3501, see Page 9-2).

3 **Start communication.**

When controlling or outputting using the PLC link with RS-232C

In addition to the steps on the previous page, the following operations are required when outputting data with the PLC link or controlling with PLC link.

1 **Check whether the PLC is compatible with the CV.**
See Page 10-3.

2 **Connect the necessary wires and cables.**
See Page 10-6.

3 **Change the RS-232C communication setting on the CV and perform control or output.**

When outputting data with PLC link
See Page 10-11.

When controlling with PLC link (Poling)
See Page 10-16.

When controlling with PLC link (PLC terminal)
See Page 10-21.

When using a computer connected by Ethernet

In addition to the steps on the previous page, the following operations are required.

1 **Change the Ethernet communication settings on the CV.**
See Page 7-6.

2 **Connect the computer.**
See Page 9-3 (for the specifications of the Ethernet port for CV, see Page 9-8).

3 **Start communication.**

When using a computer connected by USB

In addition to the steps on the previous page, the following operations are required.

► Note

CV can only be connected via USB to computers that have USB ports and that run a version of Windows later than Windows XP SP2 or Windows 2000 SP4.

1 **Change the USB communication settings on the CV.**
See Page 7-7.

2 **Connect the computer.**
See Page 9-8 (for the specifications of the USB port for CV, see Page 9-8).

3 **Start communication.**

When controlling or outputting with I/O outputs (terminal)

Control or output can be performed with a parallel I/O interface or with the terminal block interface. In addition to the steps on the previous page, the following operations are required.

1 **Change the external terminal settings on the CV.**
See Page 7-2.

2 **Connect the terminal I/O.**
See Page 11-11 (for the specifications of the parallel I/O interface or terminal block interface for CV, see Page 11-2 or Page 11-4).

3 **Start communication.**

Basic Operation

Programming Interface

An example of the standard programming interface is shown below. The display changes according to the mode (Program mode or Run mode) and the state of operation.
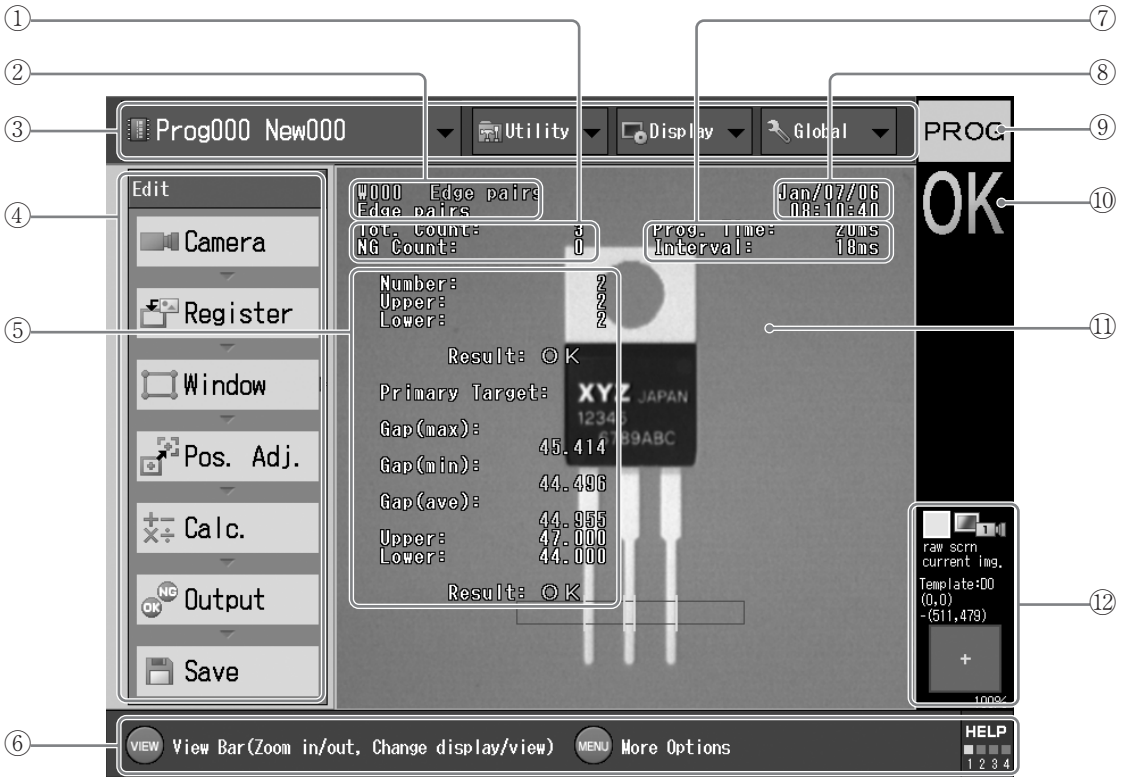
① Total Count/NG Count display

Displays the cumulative count and the cumulative count of inspections judged as NG during Run mode. The measurements and judgments from Program mode are not reflected. The upper limit for cumulative count is 1000000000. After passing this value, the count returns to 1.

② Window Name Display

Displays the measurement tool, and the name and number of the current window.

③ Menu Bar

Displays the number of the current program and the three advanced programming menus. Pressing the [MENU] button will cycle through activating and deactivating this menu.

④ Edit Menu

Appears only in Program mode. Most of the basic inspection options are configured in Edit Menu.As with the Menu bar, pressing the [MENU] button will deactivate the Edit menu.

⑤ Result View

Displays the results and inspection status for the current window.

⑥ Help Bar

Displays a guide for operations with the remote control console. The displayed information changes every time you press the [MENU] button on the remote control console.

⑦ Program Time/Date and Interval Display

• **Program Time/Date**: Displays the process time (the time from trigger input to the end of the

image processing) for the last time the current program was run.

- **Interval**: Displays the calculation of the shortest possible trigger interval that can be input according to the current program information.

Some processes do not apply during Program mode, so switch to Run mode to check the correct program time and interval.

⑧ **Date/Time Display**
Displays the date and time from the last time the current screen was refreshed.

⑨ **Operation Mode (Program/Run) Display**
Displays the current operation mode.

⑩ **Inspection Status Display**
Displays the total status of all the inspections in the current program.

⑪ **Camera Image**
Displays the image that is input from the camera.

⑫ **Information Display**
Displays information about the cameras connected to the CV or about the display template and display position.

Selecting Items

Reference

Using the following steps to select an item and perform the operation correctly is described as "Select (item name)" in the rest of this manual.

1 **Move the [ENTER] button of the console right and left or up and down to highlight the item you want to select.**
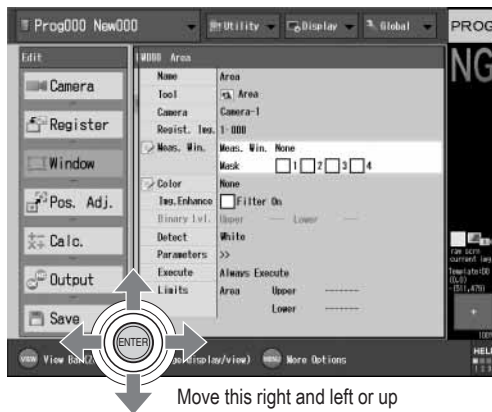
Move this right and left or up and down to highlight the item you want to select.

2 **Press the [ENTER] button.**
The item highlighted by the cursor is selected.

To cancel the operation
Press the [ESCAPE] button on the console to cancel the previously selected operation.

Inputting Values

The method of inputting items such as inspection tolerances are described below.

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

Reference

For some of the items, you can select between [Direct Input] and [Calc Ref]. Select [Direct Input] when you want to input a constant value.

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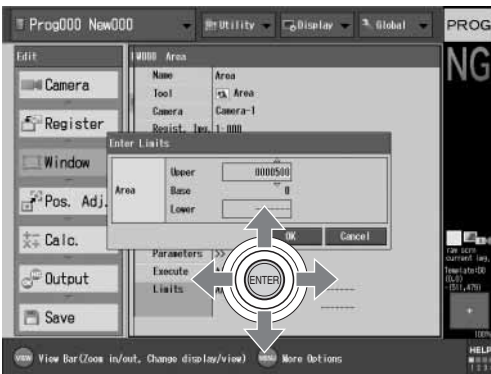
Reference

You can also specify the digit you want to modify by moving the [ENTER] button to the right or left.

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

The specified value is fixed and input.

To cancel the change

Press the [ESCAPE] button before pressing the [ENTER] button in step 3.

To return values on the [Enter Limits] screen to unset state ([------])

Select the value and select [Clear].

To refer to the calculated values from the Calc Ref window

Select [Calc Ref] and specify the Calc Ref window you want to reference.

Inputting Characters

You can input text for window and program names. This section describes how to register a name for a program number.

1 **Select the Prog. No. field in the upper left corner of the CV screen.**

The Prog. No. menu is displayed.
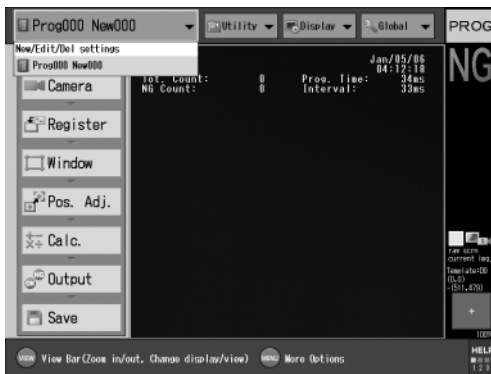
2 **Select [New/Edit/Del settings].**
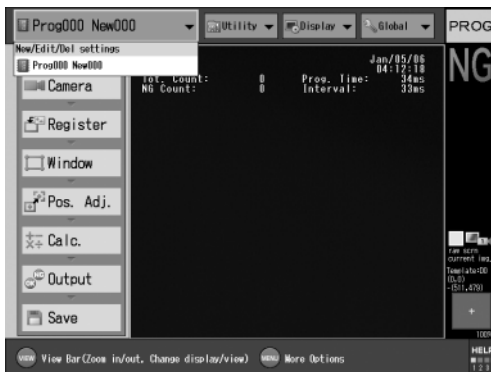
The [New/Edit/Del settings] screen appears.

3 **Select [Add].**

4 **Select [Prog. No.] and specify a program number.**
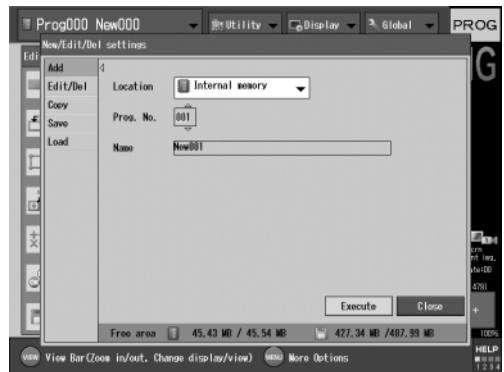
All adjustments and measurements will be saved under the selected program number until a new program is created.

5 **Select [Name].**

The [Add] menu appears.
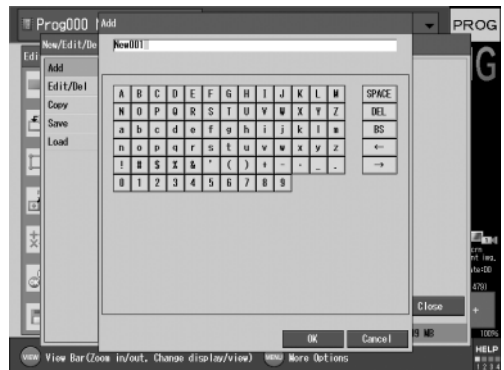
In this example, we will use the name "Sample1" for program number.

Basic Operation

6 Input "Sample1" one character at a time.

Selecting characters

Highlight the character you want to input, and then press the [ENTER] button.

Inputting a space

Select [SPACE] on the right hand side of the character input screen.

Correcting a character

Select [←] or [→] on the right hand side of the character input screen, and then select [DEL] (delete the selected character) or [BS] (delete the character immediately preceding the selected one).

Reference

To move the cursor position within the text box, hold the [FNC] button as you move the [Enter] button.

- To move the cursor left and right within the text, hold the [FNC] button as you move the [Enter] button left and right.
- To move the cursor to the beginning of the text, hold the [FNC] button and move up on the [Enter] button.
- To move the cursor to the end of the text, hold the [FNC] button and move down on the [Enter] button.

7 After completing the input, select [OK].

The program number selected in step 3 is named "Sample1".

Zooming In and Out on the Image and Scrolling on the Magnified Image (VIEW bar)

The VIEW bar can be used to zoom in and out on images and to scroll the display.

> **Reference**
>
> When the screen is split into multiple views by using the display template function (Page 6-3), hold down the [FNC] button and then toggle the [ENTER] button Up/Down/Left/Right to select the desired screen.

Zooming IN/OUT on the Displayed Image

The zoom ratios can be set from $x^1/_{25}$ (4%) to x16 (1600%) (for full screen, the range is $x^1/_{17}$ (6%) to x25 (2500%)). When using multiple screens, a different zoom ratio can be set for each screen. Zooming in can be useful when drawing inspection windows around small targets or locating defects that are difficult to see.

> **Reference**
>
> - The VIEW bar can be used to zoom in or out during Program or Run mode.
> - When the program is saved, the current Zoom settings are also saved and will appear the next time the program is used.

1 Press the [VIEW] button on the remote control console.

The VIEW bar appears on the screen.
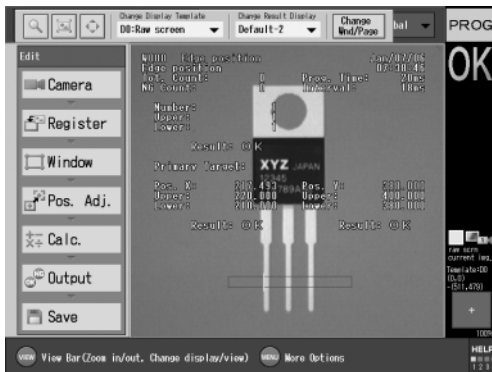
2 Select 🔍 (Zoom in/out).

The Q symbol appears on the screen.

> **Reference**
>
> When using a split screen display, the desired screen must be selected before using the Zoom function.

3 Place the Q over the point of the image to be enlanged.

4 Press the [ENTER] button.

When the Q symbol changes to $\hat{Q}$, you can zoom in or out on the image.
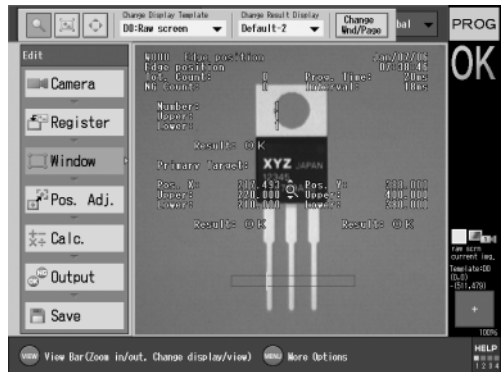
5 Move the [ENTER] button up and down to zoom in or out on the image.

Moving the [ENTER] button up zooms in, while moving the button down zooms out.
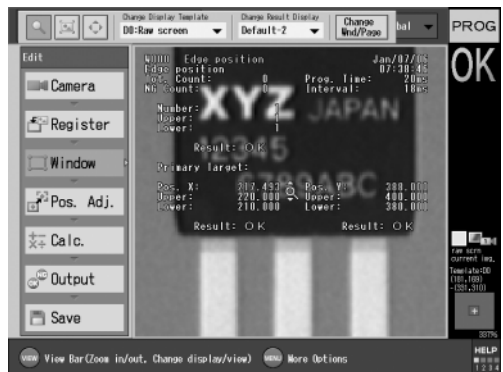
The current zoom ratio is displayed in the bottom right corner of the screen.

Basic Operation

6 **Press the [ESCAPE] button on the remote control console to hold the current zoom settings.**

7 **Press the [ESCAPE] button once more to exit the zoom feature.**

► Note

Other features cannot be used when the Q symbol is displayed. Press the [ESCAPE] button once more to make the Q symbol disappear, or cancel the VIEW bar before performing other settings.

To return to normal display (100% display)
Select ⊠ (Fit) from the VIEW bar.

To cancel the VIEW bar
Press the [VIEW] button on the remote control console.

Scrolling on the Displayed Image

When using a high definition camera or when displaying a magnified image, the entire image cannot fit into the display screen. In these situations, scroll the image to check portions that are not displayed.

Reference

The VIEW bar can be used to scroll during Program or Run mode.

1 **Press the [VIEW] button on the remote control console.**
The VIEW bar appears on the screen.
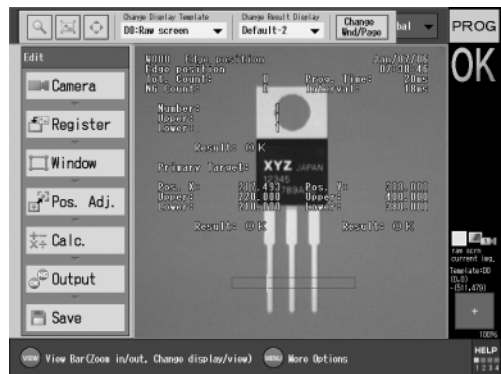
2 **Select ⊙ (Scroll).**
When the symbol appears on the screen, you can scroll on the image.
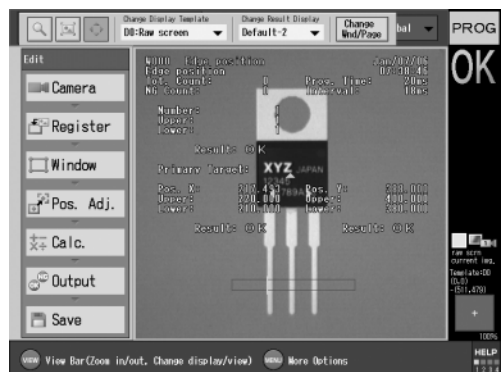
3 Move the [ENTER] button up and down or left and right to scroll through the image.
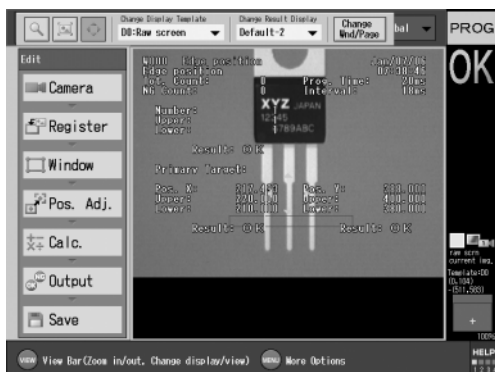
The position currently displayed on the screen is shown in the bottom right corner of the screen.

4 Press the [ESCAPE] button on the remote control console to stop scrolling.

► Note

Other features cannot be used when the symbol is displayed. Make the symbol disappear, or cancel the VIEW bar before performing other settings.

To return to normal display (no scroll)

Select (Fit) from the VIEW bar.

To cancel the VIEW bar

Press the [VIEW] button on the remote control console.

Using the Menu Bar/ Help Bar

Press the [MENU] button on the remote control console to display the menu bar or the help bar.

Menu Bar

Displays the current program number and the three advanced programming menus. Pressing the [MENU] button will cycle through activating and deactivating this menu.

Help Bar

Displays a guide on the bottom of the screen for currently available operations with the remote control console. The displayed information changes every time you press the [MENU] button.

HELP1

HELP2

HELP3

HELP4 (no Menu bar or Help bar)
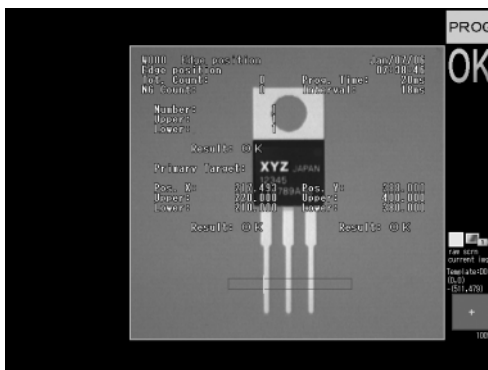
Reference

The contents of the help bar can change depending on the settings.

Using the Function Menu

Pressing the [FNC] button on the remote control console displays the function menu.
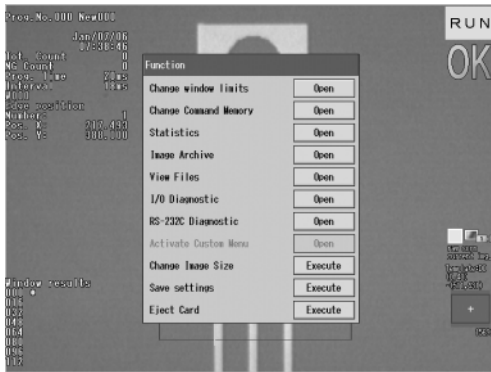
The functions that can be used with the function menu are shown below.

- **Change window limits**: Displays the [Change window limits] menu that allows the inspection limits to be changed during Run mode. See [Changing the Window Limits (Change Window Limits)] (Page 6-27) for more details.
- **Change Command Memory**: Displays the [Change command memory] menu that allows the command memory values to be changed during Run mode. See "Changing Command Memory Settings (Configure Command Memory)" (Page 6-28) for more details.
- **Statistics**: Displays the [Statistics] menu, which shows the real-time accumulated statistical data in numerical, trend graph, or histograms form. See "Analyzing Results (Statistics)" (Page 6-2) for more details.
- **Image Archive**: Displays the [Image Archive] menu for measuring/loading/saving camera images during Run mode. See "Reviewing the Saved Inspection Images (Image Archive)" (Page 6-10) for more details.
- **View Files**: Displays the [View Files] screen to view files saved onto the internal memory or memory cards for the CV and performs verification or initialization of the internal memory or memory cards. See "Viewing Files in the Internal Memory and Memory Cards (View Files)" (Page 6-16) for more details.

- **I/O Diagnostic**: Displays the [I/O Diagnostic] menu, which can be used to check the real time input and output status of the terminals on the CV. See "Verifying the Connection Status of Input/Output Signals (I/O Diagnostic)" (Page 6-22) for more details.
- **RS-232C Diagnostic**: Displays the [RS-232C Diagnostic] menu, which can be used to check the real time input and output status of the RS-232C port on the CV. See "Verifying the RS-232C Communication Status (RS-232C Diagnostic)" (Page 6-22) for more details.
- **Activate Custom Menu**: Displays the [Activate Custom Menu] menu,which allows you create, edit, or display a specified Custom Menu. See "Creating Menus that Only Display Necessary Items (Activate Custom Menu)" (Page 6-23) for more details.
- **Change Image Size**: Switches the displayed image size between Standard and Full in Run mode.
- **Save settings**: Saves the settings into the CV internal memory or the memory card. See "Saving Settings" (Page 4-303) for more details.
- **Eject Card**: Ejects the memory card. See "Removing a Memory Card" (Page 8-3) for more details.

► **Note**

The function menu can be displayed in either Run mode or Program mode, but the available functions are different.

Drawing a Measurement Window

When setting a measurement window or mask window, you must draw a specific window shape. In addition to the following shapes, the measurement window can be drawn with [Auto-Adj Rect] (Page 3-18) and [Auto-Adj Circle] (Page 3-21).

Rectangle and rotated rectangle   Circle   Oval

Ring   Arc   Polygon (e.g. hexagon)
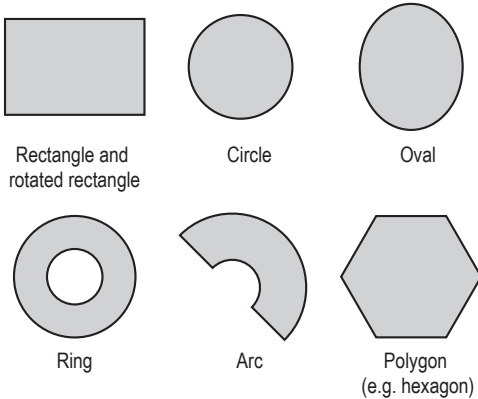
Select an appropriate shape according to the area you want to inspect.
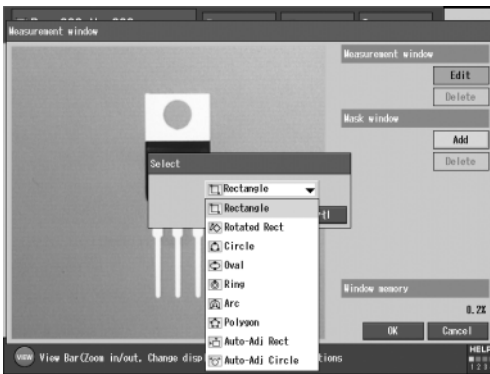
► **Note**
- The available selection of window shapes is dependent on the measurement tool.
- See "Delete the Current Window" (Page 3-25) for details on how to erase a window.
- Window memory for the CV is used each time an area is created. The current window memory (displayed as %) is displayed on the bottom right of the [Measurement Window] screen. When the displayed number becomes 100%, you will be unable to create any more areas. Erase unneeded areas to secure more window memory.
- When all or part of the drawn measurement window is outside of the image area (Page 4-11), the part of the window outside of the image area is deleted from the process area.

Drawing a Rectangle

1 **Select [Rectangle] in the [Select] window and press [OK].**

It becomes possible to draw a point.

2 **Specify the reference point of the rectangle.**

Move the cursor to specify the position of Point A, and then press the [ENTER] button.
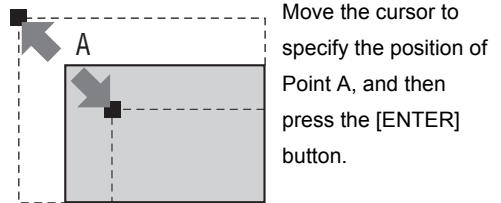
3 **Select the position of the opposite vertex.**

Move the cursor to specify the position of Point B, and then press the [ENTER] button.
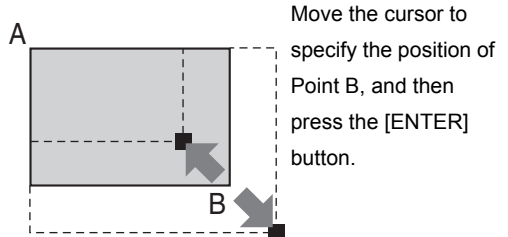
4 **Move the position of the rectangle.**
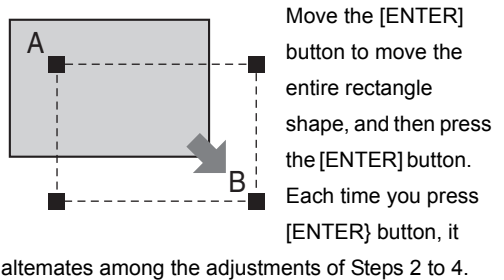
Move the [ENTER] button to move the entire rectangle shape, and then press the [ENTER] button. Each time you press [ENTER} button, it alternates among the adjustments of Steps 2 to 4.

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

Reference

The positions of the vertices can also be specified as values. See "Draw the Window by Entering Values"(Page 3-24) for more details.

Basic Operation

Drawing a Rotated Rectangle

1 **Select [Rotated Rect] in the [Select] window and press [OK].**

It becomes possible to draw a point.

2 **Set the width of the rotated rectangle.**

Move the cursor up and down to adjust the width, and then press the [ENTER] button.
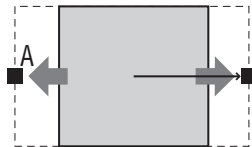
3 **Set the height of the rotated rectangle.**

Move the cursor up and down to adjust the height, and then press the [ENTER] button.
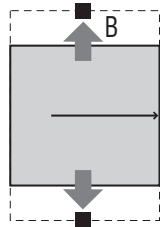
4 **Move the position of the rotated rectangle.**

Move the [ENTER] button to move the entire rotated rectangle shape, and then press the [ENTER] button.
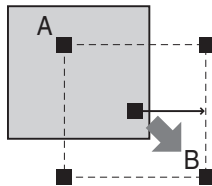
5 **Specify the angle of the rectangle.**

Move the [ENTER] button to adjust the angle, and then press the [ENTER] button.Each time you press the [ENTER-] button, it alternates among the adjustments of Steps 2 to 5.
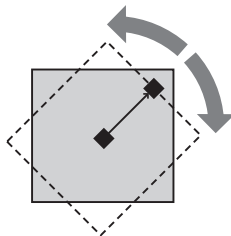
6 **When you have completed drawing the window, press the [ESCAPE] button.**

| Reference |

The height, width, points, and angle can also be specified as values. See "Draw the Window by Entering Values" (Page 3-24) for more details.

Drawing a Circle

1 **Select [Circle] in the [Select] window and press [OK].**

It becomes possible to draw a point.

2 **Move the position of the circle.**

Move the [ENTER] button to move the entire circle shape, and then press the [ENTER] button.

Each time you press the [ENTER] button, it alternates among the adjustments of Steps 2 to 3.
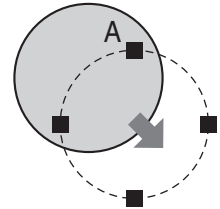
3 **Specify the size of the circle.**

Move the cursor to specify the position of Point A, and then press the [ENTER] button.
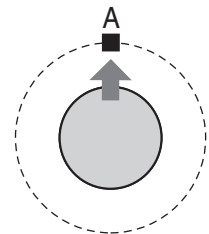
4 **When you have completed drawing the window, press the [ESCAPE] button.**

| Reference |

The radius and the position of the center can also be specified as values. See "Draw the Window by Entering Values" (Page 3-24) for more details.

Drawing an Oval

1 **Select [Oval] in the [Select] window and press [OK].**

It becomes possible to draw a point.

2 **Specify the position of the oval.**

Move the [ENTER] button to move the entire oval shape, and then press the [ENTER] button.
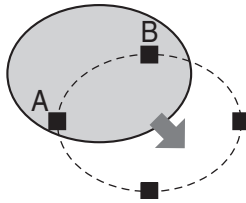
3 **Specify the horizontal size of the oval.**

Move the cursor up and down to specify the position of Point A, and then press the [ENTER] button.
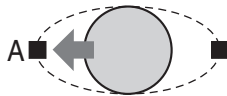
4 **Specify the vertical size of the oval.**

Move the cursor up and down to specify the position of Point B, and then press the [ENTER] button.
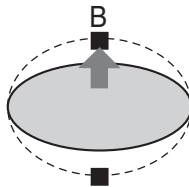
5 **Specify the angle of the oval.**
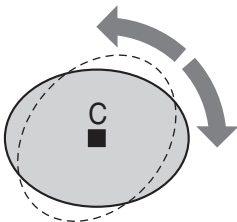
Move the cursor to adjust the angle, and then press the [ENTER] button. Each time you press the [ENTER] button, it alternates among the adjustments of Steps 2 to 5.

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

Reference

The position of the center, the rotation angle, and the radius in the X direction or Y direction can also be specified as values. See "Draw the Window by Entering Values" (Page 3-24) for more details.

Drawing a Ring

1 **Select [Ring] in the [Select] window and press [OK].**

It becomes possible to draw a point.

2 **Move the position of the ring.**

Move the [ENTER] button to move the entire ring shape, and then press the [ENTER] button. Each time you press the [ENTER] button, it alternates among the adjustments of Steps 2 to 4.
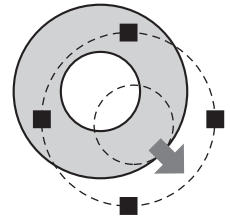
3 **Specify the outer circle size of the ring.**

Move the cursor up and down to specify the position of Point A, and then press the [ENTER] button.
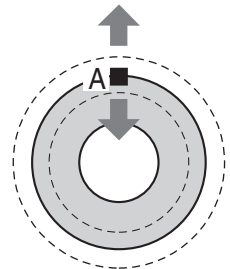
4 **Specify the inner circle size of the ring.**

Move the cursor up and down to specify the position of Point B, and then press the [ENTER] button.
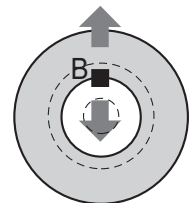
5 **When you have completed drawing the window, press the [ESCAPE] button.**

Reference

The position of the center and the radius of the inner and outer circles can also be specified as values. See "Draw the Window by Entering Values" (Page 3-24) for more details.

Basic Operation

Drawing an Arc

1 **Select [Arc] in the [Select] window and press [OK].**

It becomes possible to draw a point.

2 **Move the position of the arc.**

Move the [ENTER] button to move the entire arc shape, and then press the [ENTER] button.
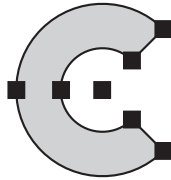
3 **Select the starting point for the arc.**

Move the cursor to specify the starting point, and then press the [ENTER] button.

Starting point
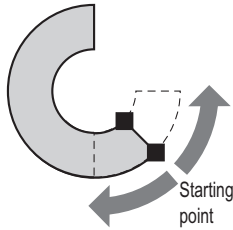
4 **Select the ending point for the arc.**

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

Ending point
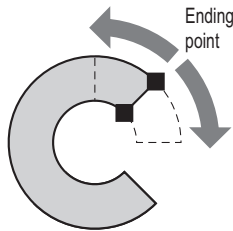
5 **Select the curvature for the arc.**

Move the cursor up and down to specify the curvature, and 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, and then press the [ENTER] button.
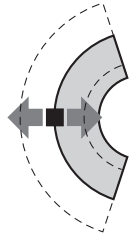
7 **Specify the inner circle size of the arc.**

Move the [ENTER] button up and down to specify the inner circle size, and then press the [ENTER] button.
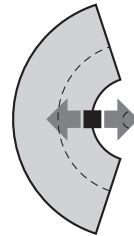
8 **Specify the angle of the arc.**

Move the cursor to adjust the angle, and then press the [ENTER] button. Each time you press the [ENTER] button, it alternates among the adjustments of Steps 2 to 8.
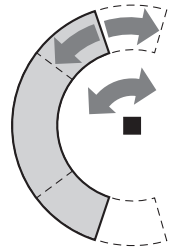
9 **When you have completed drawing the window, press the [ESCAPE] button.**

Reference

The position of the center, the starting and ending angles, and the radius of the inner and outer circles can also be specified as values. See "Draw the Window by Entering Values" (Page 3-24) for more details.

Drawing a Polygon

You can draw a polygon with up to 12 sides.

1 Select [Polygon] in the [Select] window and press [OK].

It becomes possible to draw a point.

2 Specify a vertex of the polygon.

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

A

3 Specify the next vertex.

Move the cursor to specify the position of Point B, and then press the [ENTER] button. Repeat this step until all the required vertices are specified.

A   B
F   C
E   D
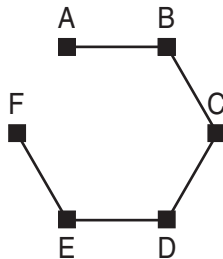
4 Select the first vertex selected in Step 2.

A polygon is drawn connecting the vertices selected in Steps 2 to 3.

Reference
Press the [ESCAPE] button to close the polygon between the first vertex and the latest vertex.
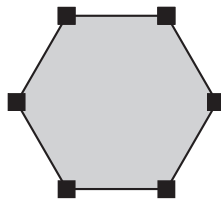
5 Move the position of the polygon.

Move the [ENTER] button to move the entire polygon shape, and then press the [ENTER] button. Each time you press the [ENTER] button, the function alternates between the vertex position adjustment and the polygon location adjustment.
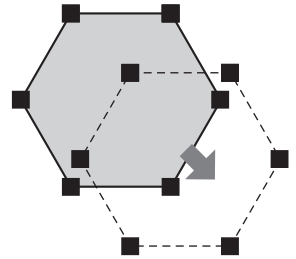
6 When you have completed drawing the window, press the [ESCAPE] button.

Reference
The center of the polygon and the position of each vertex can also be specified as values. See "Draw the Window by Entering Values" (Page 3-24) for more details.

Basic Operation

Adding vertices

Vertices can be added anywhere to a previously drawn polygon.

1 **Select [Edit] from the [Measurement window] screen.**
The [Edit] menu appears.

2 **Press the [ENTER] button to select [Add].**
The [Add] menu appears.

3 **Select the vertex number positioned before the vertex you want to add and press [OK].**
A new vertex is added after the selected vertex.

4 **Select the added vertex and adjust the position.**

Deleting vertices

Any vertex can be deleted from a previously drawn polygon.

1 **Select [Edit] from the [Measurement window] screen.**
The [Edit] menu appears.

2 **Press the [ENTER] button to select [Delete].**
The [Delete] menu appears.

3 **Select the number of the vertex you want to delete and press [OK].**
The selected vertex is deleted.

► Note

Vertices that have not been completely set cannot be deleted. Close the polygon before deleting or revising vertices.

Drawing an Auto-Adjusting Rectangle

You can create a measurement area in which a change in intensity of the image is considered the edge of the measurement window. This is a handy function for automatically changing the measurement window to suit the size of the workpiece. The size of the window can also be controlled using a calculation window as a reference.
See "Hints for Making Full Use of the Auto-Adjusting Rectangle" (Page 3-20) for examples of using the function.

Reference

The following measurements do not have the Auto-Adjusting Rectangle option.
• Pattern search
• Edge angle
• Trend edge position
• Trend edge width
• Color
• Measurement windows with subtract filter set
• OCR

Measurement window created by the Auto-Adjusting Rectangle

The measurement window is a rectangle formed by four detected sides found within four rectangles (1 through 4) as shown below.
The position of the window edge will change when the size of the target changes.
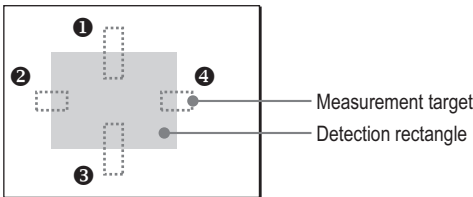
Setting the Auto-Adjusting Rectangle

Edge detection is processed using the same image as the measurement window. When using the color camera or the binary filter, complete the range and color extraction settings before creating the Auto-Adjusting rectangle.

Reference

When the edges of the image in the measurement window cannot be detected correctly, detect the edges in a different window and refer to the results via the calculation window.

1 Select [Auto-Adj Rect] in the [Select] window and press [OK].

It becomes possible to draw a point.

2 Set the edge detection variables as required.

See Page 13-15 is an "What is an Edge ?" for more details about the principles of edge detection.

Draw

Draw a window according to the range in which you want to detect the edge. For more about drawing, see Page 3-13 a Rectangle".
When you have completed drawing the window, press the [ESCAPE] button to return to the Auto-Adjusting Rectangle setup menu.

Region

Select 1 of the 4 regions to be adjusted.

Scan dir.

Specify the direction for edge detection.

When [Specify] is selected, edge detection is not performed and the value in the [Position] field is entered automatically.

Position

Specify the position of the window as a value. When [Calc Ref] is selected, the position is linked to the calculated reference and the position can be controlled. The range that can be specified is shown below.

- Up and down: 0 to 1199
- Left to right: 0 to 1599

Reference

The values for up and down, and left to right can also be reversed.

Offset

Specifies the offset of the edge detection in pixels. To set the offset in the direction of detection, specify a positive value, and to set the offset in the opposite direction, specify a negative value.

Mask offset

When the mask area is turned on, set the number of pixels to offset the mask area. To set the offset in the direction of detection, specify a positive value, and to set the offset in the opposite direction, specify a negative value.

Edge dir.

Specify the direction of the edge that you want to detect.
- **[Lght to Drk]:** Detects an edge that changes from a bright area to a dark area.
- **[Drk to Lght]:** Detects an edge that changes from a dark area to a bright area.
- **[Both]** (Default setting)**:** Detects edges that change from a bright area to a dark area, or from a dark area to a bright area.

Edge sensitivity

Specify the relative threshold value (0 to 100) of edge recognition (default value: 30).

Basic Operation

Edge Filter width

Specify the smoothing filter width (0 to 100) applied to the derivative wave to detect edges (default value: 5).

Upper Edge Intensity

Specify the threshold value (0.000 to 255.000) of upper edge intensity (default value: 255.000).

Lower Edge Intensity

Specify the threshold value (0.000 to 255.000) of lower edge intensity (default value: 5.000).

Reference

Noise can be eliminated in a detection window by adjusting the upper and lower edge intensity with reference to the maximum edge intensity within the segment. See Page 13-15 is an "What is an Edge ?" for details.

Mask

Select on to activate the selected mask area (Page 3-25) (default setting: OFF).

Angled Edge Det.

Turn ON to perform stable detection on an edge that is at an angle to the measurement area (default setting: OFF). When turned on during normal situations, it can affect the measurement accuracy.

3 **To change other edge detection window settings, select the [Region] you want to edit and perform the settings the same way as in Step 2.**

4 **Select [OK].**

The specifications for the Auto-Adjusting Rectangle are completed.

Hints for Making Full Use of the Auto-Adjusting Rectangle

To modify the measurement window size only in the Y-axis direction

The edges in the X-axis direction do not need to be detected, so set the width of the detection rectangle (Left, Right) in the X-axis direction as "0", as shown in the figure below, or set a desired position with [Specify].

The measurement window generated by the detection rectangles

The detect window will change according to the size of the target in the Y-axis direction.
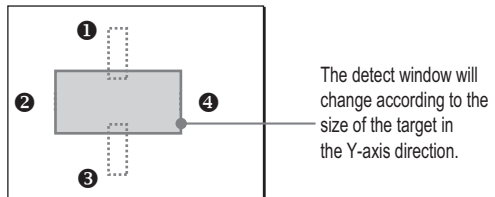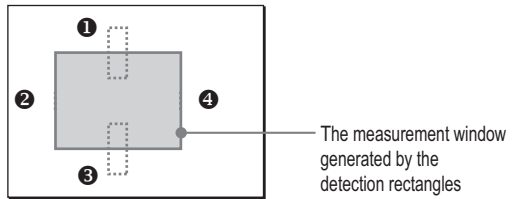
To make the window appear inside the detected target

Change the offset setting in the [Edit] menu. For example, if it is necessary to specify the measurement window within five pixels inside the target, specify the offset [5] for all of the edge detection windows (when the direction for detection is pointing inwards).

The measurement window generated by the detection rectangles
The measurement window specified inside the detected measurement window because of the offset specification
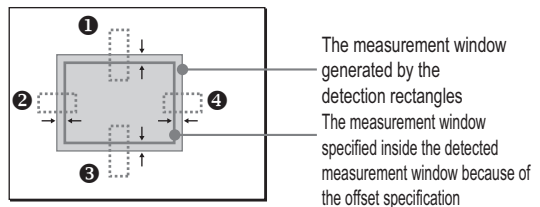
Reference

When a negative value is specified as the offset, it becomes possible to specify a window bigger than the detected object.

Drawing an Auto-Adjusting Circle

You can create a measurement area in which a change in intensity of the image is considered the edge of the measurement window. This is a handy function for automatically changing the measurement window to suit the size of the workpiece. The position of the display area can be controlled with the value setting or calculation reference. See "Hints for Making Full Use of the Auto-Adjusting Circle" (Page 3-24) for examples of using the function.

Reference

The following measurements do not have the Auto-Adjusting Circle option.
- Pattern search
- Edge angle
- Trend edge position
- Trend edge width
- Color
- Measurement windows with subtract filter set
- OCR

Measurement window specified by the Auto-Adjusting Circle

The Auto-Adjusting Circle is made up of three rotated rectangles, which sense the edge of the target and then draw a corresponding measurement window to match the circumference of the target.

Circle

Detection rectangle
Measurement target
The circle drawn by referencing the edge detection

Ring

Detection rectangle
Measurement target
The circle drawn by referencing the edge detection
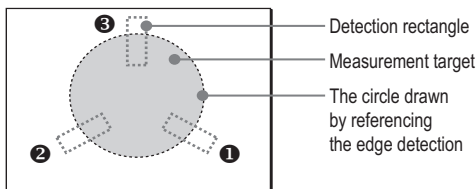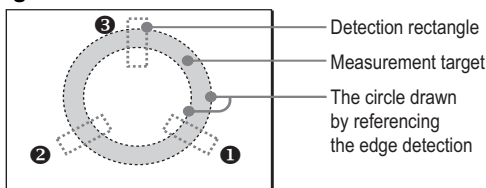
The position of the edge to be detected will change when the size of the target changes.

Setting the Auto-Adjusting Circle

► Note

Edge detection is processed using the same image as the measurement window. When using the color camera or the binary filter, complete the range and color extraction settings before creating the Auto-Adjusting Circle.

Reference

When the edges of the image in the measurement window cannot be detected correctly, detect the edges in a different window and refer to the results via the calculation window.

1 Select [Auto-Adj Circle] in the [Select] window and press [OK].
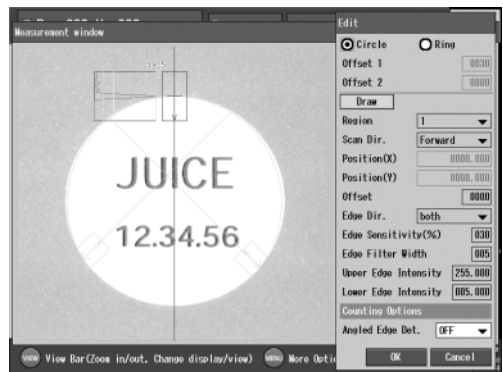
2 **Select the shape of the Auto-Adjusting Circle.**

When [Circle] is selected, go on to Step 5.

- **Circle:** The measurement window is the inside of the circle defined by the edge detection.

Detected circle (reference circle)

Measurement window
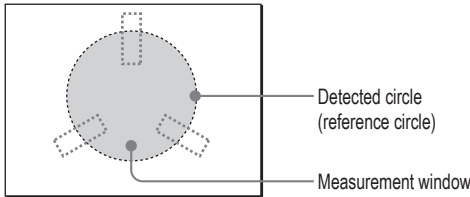
- **Ring:** The measurement window is the area between two radius offsets specified by the edge detection.

Radius offset 2
Radius offset 1

Detected circle (reference circle)

Measurement window
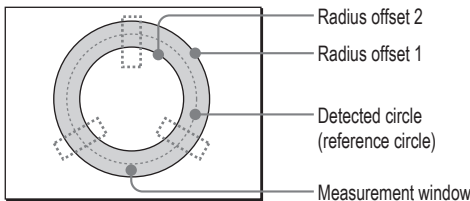
3 **Select [Offset 1], and specify the offset from the reference circle detected in the edge detection (only when [Ring] is selected).**

Ex: When the [Offset 1] is specified as [30].

30 pixels

Radius offset 1

Detected circle (reference circle)
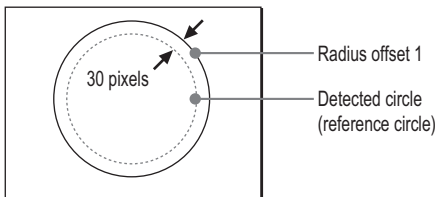
4 **Select [Offset 2], and specify the offset into the reference circle detected in the edge detection (only when [Ring] is selected).**

Ex: When the [Offset 2] is specified as [30].

30 pixels

Radius offset 1

Detected circle (reference circle)

Radius offset 2
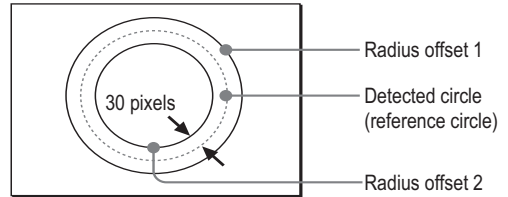
Reference

When a negative value is set for [Offset 1] and a positive value is set for [Offset 2], the ring is drawn completely inside of the detected reference circle. When a positive value is set for [Offset 1] and a negative value is set for [Offset 2], the ring is drawn completely outside of the detected reference circle.

5 **Set the edge detect variables as required.**

See Page 13-15 is an "What is an Edge ?" for more details about the principles of edge detection.

Window settings

Draw a window according to the range in which you want to detect the edge. For more about drawing, see Page 3-14 a "Drawing a Rotated Rectangle". When you have completed drawing the window, press the [ESCAPE] button to return to the Auto-Adjusting Circle setup menu.

Region
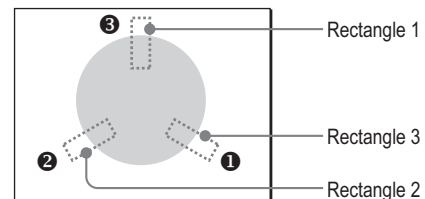
Select 1 of the 4 regions to be adjusted.

❸ Rectangle 1

Rectangle 3

❷ ❶ Rectangle 2

Scan Dir.

Specify the direction for edge detection.
When [Specify] is selected, edge detection is not performed and the value in the [Position] field is entered automatically.

Position

Specify the position of the window as a value. When [Calc Ref] is selected, the position is linked to the calculated reference and the position can be controlled. The range that can be specified between -9600 and 9600.

Offset

Specifies the offset of the edge detection in pixels. To set the offset in the direction of detection, specify a positive value, and to set the offset in the opposite direction, specify a negative value.

Edge Dir.

Specify the direction of the edge that you want to detect.

- **[Lght to Drk]:** Detects an edge that changes from a bright area to a dark area.
- **[Drk to Lght]:** Detects an edge that changes from a dark area to a bright area.
- **[Both]** (Default setting)**:** Detects edges that change from a bright area to a dark area, or from a dark area to a bright area.

Edge sensitivity

Specify the relative threshold value (0 to 100) of edge recognition (default value: 30).

Edge Filter Width

Specify the smoothing filter width (0 to 100) applied to the derivative wave to detect edges (default value: 5).

Upper Edge Intensity

Specify the threshold value (0.000 to 255.000) of upper edge intensity (default value: 255.000).

Lower Edge Intensity

Specify the threshold value (0.000 to 255.000) of lower edge intensity (default value: 5.000).

Reference

Noise can be eliminated in a detection window by adjusting the upper and lower edge intensity with reference to the maximum edge intensity within the segment. See What is an Edge ? (Page 13-13) for details.

Angled Edge Det.

Turn ON to perform stable detection on an edge that is at an angle to the measurement area (default setting: OFF). When turned on during normal situations, it can affect the measurement accuracy.

6 **To change other edge detection window settings, select the [Region] you want to set and perform the settings the same way as in Step 5.**

7 **Select [OK].**

The specifications for the Auto-Adjusting Circle are completed.

Basic Operation

Hints for Making Full Use of the Auto-Adjusting Circle

The measurement window can be changed according to the size of the target by drawing the edge detection rectangles lengthwise in the direction of the radius as shown below.

Ex: Inspection of the inside of a circular target

• Shape: Circle
• Offset: 10 (when detecting direction is inwards)

Measurement window
Detection rectangle
Reference circle

Measurement window
Detection rectangle
Reference circle
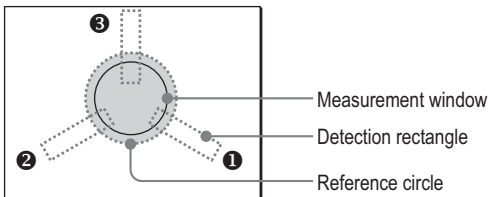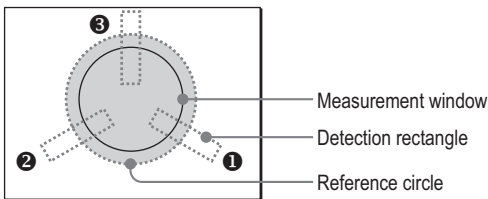
Ex: Inspection on the circumference of a circular target.

• Shape: Ring
• Offset 1: 10
• Offset 2: 10

Radius offset 2
Reference circle
Radius offset 1
Detection rectangle

Reference circle
Radius offset 1
Radius offset 2
Detection rectangle
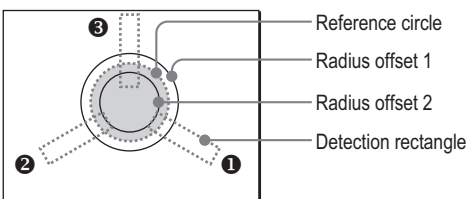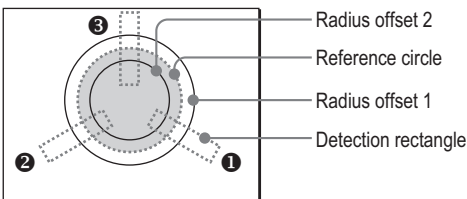
Draw the Window by Entering Values

The position of the window and other necessary information for the window can be set by specifying a value.

► **Note**

The values that can be entered differ depending on the window shape.

1 **In the screen where the cursor can be used to draw the window, press the [ESCAPE] button.**
The [Edit] menu appears.

2 **Select the value of the item to change.**
The settings for the selected items appear on the shape of the window, and a value can be entered.
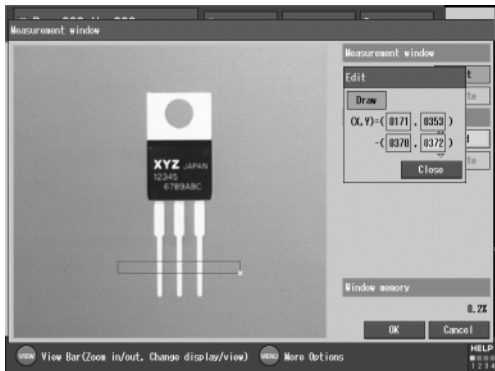
3 **Change the value.**
The window position or other selected item changes as the value is changed.

4 **After completing the drawing, select [Close].**

Reference

From the [Edit] menu, select [Draw] to continue drawing the window with the cursor.

Basic Operation

Delete the Current Window

A previously drawn window can be deleted. When multiple windows are set, you can delete only the specified windows.

1 **From the [Window settings] menu, select [Delete] for the window you want to delete.**
The confirmation screen is displayed.

2 **Select [Yes].**
The selected window is deleted.

Exclude Part of the Measurement Window (Mask Window)

You can specify up to four areas to exclude (Mask windows) in the measurement window. This is useful when the measurement target has a complicated shape or when you want to hide a part that is not necessary.

Specified measurement window

Specify the mask windows

Specified mask window

Specified measurement window

The area covered by the mask window is excluded from the measurement window.

Measurement window after the mask windows are activated
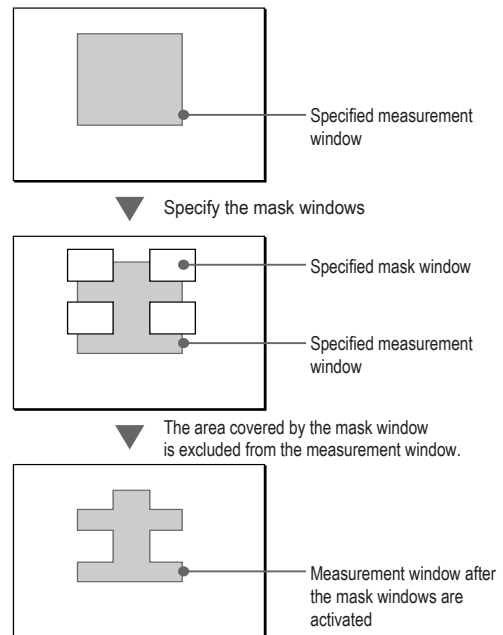
1 **From the [Measurement window] menu, select [Add] in the [Mask window] field.**
The [Add mask window] menu appears.

2 **Select the shape of the mask window you want to add and press [OK].**
It becomes possible to draw the mask window.

3 **Draw the mask window.**
See "Drawing a Measurement Window" (Page 3-13) for more details.

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

5 **Select [Close].**

Editing the mask window

Specified mask windows can be revised or temporarily turned off. The entire area for mask windows are saved, so they can be turned on again even after they have been turned off.

1 **From [Mask window] in the [Measurement window] menu, select the number of the mask window to edit.**
The [Edit] menu appears.

2 **To turn off a selected mask area temporarily, select [ON] and change it to [OFF].**
To turn it back on, select [OFF] and change it to [ON].

3 **To revise the mask window, select [Edit].**
The mask window drawing menu appears. Revise the mask window as necessary.

4 **Select [Close].**

Deleting the mask window

A previously set mask window can be deleted.

1 **From [Mask window] in the [Measurement window] menu, select [Delete].**
The [Delete mask window] menu appears.

2 **Select the number of the mask window you want to delete and press [OK].**
The confirmation screen is displayed.

3 **Select [OK].**
The mask window selected in Step 2 is deleted.

Shifting All Measurement windows

Measurement windows that use the same registered image and the same camera in the same program can be shifted all at once in the X/Y directions. This function is useful when the measurement position, not the shape of the workpiece, changes. It is much more convenient than changing the settings for each window individually.

► **Note**

The following windows cannot be shifted all at once:
• [Draw Shape] window (Page 4-218)
• Windows set by values for auto-adjust rectangle or auto-adjust circle

1 **Select [Add/Copy/Del] from the [Window] menu.**
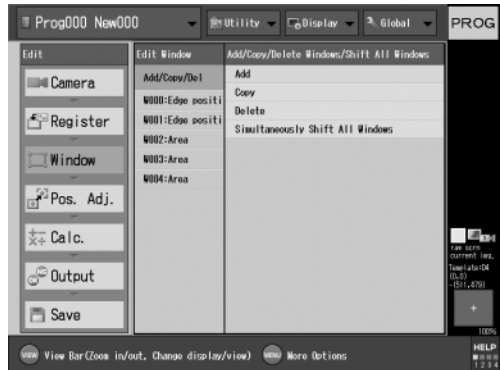
2 **Select [Simultaneously Shift All Windows].**
The [Simultaneously Shift All Windows] menu appears.
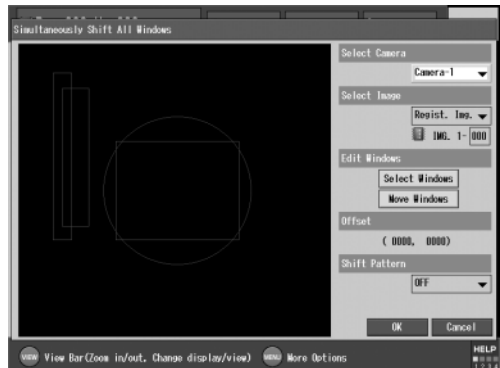
3 With [Select Camera], select the camera for the measurement window you want to move.

► **Note**

Windows from multiple cameras cannot be shifted at once.

4 With [Select Image], select the image displayed in the [Simultoneously Shift All Windows] menu.

- **Regist. Img.:** Displays the registered images. Select the number for the displayed registered image.
- **Current Img.:** Displays the image from the camera selected in Step 3.

► **Note**

- Windows for different registered images cannot be shifted at once.
- When selecting a current image, the windows cannot be shifted at once if any of the following conditions apply.
  − Windows that are used as position windows
  − Windows that use a subtract filter
  − Pattern windows for pattern search or pattern sort (when [Shift Pattern Window] is set to [OFF])

5 Select [Select Windows].

The [Select Windows] menu appears.
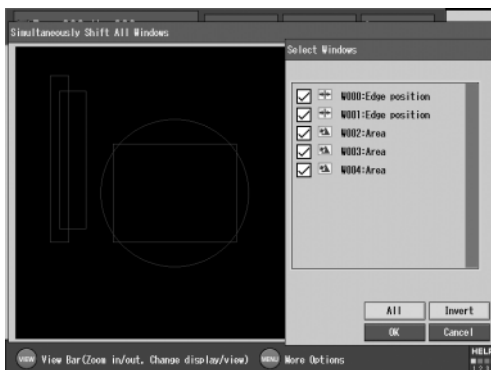
6 Place a check next to the numbers of the windows to move all at once and press [OK].

▌**Reference**

In the default state, all of the movable windows are selected.

7 When including the pattern windows for pattern search or pattern sort, in the [Shift All Windows] operation, select [ON] for [Shift Pattern Window].

▌**Reference**

When [OFF] is selected, only the search area is moved at once.

► **Note**

When [Shift Pattern Window] is set to [ON] while [Current Img.] is selected in [View], none of the pattern windows for pattern search or pattern sort, can be moved at once.

8 Select [Edit].

9 Move the [ENTER] button to move the measurement window in the X or Y direction, and then press the [ENTER] button.

Only the measurement windows checked in Step 6 are moved.

10 Select [OK].

Chapter

4

Specifying the Windows for Inspection and Measurement

Program Flow for Specifying Test and Measurement Settings

The program flow for specifying test and measurement settings is as follows:

Setting "Program No." (Page 4-2)

Select a Program No. to register a set of test and measurement conditions.

Setting "Camera" (Page 4-6)

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

Setting "Image Registration" (Page 4-18)

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

Setting "Window" (Page 4-20)

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

Setting "Position Adjustment" (Page 4-249)

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

Setting "Calculation" (Page 4-253)

Specify settings required for judgment using logic statements and mathmatical expressions as needed.

Setting "Output Settings" (Page 4-278)

Specify how you want to output the judgment results.

"Save" settings (Page 4-303)

Save the test and measurement conditions for the current Program No.

What is a Program No.?

For the CV, all of the measurement and inspection settings, camera specifications, and judgement conditions can be grouped together under a specified "Program Number". This helps organize the settings by product, allowing for easy product changeovers.

Basic Method for Saving Data of the CV

Each program No. in the CV manages and saves a folder with a group of data that includes the individual program data for image processing, as well as the library and registered image data that is required for measurement mode.
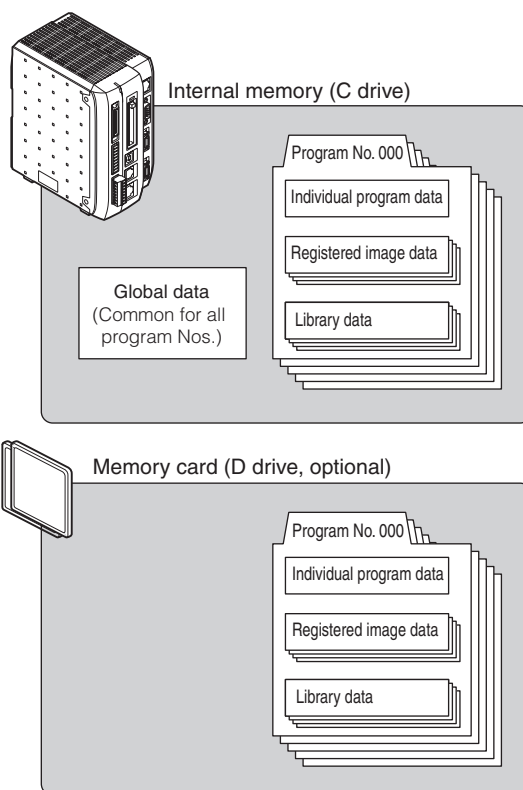
► **Note**

The internal memory and memory cards for the CV can be assigned any Program No. from 000-999. However, the quantity of programs that can be stored in the memory varies depending on the program settings.

Reference

Global settings (Page 7-1) are applied to all Program Nos.

Creating a New Program No.

Program Names can be set at the same time as Program Nos. Use this feature to create program names that are easy to identify.

1 **Select the Prog. No. field in the upper-left corner of the screen.**
The Program No. menu appears.
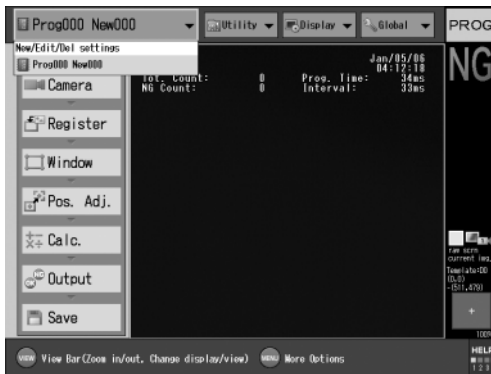
2 **Select [New/Edit/Del settings].**
The [New Edit Del settings] screen appears.
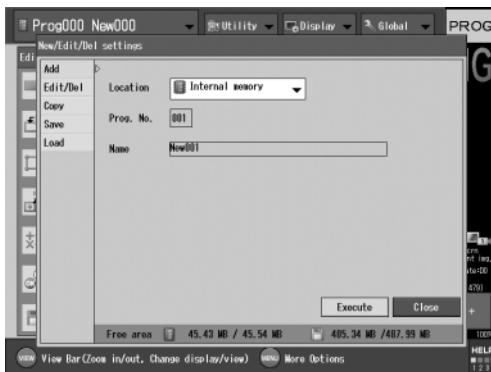
3 **Select [Add].**

4 **When adding a Program No., set [Location] to either [Internal memory] or [Memory card].**

[Location] cannot be set to a memory card if no card has been inserted into the machine. When assigning a Program No. to a memory card, be sure to first insert a memory card into the unit.

5 **Select [Prog. No.], then select the desired number**
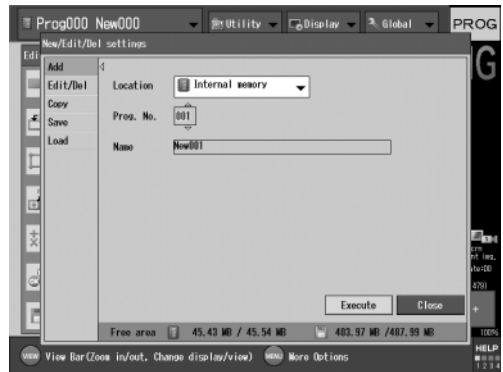
The name of the newly created program defaults to "New ***", where *** represents the No. of the program.

6 **Select [Name].**
The [Add] menu appears.

7 **After entering the name for the new program, select [OK].**
See [Inputting Characters] (Page 3-7) for details on entering text.

8 **Select [Execute].**
Program Nos. can be used for measurement once they have been added.

Reference
Selecting [Close] will cancel all actions up this point and will not create a new Program No.

Specifying the Windows for Inspection and Measurement

Copying to another Program No.

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.
- When loading or saving a Program No. stored on a memory card, be sure to first insert a memory card into the unit.
- Copies cannot be made if the copy destination lacks the necessary space to store all of the data.

1 Select [Copy] in step 3 of "Creating a New Program No."(Page 4-3).

2 For [Program], select the program data that you would like to copy.
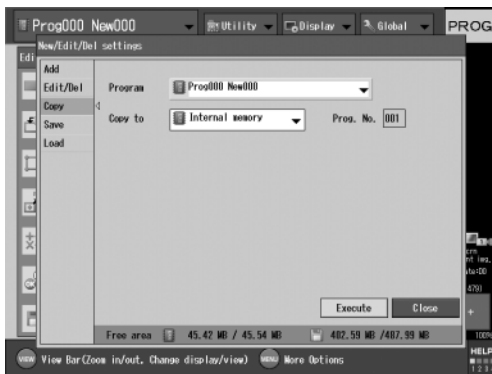
3 For [Copy to], select the destination of the copied information.

4 Select [Execute].

After copying is complete, "File(s) copied" will be displayed.

■ **Reference**

If there is already a Program No. saved at the desired location, a message confirming that you wish to overwrite will be displayed.

5 Select [Close].

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

Deleting a Program No.

► **Note**

When a Program No. is deleted, all related settings (such as camera or measurement window settings) are also deleted.

1 Select [Edit/Del] in step 3 of "Creating a New Program No." (Page 4-3).

2 Select [Location], and then select a Program No. to delete.
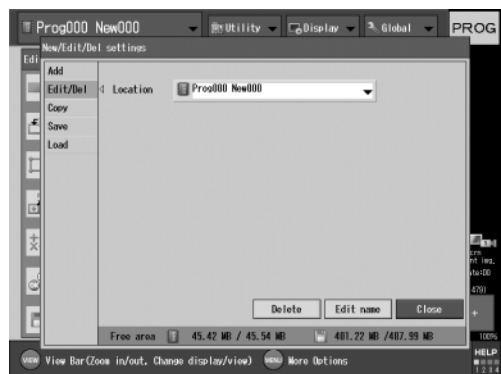
3 Select [Delete].

A confirmation screen appears.

4 Select [OK].

The Program No. selected in Step 2 is deleted.

Changing the name of a Program No.

1 **Select [Edit/Del] in step 3 of "Creating a New Program No." (Page 4-3).**

2 **Select [Location], and then select the Program No. to change.**
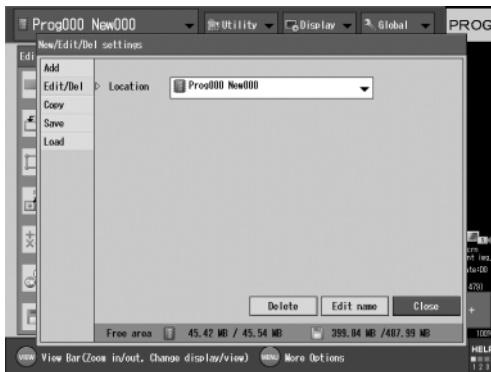
3 **Select [Edit name].**
The [Edit/Del] menu appears.

4 **After entering the new program name, select [OK].**
See [Inputting Characters] (Page 3-7) for details on entering text.

5 **Select [Close].**
The name of the Program No. is changed.

Loading/saving Program Nos.

Recorded Program No. settings can be written to a memory card. Settings saved on memory cards can be loaded into the system.

► **Note**
- Loading or saving Program Nos. requires a memory card.
- Certain conditions must be met to use data saved from a CV-3501 with a CV-3001. See "Cautions about using program data created by the CV-3501 with the CV-3001" (6 Page) for details.

Select [Save] or [Load] in step 3 of "Creating a New Program No." (Page 4-3).
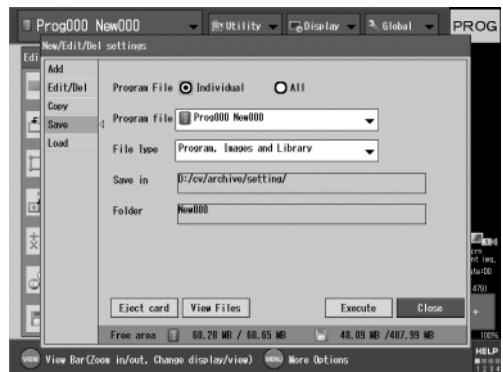
See "Chapter 8 Saving and Loading the CV Data to/from the Memory Card" (Page 8-1) for details on the save/load precess

Specifying the Windows for Inspection and Measurement

4-2

Specifying Camera Settings [CAMERA]

Overview of CAMERA Settings

Specify settings for capturing an image. The camera settings that can be altered are as follows:

Camera Settings

- Camera Specs (Page 4-7)
- Trigger (Page 4-8)
- Shutter Speed (Page 4-8)
- CCD Parameters [Gain Adjustment, Image Area, Scan Method] (Page 4-9)

Camera Common Settings

- Trigger Setting (Page 4-14)
- Multi-Image Capture (Page 4-17)

Displaying the [Camera Settings] menu

1 Select the Program No. from the initial settings screen.
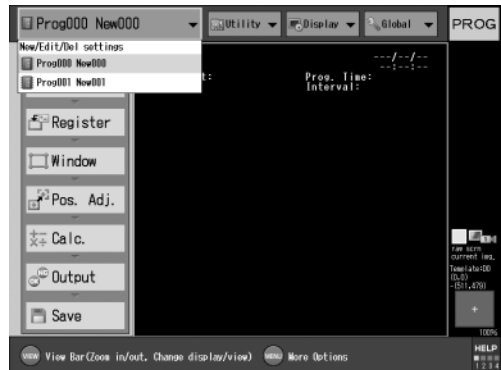
2 Select [CAMERA].

The [Camera Settings] menu appears.
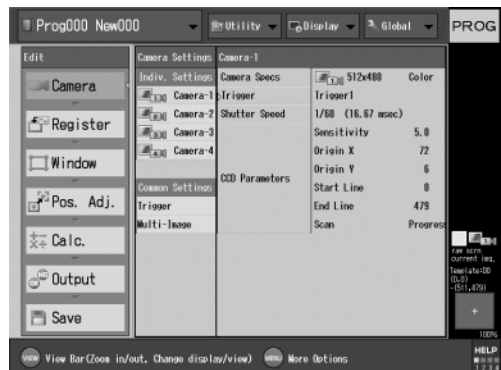
Specifying a Camera (Camera Specs)

When multiple cameras are connected to the CV, you can specify the shutter speed, gain adjustment, process area, image area, trigger, and camera type for each camera.

With setting items that can be individually configured for each camera, be sure to specify a camera in [Camera] before selecting the individual setting item.

1 **Select the camera port (Camera 1- Camera 4) that you would like to configure the Individual Camera Settings for.**

The [Individual Camera Setting] menu appears.
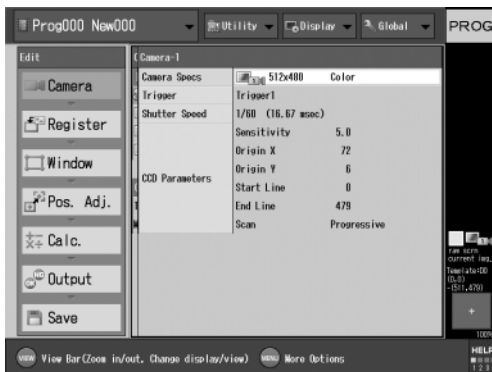
2 **Select [Camera Specs].**

The [Camera Specs] menu appears.
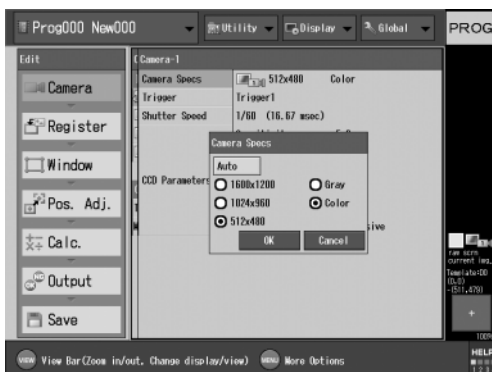
3 **After selecting the camera type for the camera selected in step 1, select OK.**

Set the color/monochrome setting and resolution to match the current camera.

- **If the connected camera is CV-200C or S200C**: Select [1600x1200] or [1024x960], then select [Color].

- **If the connected camera is CV-200M/S200M**: Select [1600x1200] or [1024x960], then select [Monochrome].

- **If the connected camera is CV-035C/S035C**: Select [512x480], then select [Color].

- **If the connected camera is CV-035M/S035M**: Select [512x480] then select [Monochrome].

Reference

Select [Auto] to automatically make the correct settings for the currently connected camera.

► Note

- If the camera is used with the CV-3001, only [512 x 480] can be selected.
- Connect the camera before turning on the power to the main unit.
- After changing the camera type, save the settings, then restart the device.

Specifying the Windows for Inspection and Measurement

Specifying a Trigger for each Camera (Trigger)

The trigger can be individually set for each camera.

1 **Select the camera port (Camera 1- Camera 4) that you would like to configure the Individual Camera Settings for.**

The [Individual Camera Setting] menu appears.

2 **Select [Trigger].**

The [Trigger] menu appears.
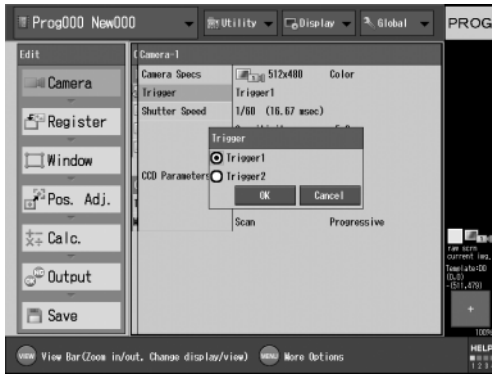
3 **Select a trigger to be used as the camera input trigger, then select [OK].**

► **Note**

- If the global setting screen update mode (Page 7-9) is [Continuous], trigger 2 cannot be used. If this is the case, trigger one will activate all cameras, regardless of their trigger settings.
- If at least three color megapixel cameras (CV-200C/ CV-S200C) are connected, the cameras should be divided between trigger 1 and trigger 2 because one trigger cannot activate all cameras at the same time. However, by using sequential trigger, (Page 4-15) trigger 2 can be set to activate immediately after trigger 1 has activated.

Selecting a Shutter Speed (Shutter Speed)

Select a shutter speed suitable for the line speed 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.

Reference

The Shutter speed can be individually set for each camera.

1 **Select the camera port (Camera 1- Camera 4) that you would like to configure the Individual Camera Settings for.**

The [Individual Camera Setting] menu appears.

2 **Select [Shutter Speed].**

The [Shutter Speed] menu appears.
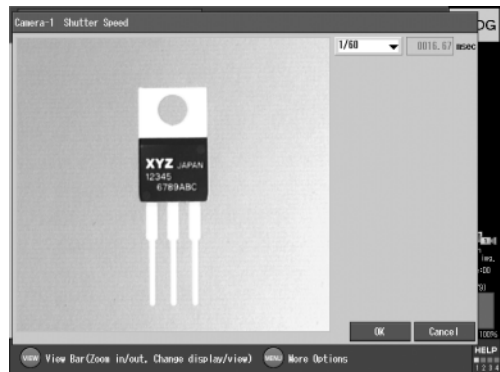
3 **Select a shutter speed, then select [OK].**

As you select different shutter speeds, the image in the background changes accordingly.

Reference

To enter shutter speed numerically, select [Custom], then enter the shutter speed. The range of values you can specify is from 0.05-9000.00 (ms).

► **Note**

When using a fast shutter speed, it may be necessary to open the lens aperture to let in more light. However, allowing an intense light into a wide open aperture may cause a smear affect (vertical streaks on the image). To compensate for this, close the lens aperture as much as possible.

Adjusting Captured Image Quality / Image Range (Parameters)

Adjusting the Brightness of the Captured Image

You can adjust image quality by changing the camera sensitivity 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.

► Note

f you adjust the gain after extracting the color (Page 13-1), the status of the color may be changed. Be sure to reset the color settings.

Reference

The gain adjustment can be set separately for each camera. It can also be set for the contrast conversion filter (Page 13-13) and for each measurement window.

Adjusting the overall brightness (Camera sensitivity)

To adjust the brightness of an image, you can change the lens aperture, shutter speed of the camera, or the lighting. However, if it is impossible to improve the brightness of the image by just adjusting these features, change the camera sensitivity as follows.

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).

Camera sensitivity	1.0	5.0	9.0
		(Default)	
Brightness	Dark	⟵⟶	Bright
Image quality	Fine	⟵⟶	Coarse
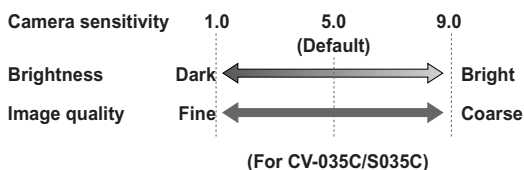
(For CV-035C/S035C)

Reference

The range of possible gain adjustment is different for each camera.
- CV-035C/035M/S035C/S035M/200M: 1.0-9.0
- CV-S200M: 1.0-7.0
- CV-200C/S200C: 1.0-4.0

1 **Select the camera port (Camera 1- Camera 4) that you would like to configure the Individual Camera Settings for.**

The [Individual Camera Setting] menu appears.

2 **Select [CCD Parameters].**

The [Gain] menu appears.
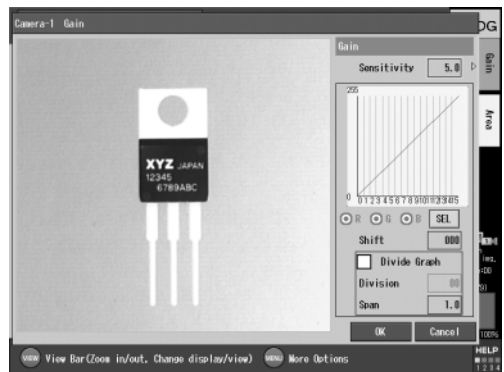
3 **Select [Sensitivity], then select the desired sensitivity.**

The bigger the number, the brighter the image; the smaller the number, the darker the image. The factory setting is 5.0 (for CV-035C/035M/S035C/S035M) or 3.0 (for the CV-200C/200M/S200C/S200M).

As you change the sensitivity, the displayed image is updated accordingly.

4 **After completing the settings, select [OK].**

► Note

When increasing the sensitivity of the camera and using a fast shutter speed, it may be necessary to open the lens aperture to let in more light. However, allowing an intense light into a wide open aperture may cause a smear affect (vertical streaks on the image). To compensate for this, close the lens aperture as much as possible.

Specifying the Windows for Inspection and Measurement

Adjusting the image brightness balance (Gain adjustment)

This is useful when adjusting a displayed image in high or low contrast regions. Offset, balance and RGB can be set independently.

Reference

The gain adjustment can be set for each measurement window through the [Contrast conversion] filter (image enhancement) (for offset and span adjustment only). Select the [Contrast conversion] filter in the [Image Enhance] menu, then select [Details] and follow the steps 4 to 5 below to adjust the gain for each measurement window.

1 **Select the camera port (Camera 1- Camera 4) that you would like to configure the Individual Camera Settings for.**

The [Individual Camera Setting] menu appears.

2 **Select [Parameters].**

The [Gain] menu appears.

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

After selecting a color, the graph at the top of the screen will be displayed in the selected color.

Reference

- To return to a state with RGB all set together, select [ALL]. Even after returning to [ALL], individual settings will be maintained until the settings are changed in [ALL] mode.
- The RGB color elements cannot be set separately in the [Contrast conversion] filter.

4 **Select [Shift], then specify the shift level for the entire digital signal.**

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

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

Downward

Processed as 0 contrast
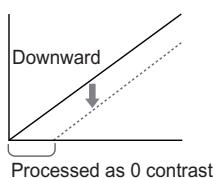
- To lighten the image: Specify a positive value to move the entire line upward. The section below the minimum value of the Y-axis is processed as 255 contrast (white).

Processed as 255 contras

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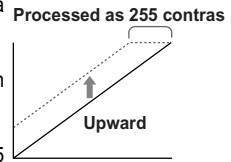
As you change the value, the image in the background is updated accordingly.

Reference

You can also make values above (or below) a specified contrast change to 255 or 0.

5 **Select [Span], then specify the degree of adjustment for the contrast level.**

The range of values you can specify is from 0.0 to 7.9 (Default: 1).
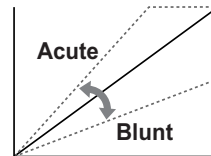
Acute

Blunt

- **To obtain high contrast images**:

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

- **To obtain low contrast images**: 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 3, the section below the minimum value of the Y-axis is processed as contrast 0 (black), and the section above the maximum value is processed as contrast 255 (white).

6 **After completing the settings, select [OK].**

Setting a different span for each level of shading in the image.

If "Divide Graph" is selected and checked, it is possible to set an individual span for each of the 16 segments on the graph. Select [Division] to choose a particular section of the graph and then adjust the span accordingly.

Reference

The [Contrast conversion] filter cannot be used for split screen settings.

Specifying a Process Area (Image Area)

Specify an active CCD range (1600x~1200 pixels for a 2 megapixel camera or 657x492 pixels for a standard 320k pixel camera) and a location to scan.

► Note

If the camera is used with the CV-3001, the only available range is only "657x492 pixels."

◄ Reference

The process area can be individually set for each camera.

Difference between active area and process area

Active area (camera image range)

A 2 megapixel camera connected to the device will have a range of 1600 (horizontal) x 1200 (vertical) pixels. A standard 320k pixel camera will have a range of 657 (horizontal) x 492 (vertical) pixels.
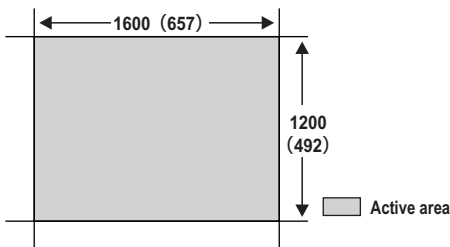
The values in ( ) are when CV-035 is used.

Measurement area (measurement range)

If a 2 megapixel camera is used with 1 megapixel mode selected, or if a standard 320k pixel camera is used, the active range will be 1024 (horizontal) x 960 (vertical) pixels (for a 2 megapixel camera) or 512 (horizontal) x 480 (vertical) pixels for a standard 320k pixel camera.
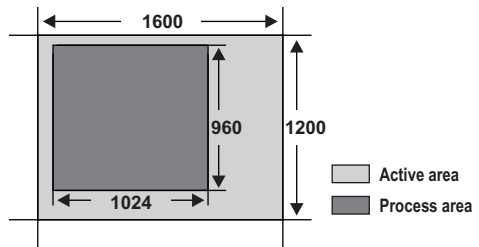
When 1 megapixel mode is selected on CV-200C

The process area within the active area can be set separately for each Program No.

The image area can be restricted within the process area.

You can further narrow the capture area in the vertical direction. By eliminating unnecessary parts of the image, the image transfer rate can be greatly increased.
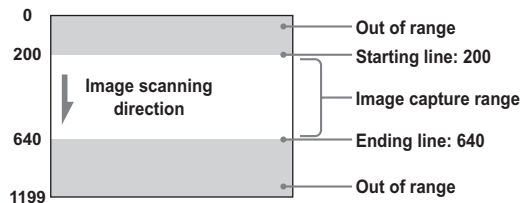
When the image range is set to "200 to 640"

► Note

Targets will not be measured if it does not lie between starting and ending lines, even if it in the process area.

Specifying the process area

Specify which area is to be processed and inspected.

1 **Select the camera port (Camera 1- Camera 4) that you would like to configure the Individual Camera Settings for.**
The [Individual Camera Setting] menu appears.

2 **Select [CCD Parameters].**
The [Gain] menu appears.

3 **Move to the tab display on the right side of the screen, and then select [Area].**
The [Image Area] menu appears.
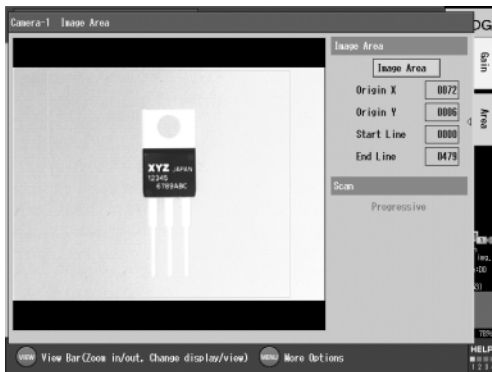
4 **Select [Image Area].**

5 **Move the [ENTER] button up, down, left and right to specify the position of the process area, and then press the [ENTER] button.**
While specifying the process area, the coordinates at the top left edge of the image currently displayed is shown in the [Origin X] or [Origin Y] sections on the right side of the screen.

> **Reference**
> • The origin coordinates displayed to the top left edge of the active area.
> • As a default, the process area is set in the center of the active area. The default (X,Y) settings are (288,120) (in 1 megapixel mode) and (72,6)(when using a 320k pixel camera)

> **▶ Note**
> The area around the captured image might darken if the process area is changed to be positioned at the edge of the CCD while using a lens whose maximum response image size is small.

6 **Move the [ENTER] button up and down to specify the start line, and then press the [ENTER] button.**
While specifying the start line, the Y coordinate of the start line (corresponding to start position Y) is shown in the [Start Line] section.

7 **Move the [ENTER] button up and down to specify the end line, and then press the [ENTER] button.**
While specifying the end line, the Y coordinate of the end line (corresponding to end position Y) is shown in the [End Line] section.

8 **When you have completed the setting, press the [ESCAPE] button.**

9 **After completing the settings, select [OK].**

Selecting an Image Capture Mode (Capture)

You can select from the following two capture modes:

► **Note**

Scan settings are only available in monochrome mode.

• **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 33ms in 2 megapixel mode), this mode is suited for fast inspection lines.

Image signals on CCD   **Odd lines**

Even lines
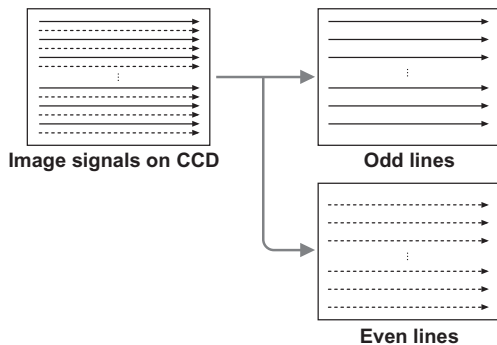
• **Progressive mode**: Transfers the image signals on the CCD of the camera in bulk starting from the top line. The image quality is high, but the transfer rate is low (approximately 59ms in 200 megapixel mode).
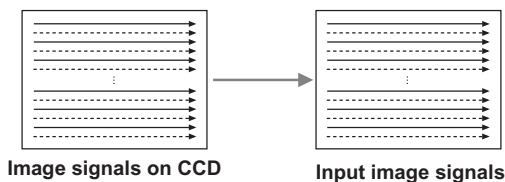
Image signals on CCD   **Input image signals**

1 **Select the camera port (Camera 1- Camera 4) that you would like to configure the Individual Camera Settings for.**
The [Individual Camera Setting] menu appears.

2 **Select [CCD Parameters].**
The [Gain] menu appears.

3 **Move to the tab display on the right side of the screen, and then select [Process Area].**
The [Image Area] menu appears.
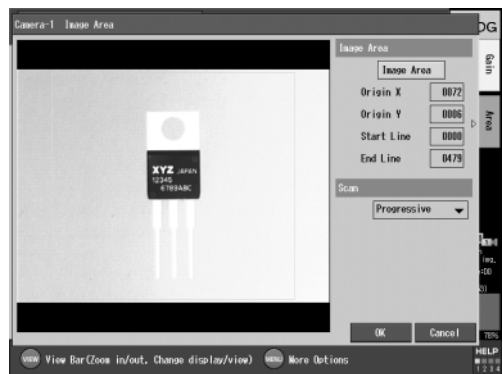
4 **Select [Scan], and then select the scan mode.**
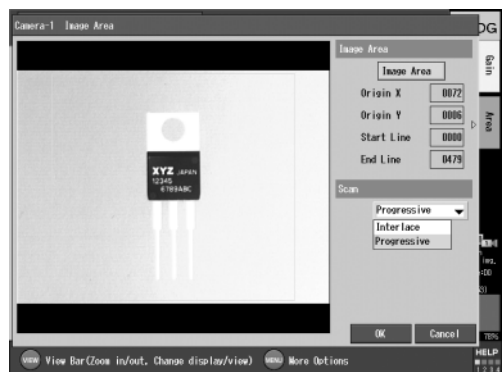
• **[Progressive]** (Default): Captures images using progressive mode.
• **[Interlace]** : Captures images using interlace mode.

5 **After completing the settings, select [OK].**

Specifying the Windows for Inspection and Measurement

Specifying the Image Capture Timing (Trigger Setting)

For the CV, you can select from the following two types of trigger inputs for image capture.

- **External triggers** (Page 4-14): 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** (Page 4-15): 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.

| Reference |

Trigger settings are applied to all cameras.

About the active camera display

- The cameras connected to the controller and their trigger numbers are shown on the bottom part of the [Trigger] screen.
- When four Color Megapixel cameras are connected to one CV-3501 controller, it is not possible to simultaneously trigger all the cameras at the same time. If one trigger is selected for all four cameras, an "X" will appear under one of the Color Megapixel cameras, indicating that the camera is inoperative for that trigger. To alleviate the problem, divide the cameras between Trigger 1 and Trigger 2.
- If an "X" is displayed in the "Trg 1,2 Multiple" field, the cameras attached to trigger 2 will only be available after the cameras attached to trigger 1 have completed their image transfer. See the timing chart on "Page 11-23" for details.

Capturing Images Using External Triggers (External trigger)

1 **Select [Trigger] from [Common Settings] on the [Camera] screen (Page 4-6).**

2 **Select [Trigger].**
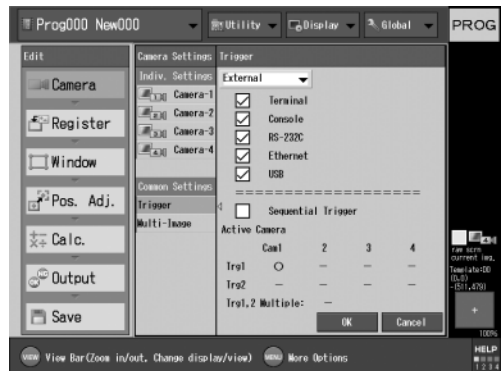
3 **Check the trigger you want to use by applying checkmarks in the corresponding checkboxes.**

You can select more than one type of trigger.

- **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
- **USB**: Triggers that are input via USB

4 **After completing the settings, select [OK].**

| Reference |

For an example of a timing chart for an external trigger, please see Page 11-25.

Automatically Activating Trigger 2 after Trigger 1 is activated

If cameras have been assigned to both trigger 1 and trigger 2 (Page 4-8), trigger 2 can be set to automatically activate immediately following the image transfer of trigger 1 (Sequential Trigger).

► Note

If sequential trigger is active direct input to trigger 2 is ignored.

Reference

In the following situations, images are taken as if sequential trigger had been set, even if an individual trigger is set.
- Screen Update Mode (Page 7-9) is set to [Continuous].
- The trigger setting is [Internal].
- Multi-Image (Page 4-17) is active.
- When there are four cameras including three or more color megapixel cameras.

1 Select [Trigger] from [Common Settings] on the [Camera] screen (Page 4-6).

2 To activate sequential trigger, check the box next to [Sequential Trigger].
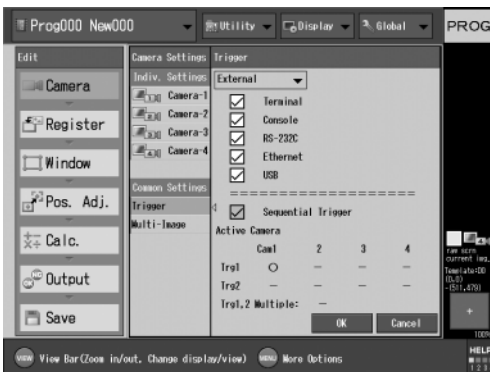
3 After completing the settings, select [OK].

Capturing Images by Using the Internal Timer (Internal trigger)

Set the trigger delay (interval time) when using an internal trigger. Interval times set on this machine refer to the time between the start of the exposure and next trigger signal.

Interval time

The double buffer can be used to decrease the time needed for a single process by allowing the controller to capture new images while processing the previous images, thus increasing the number of processing cycles per unit time. If the interval time is set to 1ms (default), the shortest trigger input, which incorporates the double-buffer, is used.
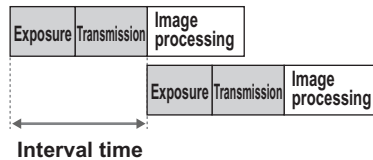
Interval time

4 Select [Trigger] from [Common Settings] on the [Camera] screen (Page 4-6).

5 Select [Internal].
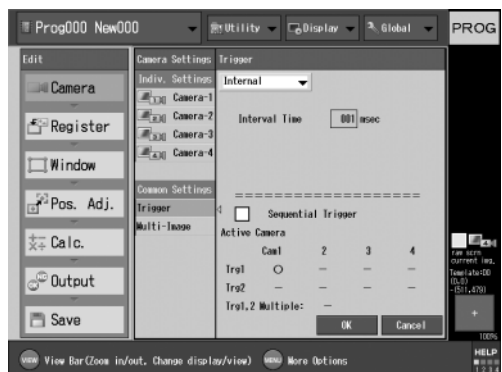
6 Select [Interval Time], then specify the length of the interval.

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

7 After completing the settings, select [OK].

► **Note**

• The trigger may fail to activate if the interval time is changed from the default and set to a value near the displayed trigger delay time.
• If the sequential trigger is not used, the "Trig 1,2 Multiple: " (Page 4-14) column shows a circle. If the trigger input is set to the internal trigger, trigger 1 and trigger 2 are read in simultaneously. External trigger input is entirely ignored.

Reference

For an example of a timing chart for an internal trigger, please see Page 11-36.

Suspending the internal trigger

The trigger operates normally when in a continuous capture mode when the internal trigger is selected. Follow these procedures to suspend the external trigger input:

Set trigger input to ignore.

Use any of the following methods to set trigger input to ignore (note that data currently being exported will continue to be transmitted):
• To ignore via a terminal input (EXT terminal): See Page 11-5.
• To ignore via communication commands (TE, OF Commands): See Page 9-30.

Changing from Continuous Capture Mode to Program Mode

Use any of the following methods to change modes:
• To change from the console (Changing Program/ Run): See Page 1-3.
• To change via communication commands (SO Commands): See Page 9-14.

Reference

Signal output can be suspended without suspending the internal trigger by using the TEST pin (Page 11-7).

Capturing an Image Multiple Times and Importing the Results (Multi-Image)

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 is useful when you want to even out variation in measurement results by averaging all results.

► **Note**
- When Screen Update Mode (Page 7-9) is set to [Continuous], Multi-Image cannot be used. Change to [Trigger].
- [Multi-Image Capture] takes more time compared to normal capture since multiple images will be captured and inspected back to back.
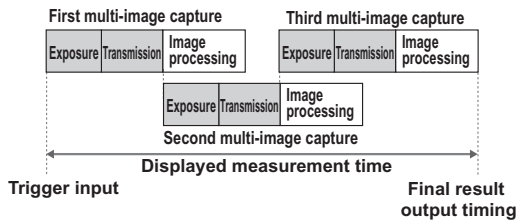
- This device uses a double buffer to take images in the least amount of time. Therefore, running time when in Multi-Image capture can be estimated by the following guidelines:

  Displayed runtime for Multi-Image = Displayed runtime for normal operation + Displayed trigger delay
  x (number of images - 1)

  Note that trigger input for the next series of images cannot be sent while the last image is being taken. Therefore, measurement time and trigger delay will be the same value in Multi-Image capture mode. See the timing chart on "Page 11-38" for details.
- Multi-Image capture can be used with all types of cameras, but only trigger 1 can be used for the external trigger. Any cameraís set to trigger 2 can be activated by trigger one with simultaneous or sequential trigger settings (Page 4-15).
- Multiple target tools such as Blob can only be used to read primary targets when in Multi-Image mode. Other targets will be measured in the last image read.
- OCR measurement tool cannot be used with Multi-Image operation. Measurement will only be performed on the last captured image.
- The image display will show the last image read. However, primary targets and their detection markers may be displayed in a different location due to the fact that they are using the combined data from all the images captured during the Multi-Image operation.
- Only the final image of the Multi-Image capture is saved in the image history Therefore, the results of a retest may differ from the results of the actual Multi-Image data.

1 Select [Multi-Image] from [Common Settings] on the [Camera] screen (Page 4-6).

2 Select [ON] to use Multi-Image.
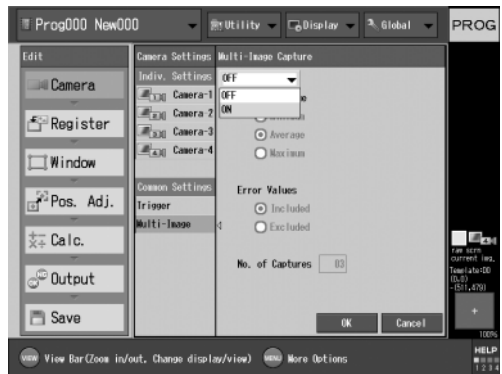
3 Select the processing method from [Measured Value].
- **Minimum**: Provides the minimum value of the measurement values acquired.
- **Average** (Default): Provides the average of the measurement values acquired.
- **Maximum**: Provides the maximum value of the measurement values acquired.

4 Select a method to handle errors from [Error Values].
- **Included** (Default): The final result is an error if any value errors occur during measurement.
- **Excluded**: Value errors during measurement are not reflected in the final result. However, if each image returns a value error, the final result will also be an error.

5 Select [No. of Captures], then specify the number of times to capture the image.
Select a value from 1 to 32 (Default: 3).

6 After completing the settings, select [OK].

To end Multi-Image mode

Select [OFF] in step 2.

Specifying the Windows for Inspection and Measurement

Overview of Screen Registration

You can register an image that is used as a template for measurement and judgment 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.

Displaying the [Register Image] menu

To register images, display the [Register Image] menu by performing the following steps.

1 Select the Program No.

2 Adjust [Camera Settings].

3 Select [Regist. Img.].
The [Register Image] menu appears.
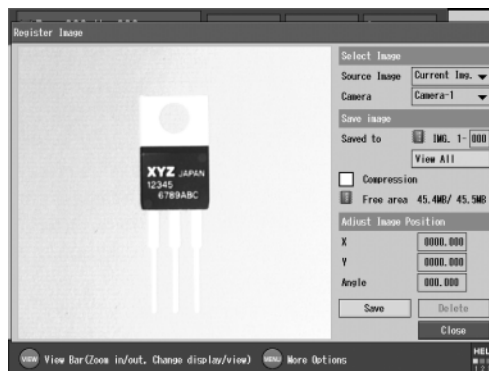
Registering an Image

1 **Select the target you want to use as a reference for measurement and judgment settings and take the steps necessary to prepare it to be captured by the camera.**

2 **Select [Current Img.] from [Source Image] on the [Register Image] menu (Page 4-18).**
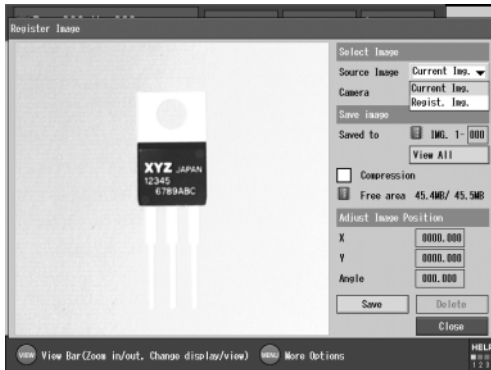
3 **Select the camera to use next to [Camera].**
The image and inspection windows of the camera are displayed.

4 **Press the [TRG] button on the remote control console.**
The image captured by the camera selected in step 3 is displayed.

5 **Specify an image number for the first image saved next to [Saved to].**
It is advisable to always use the standard image number "Image (camera number)-000" (Example: Image 1-000)

6 **Place a check mark in the box next to [Compress] when necessary.**
Placing a check mark in the box compresses the registered image before saving, which helps conserve memory space in the save location.

► Note
There may be some deterioration in image quality due to the compression. The measurement results when using a compressed image may differ from results when using an uncompressed image.

Reference
The settings for [Registered image standard save format] (Page 7-16) in the Global settings can be changed to either use or not use compression by default.

7 **Select [Save] to register the displayed image.**
• Adjust the position in the X (horizontal) direction.
• Adjust the position in the Y (vertical) direction.
• Adjust the rotational position θ.
The displayed image is saved to the CV as the reference image for measurement and judgment settings.

8 **Select [Save] to register the displayed image.**
The displayed image is saved to the CV as the reference image for measurement and judgment settings.

9 **Repeat steps 3 and 6 to register an image for another camera.**

Recording multiple screens

Multiple screens can be recorded for each Program No. so that the whichever screen is needed can be recalled. The number of screens that can be saved varies with the amount of available space in the location where the Program No. is saved. However, the maximum number of screens that can be saved to a Program No. is 1000.

To record multiple images, go to step 5 on this page, specify an image number (from 000 to 999) for [Saved to], then select [Save].

Deleting recorded images

1 **Select [Regist. Img.] from [Source Image] on the [Register Image] menu.**

2 **Specify the number of the image to delete under [Saved to].**
The specified image appears.

3 **Select [Del].**
A confirmation screen appears.

4 **Select [OK].**
The displayed image is removed from the device.

Reference
Select [View All] to view the currently recorded images.

Specifying the Windows for Inspection and Measurement

Overview of Setting Inspection Windows

4-4

Creating Inspection and Measurement Windows (Window)

Select a measurement tool for each unit (window) of inspection and measurement. Seventeen different measurement tools can be used in the system. See "List of Measurement Tool Functions" on the next page for more details.

Displaying the [Edit Window] menu

Select the [Edit Window] menu as follows:

1 **Select the Program No. to record from the initial settings screen.**

2 **Select [Window].**
The [Edit Window] menu appears.

List of Measurement Tool Functions

A list of measurement tool functions available on the system is shown below. You can perform various inspections by combining the following measurement functions.

Measurement name	Description	Size			Position		Shape		Number	Stain	Intensity	Text
		Area	Gap	Pitch	Coordinate	Angle	Feature characteristics	Correlation value				
Area (Page 4-24)	Measures the area.	○	—	—	—	—	—	—	—	—	—	—
Pattern Search (Page 4-33)	Detects a pattern.	—	—	—	○	○	—	○	○	—	—	—
Pattern sort (Page 4-45)	Detects a pattern by using multiple registered patterns.	—	—	—	○	○	—	○	○	—	—	—
Shape Trax (Page 4-60)	Detects a pattern.	—	—	—	○	○	—	○	○	—	—	—
Edge Position (Page 4-76)	Measures the edge position.	—	—	—	○	○	—	—	○	—	—	—
Edge Gap (Page 4-87)	Measures the edge gap.	—	○	—	○	○	—	—	○	—	—	—
Edge Pitch (Page 4-100)	Measures the maximum, minimum and average distance between edges.	—	—	○	○	○	—	—	○	—	—	—
Edge Counting (Page 4-112)	Counts the number of edges.	—	—	—	—	—	—	—	○	—	—	—
Edge Angle (Page 4-121)	Measures the edge angle.	—	—	—	○	○	—	—	○	—	—	—
Edge Pairs (Page 4-131)	Measures the maximum, minimum and average distance between edges.	—	—	○	○	○	—	—	○	—	—	—
Stain (Page 4-144)	Detects flaws from a change.	—	—	—	○	—	—	—	○	○	—	—
Blob (Page 4-159)	Measures the feature characteristics of blobs.	○	—	—	○	○	○	—	○	—	—	—
Trend Edge Position (Page 4-172)	Scans the measurement area in a specified direction and measures the edge position.	—	—	—	○	—	—	—	○	—	—	—
Trend Edge Width (Page 4-187)	Scans the measurement area in a specified direction and measures the edge gap.	—	○	—	○	—	—	—	○	—	—	—
Intensity Inspection (Page 4-202)	Measures the maximum, minimum and average values of intensities within the measurement area and also measures the standard deviation.	—	—	—	—	—	—	—	—	—	○	—
Color (Page 4-210)	Measures the maximum, minimum and average values of color information within the measurement area and also measures the standard deviation.	—	—	—	—	—	—	—	—	—	○	—
Draw Shape (Page 4-218)	Specifies lines, circles and points associated with an image (Does not measure)	—	—	—	—	—	—	—	—	—	—	—
OCR (page 4-224)	Reads and references text information.	—	—	—	—	—	—	—	—	—	—	○

Specifying the Windows for Inspection and Measurement

Managing the Measurement Window

This system uses measurement windows to perform inspections. A unique window name in the format "Wxxx" (xxx is a three-digit numeral from 000 to 127) is given to each measurement window. A maximum of 128 measurement windows can be set for each Program No. Each of the 128 inspection windows can be assigned a specific measurement tool.

► **Note**

- Windows that have a "!" before their numbers (Example: "!W000") have some necessary parameters unspecified. When measurement begins, all windows in this state will have their results set to "0".
- Up to 11 windows are displayed in order in the Window No. list To display a window not on the list, select a page number of at the very bottom of the screen to change pages.

Adding a Measurement Window

1 Select [Add/Copy/Del] from the [Edit Window] menu.

2 Select [Add].

The [Add Window] menu appears.

3 Select [Window Number], then select the desired window number.

4 Select a measurement tool from [Measurement tool], then select [OK].

The window numbers specified in step 2 are added. The following procedure differs depending on the measuring tool. For a list of measurement tools, see the previous page.

Copying a Measurement Window

All of the saved setting values for an existing measurement window can be copied to other measurement windows.

► **Note**

When the setting values are copied, all current contents will be overwritten by the new contents.

1 **Select [Add/Copy/Del] from the [Edit Window] screen.**

2 **Select [Copy].**

The [Copy Windows] menu appears.

3 **Select location to copy from.**
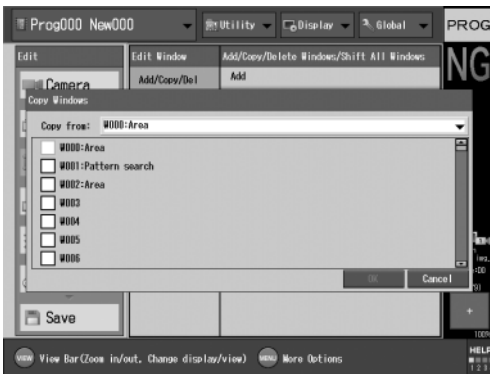
4 **After selecting a location to copy from select a new window number and put a checkmark next to it.**

Multiple windows can be selected to copy to.

5 **Select [OK].**

A confirmation screen appears.

6 **Select [OK].**

Copying will be executed.

To stop copying, select [Cancel] instead of [OK] in Step 4.

Deleting a Measurement Window

► **Note**

• When a measurement window is deleted, all related settings (such as measurement tool, measurement conditions, and measurement area settings) are also deleted.
• All parameters such as calculation(Page 4-253) and output settings (Page 4-278), are set to "0" for deleted windows.

1 **Select [Add/Copy/Del] from the [Edit Window] screen.**

2 **Select [Delete].**

The [Delete Windows] menu appears.

3 **Select the measurement windows that you want to delete and click the respective check boxes.**
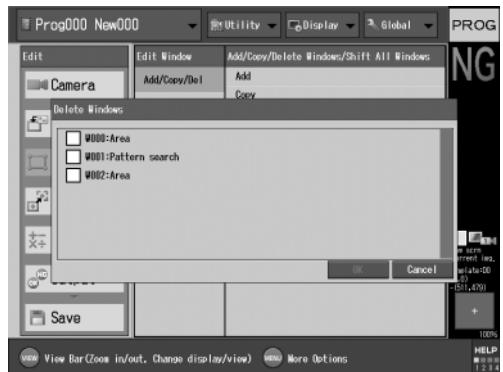
Multiple windows can be selected for deletion.

4 **Select [OK].**

A confirmation screen appears.

5 **Select [OK].**

The measurement window selected in Step 3 is deleted.

Simultaneously Shift All Windows

All cameras and measurement areas in windows using registered images in the current Program No. are moved in the X or Y direction. See "Shifting All Measurement windows" (Page 3-26) for details.

Area

What is the [Area] Measurement Tool?

You can binarize (convert into black-and-white binary data) the captured image and measure either the white area or the black area. Using the Area measurement mode, captured images are converted into black and white binary data. Either black or white binary data can be measured.

Measurement image

Measurement area

Measurement target
Measures the amount of white (or black) pixels only.
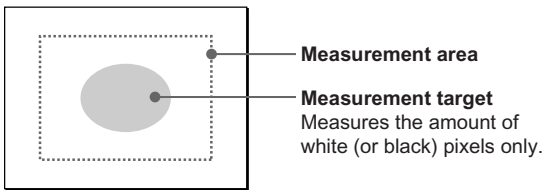
Measurement results

The following measurement results are output in the Area measurement tool.

- **Target Area**: Area output in pixels. (Available in the limits menu)
- **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.
- **Measurement Area Position**: Outputs the measurement window position in pixels (available as a reference after calculation) Note that polygon measurement window information is not output.

Measurement sample

Example showing the results of a measurement performed under the following conditions:
- Detect color: Black
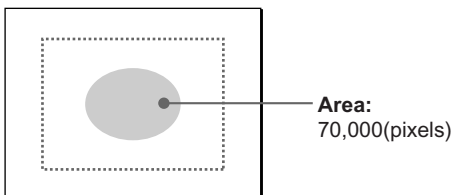
Area:
70,000(pixels)

Selecting Measurement Tools

Select the [Area] measurement tool as follows:

1 **Select [Add/Copy/Del] from the [Edit Window] menu.**

2 **Select [Add].**
The [Add Window] menu appears.

3 **Select [Window Number], then specify the measurement window number.**
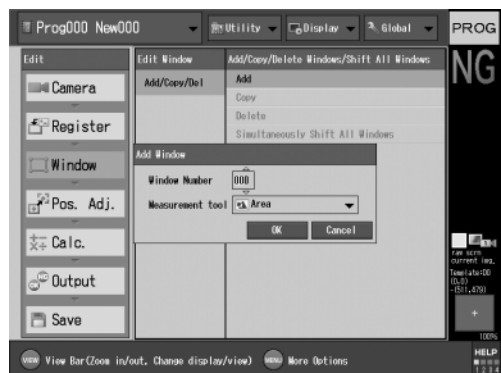
Window numbers can be freely set at any value from 0 to 127 .

4 **Select [Measurement tool] and then select [Area].**
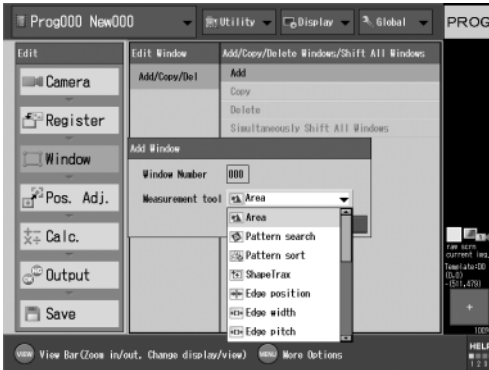
5 **Select [OK].**

A window with the specified number is added as an area measurement window. The current window setting list is then displayed.

The necessary settings for the area window are added next.

Selecting a Camera to Take Images

1 **Select [Window] and then select an area measurement window.**

The window setting menu appears.
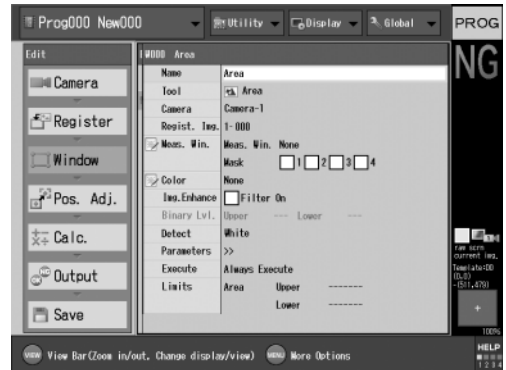
2 **Select [Camera], then selecting a camera to take images**

► **Note**

Unconnected cameras can be selected. However, if the selected camera is not connected at the time of imaging, an error will occur.

Specifying the Windows for Inspection and Measurement

Specifying a Registered Image to Use

Specify a registered image to use for processing.

Reference

The image to be used must have been previously saved to an image number in the [Register Image] menu (Page 4-18).

Select [Regist. Img.], then specify the number of the registered image to be used.

The registered image number will be displayed as "Camera number-xxx."

Specifying a Measurement Window

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, see "Exclude an unwanted area (mask window)" located after "Setting the Measurement Area".

1 **Select [Meas. Win].**

The [Measurement window] menu appears.

2 **Select [Edit] in the [Measurement window] field.**

The [Select] menu appears.

3 Select a shape, then select [OK].

4 Draw the measurement area.

See "Drawing a Measurement Window" (Page 3-13) for details.

5 After completing the drawing, select [Close] in the [Edit] field.

Clearing the measurement area

The measurement area can be cleared by following the procedure below.

1 Select [Delete] in the [Measurement window] field.

A confirmation screen appears.

2 Select [OK].

Exclude an unwanted area (mask window)

You can set up to four areas (mask windows) that will not be measured inside the measurement area. This is useful when the measurement target has a complicated shape or when you want to hide an unnecessary part of the target.

Select [Add] in the [Mask window] field.

The [Add mask window] menu appears.
See Exclude Part of the Measurement Window (Mask Window)(Page 3-25) for details.

Extracting a Color

When using a color camera, color images can be converted to black and white through an extraction process.

► Note

This feature is not available when using a monochrome camera.

Select [Color].

The [Color] menu appears.

See Processing a Color Image [Color](Page 13-1) for details on color extraction.

Selecting an Image Enhancement

Specify an appropriate filter for the image.
When using a color camera, the filter is applied to pixels of the extracted color.

1 Select [Img. Enhance].

The [Image Enhance] menu appears.

2 Select a filter to use, then select [OK].

See Filter List(Page 13-9) for details on the individual filters.

Reference

• More advanced filter settings can also be made by selecting [Detail].
• If [Color to Gray] or [Gray] are selected, [Binary] will be automatically added to the front of the filter.
• Up to 13 filters can be used. When multiple filters are set, they are executed starting from the filter specified in the top portion of the screen.

Setting the Binary Level

Because area measurements require a binary image, set a threshold and create a binary (black and white) image.

► Note

If [Color to Binary] is selected, the following procedure is required.

Reference

Settings made will be reflected in the binary filter settings.

1 Select [Binary Lvl.].

The [Select Binary Level] menu appears.

2 Select [Upper], 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] 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 [OK].**

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

You can set the upper and lower limit values of the binary level by displaying the intensity distribution of the image as a histogram.

1 **In the [Select Binary Level] menu, select the LO line (lower limit) in the [Histogram] field, then move the [ENTER] button to set the lower limit line.**

2 **Select the UP line (upper limit) and then use the [ENTER] button to set the upper line.**

> **Reference**
>
> When the measurement window is not set, intensity distribution over the entire screen is shown as the histogram.

3 **After completing the settings, select [OK].**

Specifying the Color to Detect

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

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

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

Specifying the Windows for Inspection and Measurement

Setting Other Detection Conditions

Set other detection conditions as necessary.
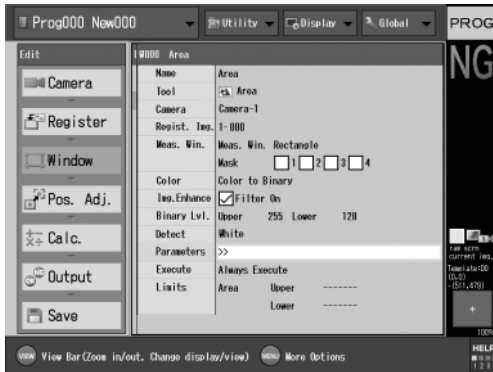
1 Select [Parameters].

Select [Tool Parameters]. The [Tool Parameters] menu appears.

2 Make the necessary settings.

After completing the settings, select [OK].

You can change the reference position of the origin using [Origin] in the [Tool Parameters] menu.

Specify the reference position of the origin in [Origin] in the [Tool Parameters] menu.

Make the necessary settings in the [Origin] menu.

- **specified point** (Default): The origin point is set at the top left of the screen by default. Move the [+] cursor to the position where you want to set the origin point. The coordinates of the set position are displayed in the [Pos. X] and [Pos. Y] fields.
- **registered point** : Not used in area measurement.

Reference

If [specified point] has been selected, the origin point can be set outside the process area. The range of points you can set is from -9600 to 9600 (X) and -7200 to 7200 (Y).

Selecting the coordinate system for position adjustment

You can select the coordinate system using [Coordinate Value] in the [Tool Parameters] menu.

If position correction (Page 4-249) is not being done, this setting will have no effect on the output.

- **[After Position Adjust]** (Default): If the position of the window used as the source of correction has shifted, the amount of this error is reflected on the measurement.
- **[Before Position Adjust]**: The distance from the position of the "Origin point" is measured.

Reference

These settings are reflected when the measurement window position from the calculation is referenced.

Setting the Execute Conditions

The measurement window can be set to execute or not, based on the results of an OK or NG judgment of a specified window. This can be useful for instances where inspections need to be skipped. See "What are Execute Conditions?" (Page 4-247) for details.

1 Select [Execute].

The [Window Execute Condition] menu appears.

2 Select an appropriate condition.

- **Always Execute** (Default) **:** Always execute on trigger input.
- **Never Execute:** Do not execute even with trigger input (skip).
- **Window Number (Measurement, Calculation):** Skips or measures depending on the judgment results of the selected window.

| Reference |

If measurement is skipped, measurement and judgment results for that window become 0 and are not reflected in the final results.

► Note

- If the reference window is set to itself, a circular reference error will result. If this happens, all windows in the same Program No. will have their settings invalidated (set to Always Execute).
- If a circular reference error occurs, a "!" will appear before the window number and the execution conditions to indicate an error.

3 If window number is selected, measurement can be skipped or carried out depending on the judgment results of the specified window.

- **OK:** Executes if the judgment result of the specified window is OK.
- **NG:** Executes if the judgment result of the specified window is NG.

| Reference |

If no tolerance is set for the selected window, the judgment result is always OK.

4 After completing the settings, select [OK].

Specifying the Windows for Inspection and Measurement

Setting the Limits Settings

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

1 **Select [Limits].**

The [Enter Limits] menu appears.

2 **Select [Upper] or [Lower] and set the tolerance.**

The unit of tolerance is the "number of pixels" inside the measurement area.

Reference

Tolerance can be entered by selecting [Direct Input] and specifying a tolerance or by selecting [Calc Ref] and using the results of a chosen calculation window.

3 **After completing the settings, select [OK].**

Reference

• [-----] indicates that no tolerance has been set and no judgment will take place after measurement.
• Press [Clear] to clear the value.

Pattern Search

What is the [Pattern Search] Measurement Tool?

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.

► Note

• The size of the pattern greatly affects the window memory. Each program only has a specified amount of window memory, and pattern windows take up a significant amount of memory. When processing multiple inspection windows, the total amount of memory used must be less that the window memory. Once the memory has reached 100%, no more inspection windows can be created. Try to limit the size of the pattern window when it is necessary to create multiple inspection windows.

• The following reference values show the number of pattern windows that can be stored based on the initial window memory size (the reference value varies depending on the size of the window)
  – CV-3501: Each program can store 22 windows (512 x 480)
  – CV-3001: Each program can store 18 windows (512 x 480)

• Up to 256 pattern areas can be set within one setting for search processing. Patterns cannot be added to pattern search if 256 patterns are already set for another window.

Measurement image

When registering a pattern

Search area
Pattern area
Detection point:
(Can be freely specified)

Registered pattern

While the system is in operation

Origin
Tilt angle
Search area
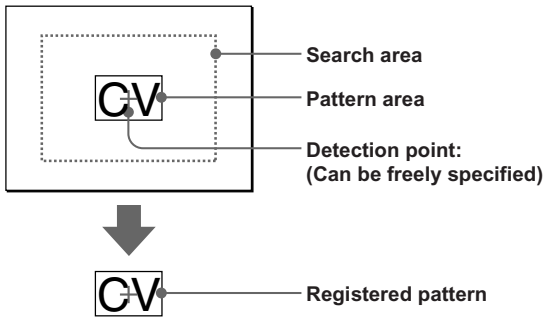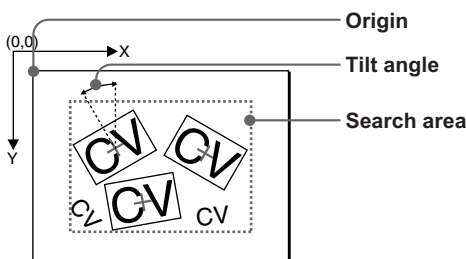
Reference

The pattern size when registering a pattern (basic pattern size) can be displayed in the results graphic (Page 6-46).

The order of the detected patterns can be selected.

There are ten ways the patterns can be ordered.
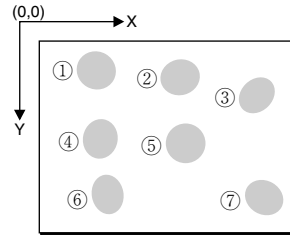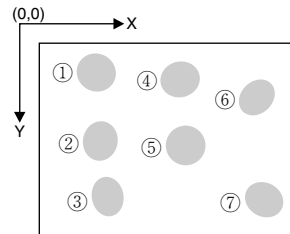
• Y>X ascending order

• X>Y ascending order

• X ascending order
• X descending order
• Y ascending order
• Y descending order
• Correlation value descending order

Correlation value
① **99.9**
② **99.0**
③ **98.2**
④ **97.5**
⑤ **95.9**
⑥ **94.1**
⑦ **92.4**
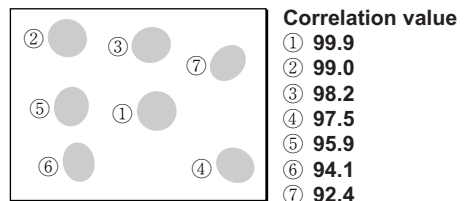
• Correlation value ascending order
• Clockwise
• Counter-clockwise

To select a different order, see [Detect. Order] (Page 4-57) in the [Tool Parameters] menu.

Specifying the Windows for Inspection and Measurement

Measurement results

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

- **Count**: Outputs the number of detected patterns. (Subject to tolerance test)
- **Position (X,Y) [ ]**: Outputs the coordinates of all detected patterns (in pixels). (Available in the limits menu) (Labeled)
- **Angle [ ]**: Angles of difference between the registered pattern and each detected pattern are output in degrees. The angle difference in the clockwise direction is shown with a positive (+) sign. The angle difference in the counter-clockwise direction is shown with a minus (-) sign. (Available in the limits menu) (Labeled)
- **Match % [ ]**: 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 99.999. (Available in the limits menu) (Labeled)
- **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.
- **Measurement Window Position**: Outputs the window position in pixels (available as a reference after calculation) Note that polygon window information is not output.

Measurement sample

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

- Pattern Order: X>Y ascending order
- [No. to Judge]: 1
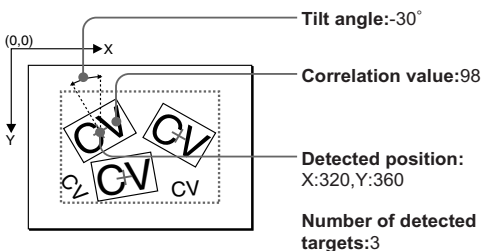
Tilt angle:-30˚

Correlation value:98

Detected position: X:320,Y:360

Number of detected targets:3

Selecting Measurement Tools

1 **Select [Add/Copy/Del] from the [Edit Window] menu.**

2 **Select [Add].**
The [Add Window] menu appears.

3 **Select [Window Number], then specify the measurement window number**
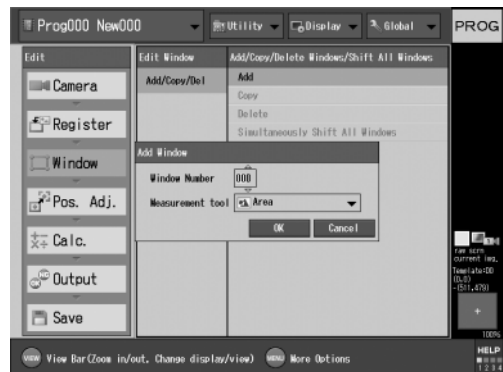
Window numbers can be freely set at value from 0 to 127 .

4 Select [Measurement tool] and then select [Pattern search].
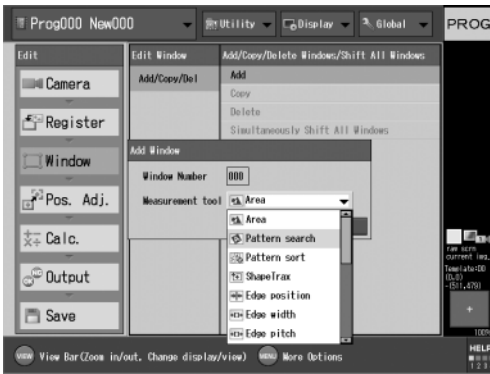
5 Select [OK].

A window with the specified number is added as a pattern search window. The current window setting list is then displayed.
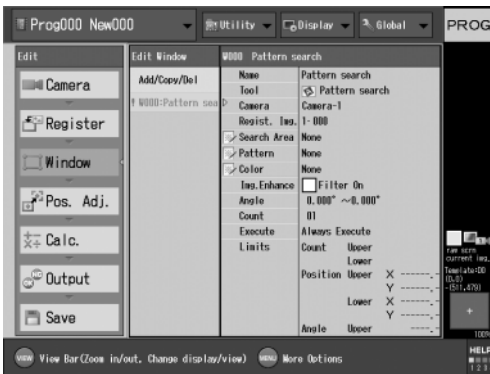
The necessary settings for the pattern search window are added next.

Selecting a Camera to Take Images

1 Select [Window] and then select a pattern search window.

The window setting menu appears.

2 Select [Camera], then selecting a camera to take images

Reference

Unconnected cameras can be selected. However, if the selected camera is not connected at the time of imaging, an error will occur.

Specifying the Windows for Inspection and Measurement

Specifying a Registered Image to Use

Specify a registered image to use for processing.

The image to be used must have been previously saved to an image number in the [Register Image] menu (Page 4-18).

Select [Regist. Img.], then specify the number of the registered image to be used.

The registered image number will be displayed as "Camera number-xxx."

Specifying a Measurement Window

Set a range (search area) in the image to search for the target recorded in the pattern window (next page).

Smaller search windows will decrease processing time.

1 Select [Search Area].

The [Search Area] menu appears.

2 Select [Edit] in the [Measurement window] field.

The [Select] menu appears.

3 Select a shape, then select [OK].

▶ **Note**

Auto-adjust rectangle and Auto-adjust circle cannot be selected.

4 Draw the search area.

See "Drawing a Measurement Window" (Page 3-13) for details.

5 After completing the drawing, select [Close] in the [Edit] field.

Clearing the measurement area

The measurement area can be cleared by following the procedure below:

1 Select [Delete] in the [Measurement window] field.

A confirmation screen appears.

2 Select [OK].

Exclude an unwanted area (mask window)

You can set up to four areas (mask windows) that will not be measured inside the measurement area. This is useful when the measurement target has a complicated shape or when you want to hide an unnecessary part of the target.

Select [Add] in the [Mask window] field.

The [Add mask window] menu appears.
See Exclude Part of the Measurement Window (Mask Window)(Page 3-25) for details.

Registering the Pattern to Detect

Record the image of the target you wish to search as a [Pattern].

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, see "Exclude an unwanted area (mask window)" located after "Setting the Measurement Area".

1 Select [Pattern].

The [Pattern] menu appears.

2 Select [Edit] in the [Measurement window] field.

The [Select] menu appears.

Specifying the Windows for Inspection and Measurement

3 **Select a shape, then select [OK].**
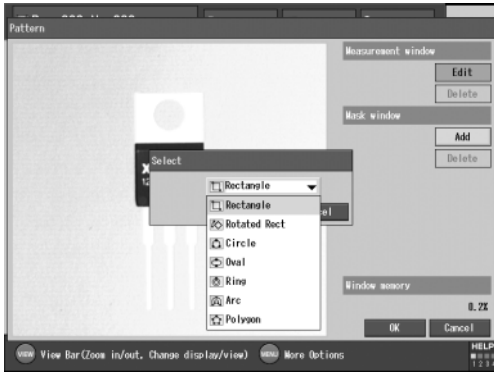
► **Note**

Auto-adjust rectangle and Auto-adjust circle cannot be selected.

4 **Draw the pattern area.**

See "Drawing a Measurement Window" (Page 3-13) for details.

5 **After completing the drawing, select [Close] in the [Edit] field.**

Clearing the measurement area

The measurement area can be cleared by following the procedure below.

1 Select [Pattern] in the [Measurement Window] field.

A confirmation screen appears.

2 Select [OK].

Exclude an unwanted area (mask window)

You can set up to 4 areas (mask windows) that will not be measured inside the pattern area. This is useful when the measurement target has a complicated shape or when you want to hide a part that is not necessary.

Select [Add] in the [Mask window] field.

The [Add mask window] menu appears.
See "Exclude Part of the Measurement Window (Mask Window)" (Page 3-25) for details on the following information.

Extracting a Color

When using a color camera, color images can be converted to black and white through an extraction process.

► **Note**

This feature is not available when using a monochrome camera.

Select [Color].

The [Color] menu appears.

See Processing a Color Image [Color](Page 13-1) for details on color extraction.

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</div>

Selecting an Image Enhancement

Specify an appropriate filter for the image.
When using a color camera, the filter is applied to pixels of the extracted color.

1 Select [Img. Enhance].

The [Image Enhance] menu appears.

2 Select a filter to use, then select [OK].

See Filter List(Page 13-9) for details on the individual filters.

► Note

The subtraction filter is not available in this measurement mode.

Reference

• More advanced filter settings can also be made by selecting [Detail].
• Up to 13 filters can be used. When multiple filters are set, they are executed starting from the filter specified in the top portion of the screen.

Setting the Angle Range

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

1 Select [Angle].

The [Select Angle Range] menu appears.

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

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

4 After completing the settings, select [OK].

Setting the Number of Patterns to Detect

The number of detected patterns can be set from 1 to 99. For example, when [3] is set, the pattern search will search for up to 3 targets.

► **Note**

The maximum number of patterns that can actually be detected changes depending on the settings.

Reference

Even if there is only one pattern in the search range, setting the count to a number higher than one will enhance the search process and make the results more reliable.

1 Select [Count].

The [Count] menu appears.

2 Select [Count] and set the maximum number of patterns to detect.

3 After completing the settings, select [OK].

Setting Other Detection Conditions

1 Select [Parameters].

Select [Tool Parameters]. The [Tool Parameters] menu appears.

2 Make the necessary settings.

After completing the settings, select [OK].

Selecting the search sensitivity

You can select the level of search sensitivity [Sensitivity] in the [Tool Parameters] menu. When detection is unstable, increase the level of sensitivity.

Search sensitivity	Low -3	Normal 0	High +3
Stability	Low	←——————→	High
Process time	Fast	←——————→	Slow

> ► **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] in the [Tool Parameters] menu. To measure with a high level of accuracy, set the search accuracy to [Highest].

Search sensitivity	Coarse -2	Normal 0	Fine +2
Accuracy	Low ◄——————————►		High
Process time	Fast ◄——————————►		Slow

> ► **Note**

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

You can change the reference position of the origin using [Origin] in the [Tool Parameters] menu.

Specify the reference position of the origin in [Origin] in the [Tool Parameters] menu.
Make the necessary settings in the [Origin Selection] menu.

- **specified point** (Default): The origin point is set at the top left of the screen by default. 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 [Pos. X] and [Pos. Y] fields.
- **registered point**: The position of the "Detection point" in the pattern area is used as the origin point. The present origin point is displayed in the [Pos. X] and [Pos. Y] fields.

> **Reference**

- To measure the amount of error (deviation) from the reference position where the image is registered, select [registered point].
- If [specified point] has been selected, the origin point can be set outside the process area. The available range for the origin is
from -9600 to 9600 (X), -7200 to 7200 (Y).

Changing the Position of the Detection Point

You can change the position of the detection point using [Detection Point] in the [Tool Parameters] menu.

> **Reference**

- Normally, the detection point is at the center position of the pattern area (0000.000, 0000.000).
- The detection point can be set outside the process area. The range of detection points you can set is from -9600 to 9600 (X) and -7200 to 7200 (Y).

Selecting the Coordinate System for Position Adjustment

You can select the coordinate system using [Coordinate Value] in the [Tool Parameters] menu. If a position correction (Page 4-249) is not being done, this setting will have no effect on the output.

- **[After Position Adjust]** (Default): If the position of the window used as the source of correction has shifted, the amount of this error is reflected on the measurement.
- **[Before Position Adjust]**: The distance from the position of the "Origin point" is measured.

> **Reference**

These settings are reflected when the measurement window area position from the calculation is referenced.

Eliminating patterns based on correlation value

You can specify this item using [Min. Match%] in the [Tool Parameters] menu (Default: 60).
This function is used as follows. When [Min. Match%] 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 useful in preventing erroneous detection.

The detected patterns can be sorted using the following methods:
You can select the pattern sorting conditions using the [Detect. Order] in the [Tool Parameters] menu.
• Y>X ascending order:

• X>Y ascending order:

• X ascending order
• X descending order
• Y ascending order
• Y descending order
• Match% descending (Default): Patterns are sorted in order starting from the pattern having the highest match%.

Correlation value
① **99.9**
② **99.0**
③ **98.2**
④ **97.5**
⑤ **95.9**
⑥ **94.1**
⑦ **92.4**

• Correlation value ascending order
• Clockwise
• Counter-clockwise

Specify the starting angle when setting pattern numbers by clockwise/counter-clockwise order.
You can specify the [Starting Angle] in the [Tool Parameters] menu.
Specify the starting angle and position when the [Detect. Order] setting is [Clockwise] or [Counter CW].

► **Note**

These angles can not be specified if the [Detect Order] is not [Clockwise] or [Counter CW].

Specifying the pattern to be evaluated
You can specify which pattern will use the set tolerances for judgment using the [Primary Target] in the [Tool Parameters] menu.
Up to 99 can be set, but [1] is the default value.

► **Note**

Only data for the pattern set here can be used for judgment (excluding number of pattern measurements).

Setting the Execute Conditions

The measurement window can be set to execute or not, based on the results of an OK or NG judgment of a specified window. This can be useful for instances where inspections need to be skipped. See "What are Execute Conditions?" (Page 4-247) for details.

1 Select [Execute].

The [Window Execute Condition] menu appears.

2 Select an appropriate condition.

- **Always Execute** (Default) **:** Always execute on trigger input.
- **Never Execute:** Do not execute even with trigger input (skip).
- **Window Number (Measurement, Calculation):** Skips or measures depending on the judgment results of the selected window.

If measurement is skipped, measurement and judgment results for that window become 0 and are not reflected in the final results.

► Note

- If the reference window is set to itself, a circular reference error will result. If this happens, all windows in the same Program No. will have their settings invalidated (set to Always Execute).
- If a circular reference error occurs, a "!" will appear before the window number and the execution conditions to indicate an error.

3 If window number is selected, measurement can be skipped or carried out depending on the judgment results of the specified window.

- **OK:** Executes if the judgment result of the specified window is OK.
- **NG:** Executes if the judgment result of the specified window is NG.

Reference

If no tolerance is set for the selected window, the judgment result is always OK.

4 After completing the settings, select [OK].

Specifying the Windows for Inspection and Measurement

Setting the Limits Settings

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

1 Select [Limits].

The [Enter Limits] menu appears.

2 Select an item to set limits for.

3 Select [Upper] or [Lower] and set the tolerance.

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

- **Count (Number of detected patterns)** :
  Number of patterns

- **Position (Detected coordinates of the pattern)**: Pixels
- **Angle (Tilt angle of the pattern)**: Degrees
- **Match% (correlation value of patterns)**:Numerical value in the range of 0 to 99.999.

Reference

Tolerance can be entered by selecting [Direct Input] and specifying a tolerance or by selecting [Calc Ref] and using the results of a chosen calculation window.

4 To specify the tolerance of another measurement value, repeat Steps 2 and 3.

5 After completing the settings, select [OK].

Reference

- [-----] indicates that no tolerance has been set and no judgment will take place after measurement.
- Press [Clear] to clear the value.

Pattern Sort (Variable Search)

What is [Pattern sort] Measurement Tool?

Unlike the Pattern Search tool (Page 4-33), the Pattern Sort tool has the ability to detect a variety of different targets in a single inspection window. The different targets are registered and stored as elements of a group; when a particular target is detected the Pattern Sort tool outputs both the element number and the group that contains the target. This is helpful when sorting multiple different targets and when trying to stabilize the detection of a target that varies in shape and size. The angle, position, and correlation value of each pattern can also be measured and output.

► **Note**
- The size of the pattern window greatly effects the Window memory. Each program only has a specified amount of window memory; once the memory has reached 100%, no more inspection windows can be created.Try to limit the size of the pattern window when it is necessary to create multiple inspection windows.
- Initial target memory size is as follows (the reference value varies depending on the size of the window)
  - CV-3501: Each program can store 22 Full screens (512x480).
  - CV-3001: Each program can store 18 Full screens (512x480).
- Up to 256 pattern areas can be registered within one inspection window. Once the 256 patterns have been registered, no more Pattern sort windows may be created.

Measurement image

When registering multiple patterns into separate groups G000 to G002
- When registering a pattern
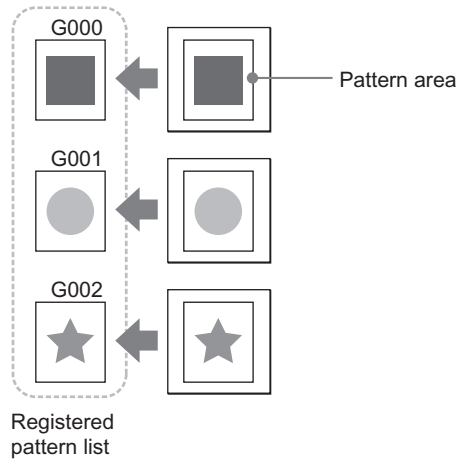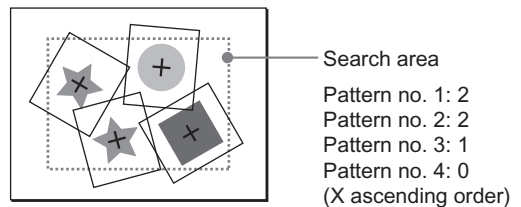
Pattern area

Registered pattern list

- While the system is in operation

Search area

Pattern no. 1: 2
Pattern no. 2: 2
Pattern no. 3: 1
Pattern no. 4: 0
(X ascending order)

Reference

The position of the pattern used as a reference value (Pattern reference window) can be constantly displayed using [Configure Graphic Colors] (page 6-46).

When registering multiple patterns into one group as elements E000 to E002

• When registering a pattern

E000

Pattern area

E001

E002

Registered pattern list

• While the system is in operation

Search area

Correlation value: 99.9

Search area

Correlation value: 99.9

Search area
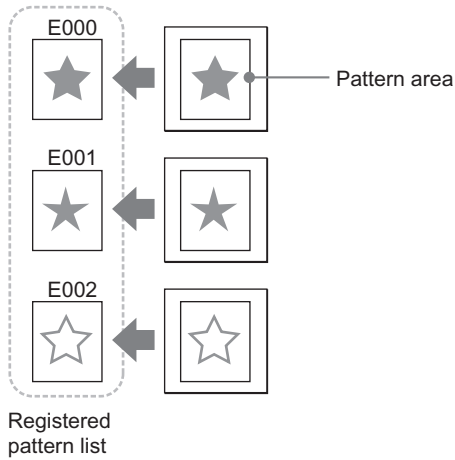
Correlation value: 99.9
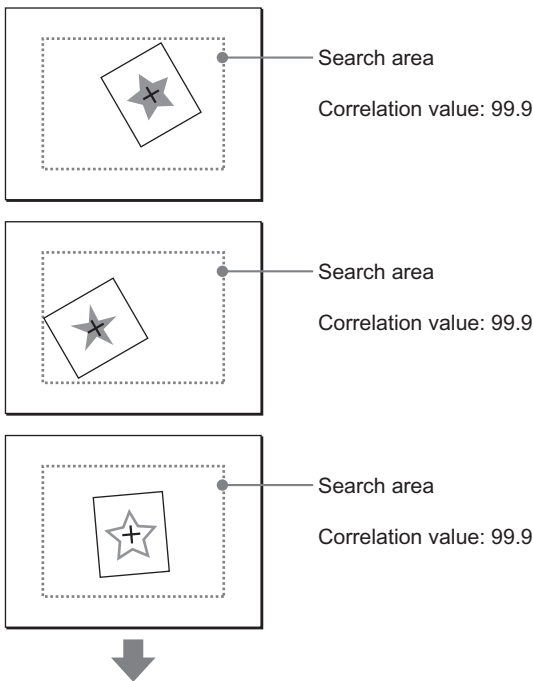
When multiple patterns are registered as elements, the correlation value is 99.9 for any of the patterns

Reference

The position of the pattern used as a reference value (Pattern reference window) can be constantly displayed using [Configure Graphic Colors] (page 6-46).

The order of the detected patterns can be selected.

There are eleven ways the patterns can be ordered.
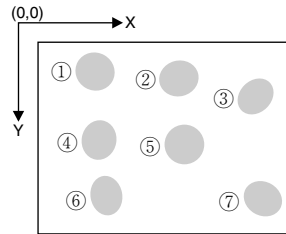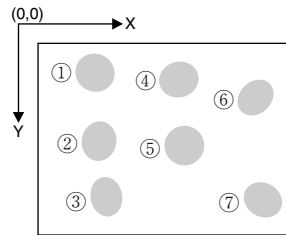
• Y>X ascending order

• X>Y ascending order

• X ascending order
• X descending order
• Y ascending order
• Y descending order
• Correlation value descending order

Correlation value
① **99.9**
② **99.0**
③ **98.2**
④ **97.5**
⑤ **95.9**
⑥ **94.1**
⑦ **92.4**
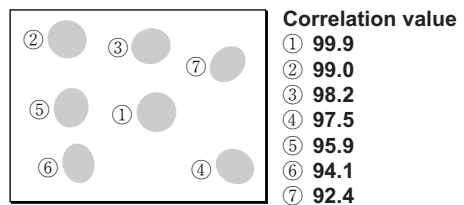
• Correlation value ascending order
• Pattern number ascending order
• Clockwise
• Counter-clockwise

To select a different order, see [Detect. Order] (Page 4-42) in the [Parameters] menu.

Measurement results

The measurement results that can be output in the Pattern sort tool are shown below.

- **Count**: Outputs the number of detected patterns. (Available in the limits menu)
- **Group no. [ ]**: Outputs all of the group numbers for the detected pattern. (Available in the limits menu) (Available through outputs)
- **Element no. [ ]**: Outputs all of the element numbers that match the detected pattern. (Available through outputs)
- **Position (X,Y) [ ]**: Outputs the coordinates of all detected patterns (in pixels). (Available in the limits menu) (Available through outputs)
- **Angle [ ]**: Angles of difference between the registered pattern and each detected pattern are output in degrees. The angle difference in the clockwise direction is shown with a positive (+) sign. The angle difference in the counter-clockwise direction is shown with a minus (-) sign. (Available in the limits menu) (Available through outputs)
- **Match % [ ]**: 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 99.999. (Available in the limits menu) (Available through outputs)
- **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.
- **Measurement Window Position**: Outputs the window position in pixels (available as a reference after calculation) Note that polygon window information is not output.

Measurement sample

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

- Pattern order: X ascending order
- [No. to Judge]: 1
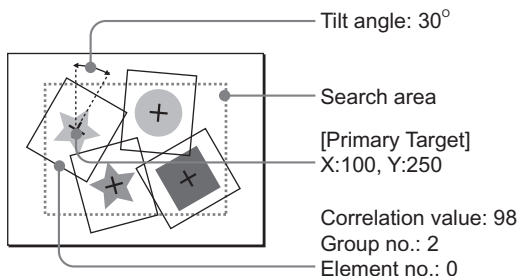
Tilt angle: 30°

Search area

[Primary Target]
X:100, Y:250

Correlation value: 98
Group no.: 2
Element no.: 0

Selecting Measurement Tools

1 **Select [Add/Copy/Del] from the [Edit Window] menu.**
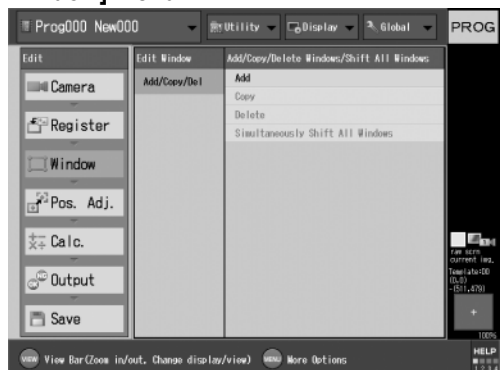
2 **Select [Add].**

The [Add Window] menu appears.
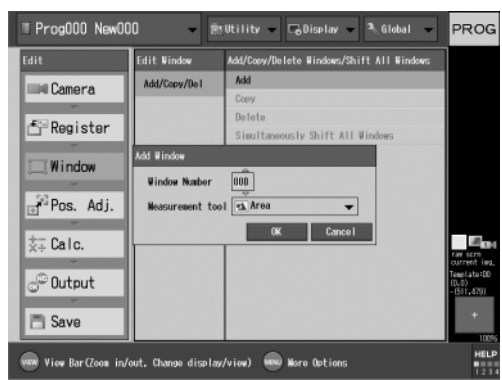
3 **Select [Window Number], then specify the measurement window number**

Window numbers can be freely set at value from 0 to 127 .

4 **Select [Measurement tool] and then select [Pattern sort].**

5 **Select [OK].**

A window with the specified number is added as a Pattern sort window. The current window setting list is then displayed.

The necessary settings for the Pattern sort window are added next.

Selecting a Camera to Take Images

1 **Select [Window] and then select a Pattern sort window.**

The window setting menu appears.
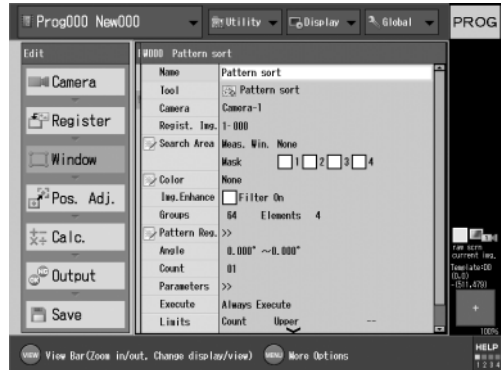
2 **Select [Camera], then selecting a camera to take images**

Reference

Unconnected cameras can be selected. However, if the selected camera is not connected at the time of imaging, an error will occur.

Specifying a Registered Image to Use

Specify a registered image to use for processing.
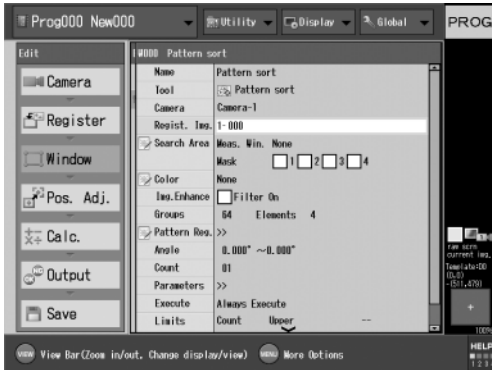
Reference

- The image to be used must have been previously saved to an image number in the [Register Image] menu (Page 4-18).
- The registered image that is specified here is the registered image that appears when saving patterns in G000-E000. However, the registered image used for pattern registration can be selected again in the [Pattern List] menu (Page 4-52).

Select [Regist. Img.], then specify the number of the registered image to be used.
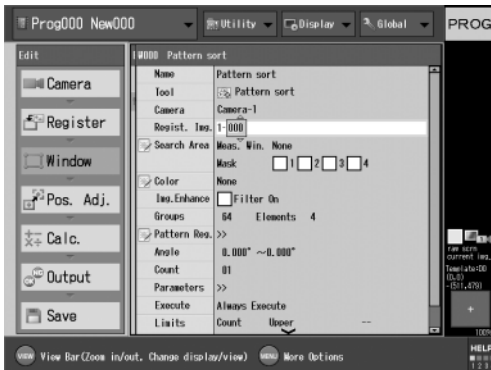
The registered image number will be displayed as "Camera number-xxx."

Specifying a Measurement Window

Set a range (search area) in the image to search for the target recorded in the pattern window (Page 4-52).
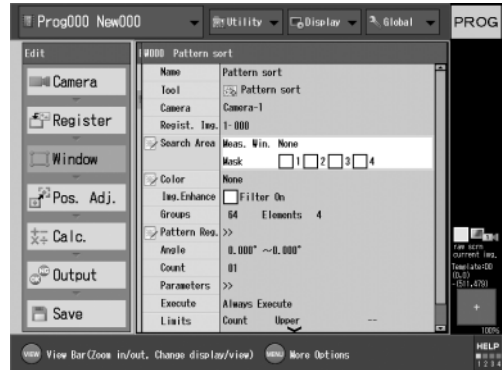
Reference

Smaller search windows will decrease processing time.

1 Select [Search Area].

The [Search Area] menu appears.
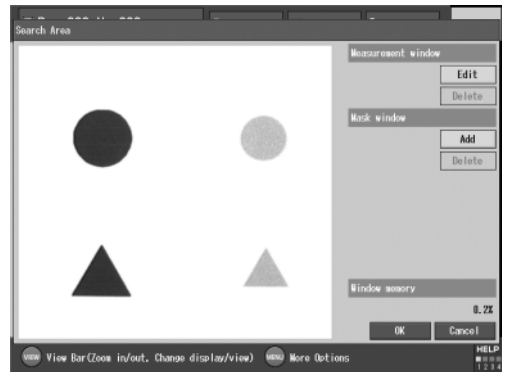
2 Select [Edit] in the [Measurement window] field.

The [Select] menu appears.

3 **Select a shape, then select [OK].**
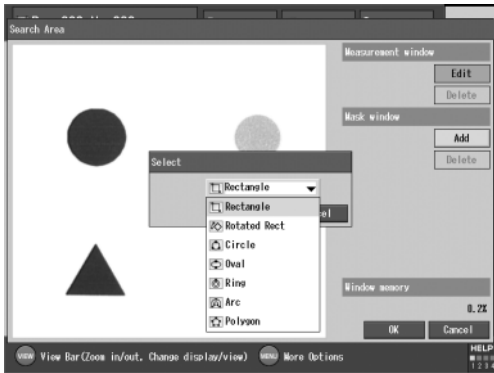
Auto-adjust rectangle and Auto-adjust circle cannot be selected.

4 **Draw the search area.**

See "Drawing a Rectangle" (page 3-13) for details.

5 **After completing the drawing, select [Close] in the [Edit] field.**

Clearing the measurement area

The measurement area can be cleared by following the procedure below:

1 **Select [Delete] in the [Measurement window] field.**

A confirmation screen appears.

2 **Select [OK].**

Exclude an unwanted area (mask window)

You can set up to four areas (mask windows) that will not be measured inside the measurement area. This is useful when the measurement target has a complicated shape or when you want to hide an unnecessary part of the target.

Select [Add] in the [Mask window] field.

The [Add mask window] menu appears. See "Exclude Part of the Measurement Window (Mask Window)" (page 3-25) for details.

Extracting a Color

When using a color camera, color images can be converted to black and white through an extraction process.

► **Note**

This feature is not available when using a monochrome camera.

Select [Color].

The [Color] menu appears.

See "Processing a Color Image [Color]" (page 13-1) for details on color extraction.

Selecting an Image Enhancement

Specify an appropriate filter for the image. When using a color camera, the filter is applied to pixels of the extracted color.

1 Select [Img. Enhance].

The [Image Enhance] menu appears.

2 Select a filter to use, then select [OK].

See "Filter List" (page 13-9) for details on the individual filters.

► Note

The subtraction filter is not available in this measurement mode.

Reference

• More advanced filter settings can also be made by selecting [Detail].

• Up to 13 filters can be used. When multiple filters are set, they are executed starting from the filter specified in the top portion of the screen.

Setting the Number of Groups

You can set the number of groups and the number of elements to use for the window. The number of groups and the number of elements can be changed freely, as long as the number of groups multiplied by the number of elements is less than or equal to 256 ((number of groups) x (number of elements) ≤ 256).

• **Group**: A different type of pattern is registered in each group, and the group numbers sort between different types of patterns (G000 to G255).

• **Element**: The same type of patterns with different images are registered for each element, improving the measurement stability when the detected target varies (E000 to E255).
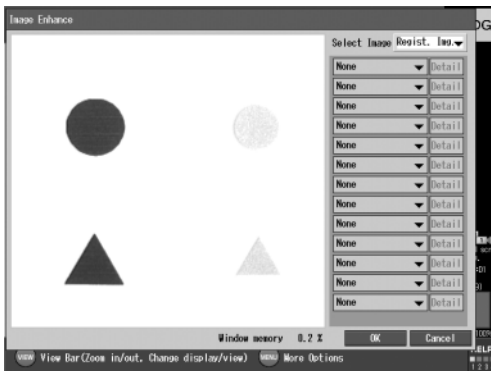
► Note

Up to 256 pattern areas can be registered within one inspection window. Once the 256 patterns have been registered, no more Pattern sort windows may be created.

Reference

When sorting between different types of patterns (targets), set the group number to match the number of target variations. When detecting 1 type of target that varies in size or shape, use 1 group with many elements.

Specifying the Windows for Inspection and Measurement

1 Select [Groups].

The [Groups] menu appears.
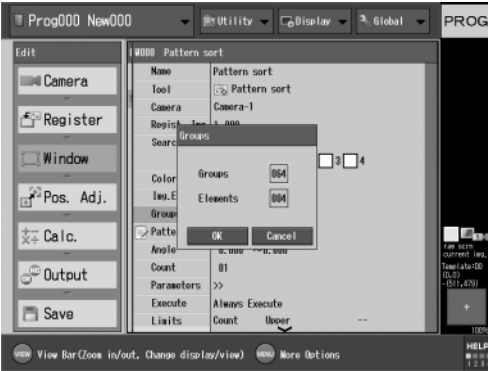
2 Change the number of groups or the number of elements to the desired value.

► Note

If the number of groups and number of elements are set less than the currently saved number, the current data that exceeds the new number set will be erased.

3 After completing the settings, select [OK].

Registering the Pattern to Detect

Register the image of the target you want to search for as [Pattern] in a group or an element.
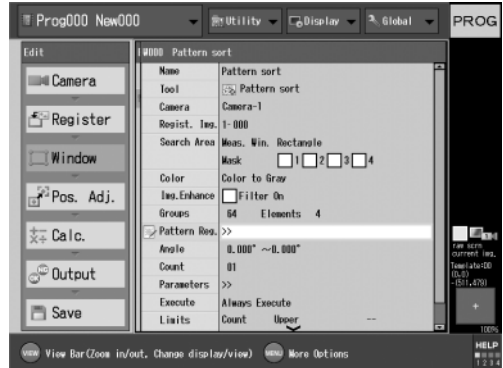
1 Select [Pattern Reg.].

The [Pattern List] menu appears.
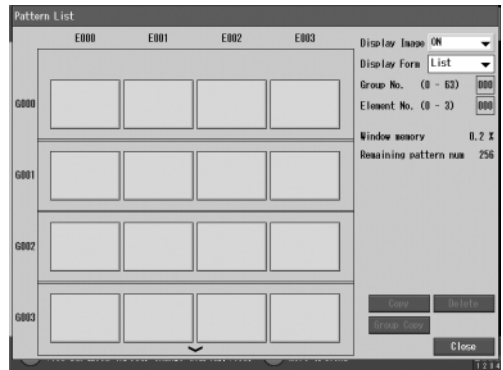
Reference

The number of compressed images that can be displayed and their size depends on the settings and the model of the connected camera.

2 From the list, select the pattern that you want to register for the group number and element number.

The [Pattern Registration] menu appears.
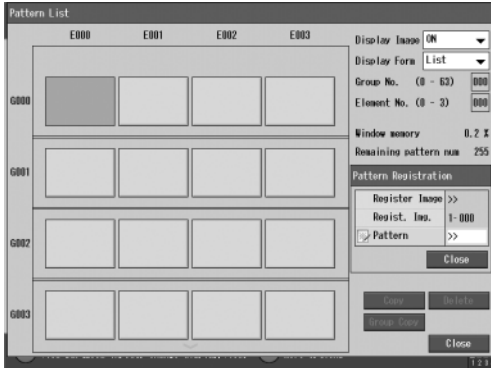
▶ Note

When using Pattern sort for position windows, you must register a pattern in G000-E000 that will be used as the standard for position correction.

▶ Reference

To display the group number and element number that you want to set, either scroll through the list or directly enter the group number or element number.

When the menu display updates slowly

Switching [Display Image] to [OFF] displays the registered image numbers instead of the compressed images. This allows the list to update smoothly.

Changing the list format

The display format can be changed in [Display Form].

- List (default): Displays the groups and elements in a matrix format.
- Element: Only displays the elements in a specified group.
- Group: Only displays the specified element numbers for all groups.

Copying and deleting registered data

Select [Copy] or [Delete] to copy or delete the registered data for the specified group number or element number.

Select [Group Copy] to copy all of the elements of registered data in the selected group number to another group number.

▶ Reference

The data cannot be copied to another measurement window.

▶ Note

If the copied information would exceed either the window memory or the limit on the number of patterns that can be added, only part of the data will be copied.

3 Select [Regist. Img.] and specify the registered image to reference when saving the pattern.

▶ Reference

Reference images can also be registered in this menu.

4 Select [Pattern].

The [Pattern] menu appears.
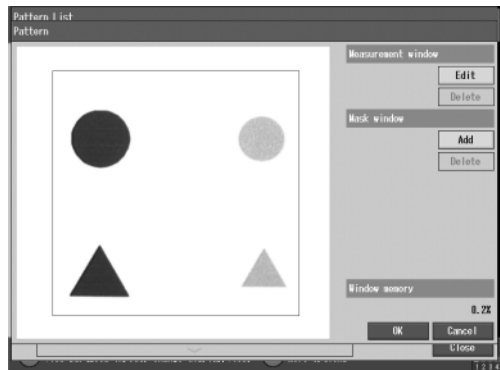
5 Select [Edit] from the [Measurement window] field.

The [Select] menu appears.

6 Select a shape, then select [OK].

▶ Note

Auto-adjust rectangle and Auto-adjust circle cannot be selected.

7 Draw the pattern area.

See "Drawing a Measurement Window" (page 3-13) for details.

▶ Note

When drawing patterns for elements in the same group, try to set the detection points in the same position for all of the elements. If the detection points are set in different locations, the position of the measurement results varies depending on the elements that are used.

8 After completing drawing, select [Close] in the [Edit] field.

Specifying the Windows for Inspection and Measurement

9 Select [OK].

The CV returns to the [Pattern List] menu.
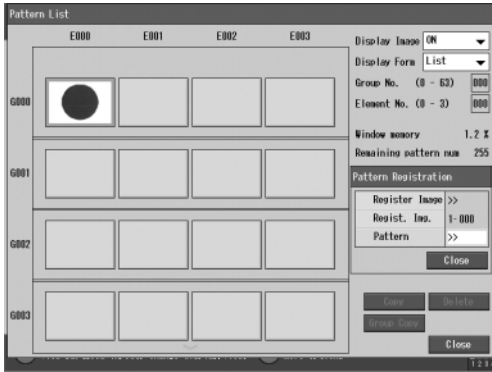
10 Select [Colse].

11 Repeat steps 2 to 9 as necessary to register other groups and images.

12 Select [Close].

Clearing the measurement area

The measurement area can be cleared by following the procedure below.

1 Select [Delete] in the [Pattern] field.

A confirmation screen appears.

2 Select [OK].

Exclude an unwanted area (mask window)

You can set up to 4 areas (mask windows) that will not be measured inside the pattern area. This is useful when the measurement target has a complicated shape or when you want to hide a part that is not necessary.

Select [Add] in the [Mask window] field.
The [Add mask window] menu appears.
See "Exclude Part of the Measurement Window (Mask Window)" (page 3-25) for details on the following information.

Setting the Angle Range

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

1 Select [Angle].

The [Select Angle Range] menu appears.

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

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

4 After completing the settings, select [OK].

Setting the Number of Patterns to Detect

The number of detected patterns can be set from 1 to 99. For example, when [3] is set, the Pattern sort will search for up to 3 targets.

► **Note**

The maximum number of patterns that can actually be detected changes depending on the settings.

Reference

Even if there is only one pattern in the search range, setting the count to a number higher than one will enhance the search process and make the results more reliable.

1 Select [Count].

The [Count] menu appears.

2 Select [Count] and set the maximum number of patterns to detect.

3 After completing the settings, select [OK].

Setting Other Detection Conditions

1 Select [Parameters].

Select [Tool Parameters]. The [Tool Parameters] menu appears.

2 Make the necessary settings.

After completing the settings, select [OK].

Selecting the search sensitivity

You can select the level of search sensitivity [Sensitivity] in the [Tool Parameters] menu. When detection is unstable, increase the level of sensitivity.

Specifying the Windows for Inspection and Measurement

► **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] in the [Tool Parameters] menu. To measure with a high level of accuracy, set the search accuracy to [Highest].

Search sensitivity	Coarse -2	Normal 0	Fine +2
Accuracy	Low	←————————→	High
Process time	Fast	←————————→	Slow

► **Note**

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

You can change the reference position of the origin using [Origin] in the [Tool Parameters] menu.
Specify the reference position of the origin in [Origin] in the [Tool Parameters] menu. Make the necessary settings in the [Origin] menu.

- **specified point** (Default): The origin point is set at the top left of the screen by default. 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 [Pos. X] and [Pos. Y] fields.

- **registered point**: The position of the "Detection point" on the registered image G000-E000 is used as the origin point. The present origin point is displayed in the [Pos. X] and [Pos. Y] fields.

Reference

- To measure the amount of error (deviation) from the reference position where the image is registered, select [registered point].
- If [specified point] has been selected, the origin point can be set outside the process area. The available range for the origin is from -9600 to 9600 (X), -7200 to 7200 (Y).

Changing the Position of the Detection Point

You can change the position of the detection point using [Detection Point] in the [Tool Parameters] menu.

Reference

- Normally, the detection point is at the center position of the pattern area (0000.000, 0000.000).
- The detection point can be set outside the process area. The range of detection points you can set is from -9600 to 9600 (X) and -7200 to 7200 (Y).
- The specified detection point is the same for all pattern areas in the window.

Selecting the Coordinate System for Position Adjustment

You can select the coordinate system using [Coordinate Value] in the [Tool Parameters] menu. If a position correction (4-210EyA[EW) is not being done, this setting will have no effect on the output.

- **[After Position Adjust] (Default)**: If the position of the window used as the source of correction has shifted, the amount of this error is reflected on the measurement.

- **[Before Position Adjust]**: The distance from the position of the "Origin point" is measured.

Reference

These settings are reflected when the measurement window area position from the calculation is referenced.

Eliminating patterns based on correlation value

You can specify this item using [Min. Match%] in the [Tool Parameters] menu (Default: 60). This function is used as follows. When [Min. Match%] 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 useful in preventing erroneous detection.

Reduce processing time

When detecting multiple detection patterns, switch [Fast Mode] on the [Tool Parameters] menu to [ON] to reduce processing time.

► **Note**

A detection error may occur when multiple patterns are close to each other. Switch [Fast Mode] to [OFF], as fast mode cannot be used when patterns are close to each other.

The detected patterns can be sorted using the following methods:
You can select the pattern sorting conditions using the [Detect. Order] in the [Tool Parameters] menu.

• Y>X ascending order:

• X>Y ascending order

• X ascending order
• X descending order
• Y ascending order
• Y descending order
• Match% descending (Default): Patterns are sorted in order starting from the pattern having the highest match%.
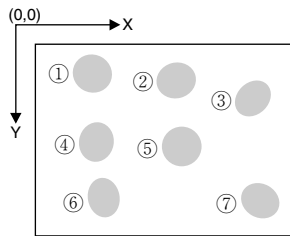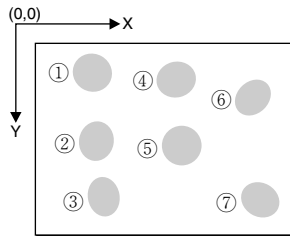
Correlation value
① **99.9**
② **99.0**
③ **98.2**
④ **97.5**
⑤ **95.9**
⑥ **94.1**
⑦ **92.4**
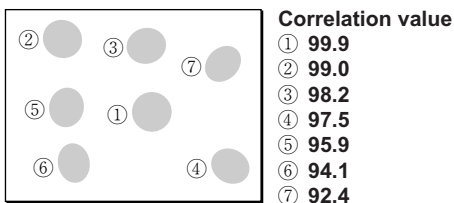
• Correlation value ascending order
• Clockwise
• Counter-clockwise
• Pattern number ascending order

Specify the starting angle when setting pattern numbers by clockwise/counter-clockwise order.
You can specify the [Starting Angle] in the [Tool Parameters] menu.
Specify the starting angle and position when the [Detect. Order] setting is [Clockwise] or [Counter CW].

► **Note**

These angles can not be specified if the [Detect. Order] is not [Clockwise] or [Counter CW].

Specifying the pattern to be evaluated
You can specify which pattern will use the set tolerances for judgment using the [Primary Target] in the [Tool Parameters] menu.
Up to 99 can be set, but [1] is the default value.

► **Note**

Only data for the pattern set here can be used for judgment (excluding number of pattern measurements).

Specifying the Windows for Inspection and Measurement

Setting the Execute Conditions

The measurement window can be set to execute or not, based on the results of an OK or NG judgment of a specified window. This can be useful for instances where inspections need to be skipped. See "What are Execute Conditions?" (page 4-247) for details.

1 **Select [Execute].**

The [Window Execute Condition] menu appears.

2 **Select an appropriate condition.**

- Always Execute (Default) : Always execute on ger input.
- Never Execute: Do not execute even with trigger input (skip).
- Window Number (Measurement, Calculation): Skips or measures depending on the judgment results of the selected window.

Reference

If measurement is skipped, measurement and judgment results for that window become 0 and are not reflected in the final results.

► Note

- If the reference window is set to itself, a circular reference error will result. If this happens, all windows in the same Program No. will have their settings invalidated (set to Always Execute).
- If a circular reference error occurs, a "!" will appear before the window number and the execution conditions to indicate an error.

3 **If window number is selected, measurement can be skipped or carried out depending on the judgment results of the specified window.**

- **OK**: Executes if the judgment result of the specified window is OK.
- **NG**: Executes if the judgment result of the specified window is NG.

Reference

If no tolerance is set for the selected window, the judgment result is always OK.

4 **After completing the settings, select [OK].**

Setting the Limits Settings

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

1 Select [Limits].

The [Enter Limits] menu appears.

2 Select an item to set limits for.

3 Select [Upper] or [Lower] and set the tolerance.

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

- [Count] (Number of detected patterns) : Number of patterns
- Group No. (Group No. for the pattern): Value from 0 to 255
- Position (Detected coordinates of the pattern): Pixels
- Angle (Tilt angle of the pattern): Degrees
- Match% (correlation value of patterns):Numerical value in the range of 0 to 99.999.
- Pattern No. 1-8: Value from 0 to 255. Sets the pattern number for patterns to be detected and sets the pattern order 1 to 8 for multiple detected patterns.

Reference

- Tolerance can be entered by selecting [Direct Input] and specifying a tolerance or by selecting [Calc Ref] and using the results of a chosen calculation window.
- If the pattern is not detected, the group No. becomes "999". If the group No. is unexecuted by the execute conditions, it becomes "0".

4 To specify the tolerance of another measurement value, repeat Steps 2 and 3.

5 After completing the settings, select [OK].

Reference

- [-----] indicates that no tolerance has been set and no judgment will take place after measurement.
- Press [Clear] to clear the value.

Specifying the Windows for Inspection and Measurement

ShapeTrax

What is [ShapeTrax] Measurement Mode?

By comparing edge data from registered image patterns and current image, the most precise measurements of position, angle, and correlation value can be made.

Differing from pattern searches (Page 4-33), which refer to edge information mainly in the form of an outline of the target, ShapeTrax is suitable to position searches on surfaces that are damaged or changing and require stability and accuracy.

▶ **Note**

- When template edges (Page 4-72) are active, a maximum of 5 or 10 ShapeTrax windows can be set for each Program No. Other measurement window settings may further limit the number of ShapeTrax windows that can be set.
- This is limited by the amount of target memory remaining. In ShapeTrax measurement mode, the amount of target memory required varies depending on the edge extraction state of the recorded image. Working memory for all windows, including ShapeTrax, must be stored in the target memory of the main device so that target memory may be common across all windows in a setting. Target memory usage is displayed as [Window memory] when making area, search or detailed settings. As the value displayed here approaches 100, fewer settings can be made.
- Changes in the state of the current image can cause changes in processing time. Because edge information is extracted from the current image processing time can change when the amount of edge information changes. If changes in processing time are problem, use the timeout setting (Page 4-73) and confirm the actual shape.
- Up to 256 pattern areas can be set within one setting for search processing. Patterns cannot be added to ShapeTrax search if 256 patterns are already set for another window.

Measurement image

When registering a pattern

Search area
Pattern area
Detection point:
(Can be freely specified)

Registered pattern

While the system is in operation

Origin
Tilt angle
Search area

Even when there is a flaw, the edge is detected based on the registered pattern.

Even when the targets overlap, the edge is detected based on the registered pattern.

Reference

The pattern size when registering a pattern (basic pattern size) can be displayed in the results graphic (Page 6-46).

…

Selecting Measurement Tools

Select [ShapeTrax].

1 Select [Add/Copy/Del] from the [Edit Window] screen.
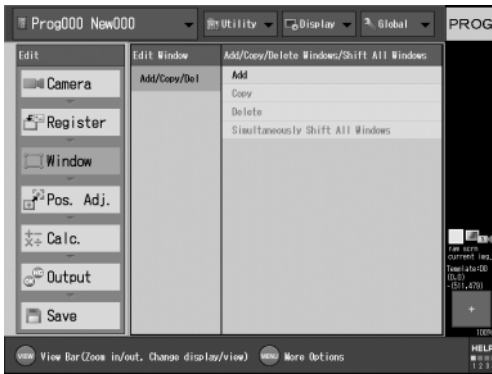
2 Select [Add].
The [Add Window] menu appears.

3 Select [Window Number], then specify the measurement window number.
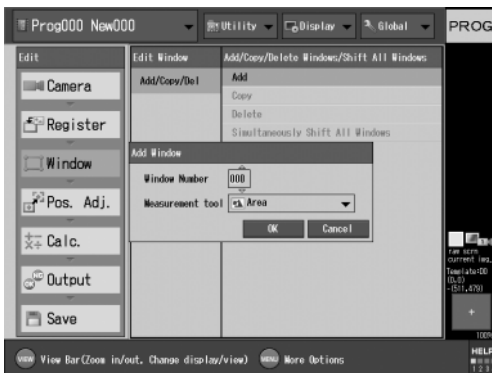
Window numbers can be freely set any value from 0 to 127 .

4 Select [Measurement tool] and then select [ShapeTrax].
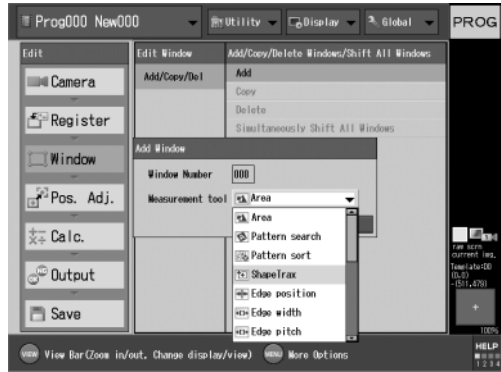
5 Select [OK].
The window with the specified number is added as a ShapeTrax measurement window. The current window setting list is then displayed.
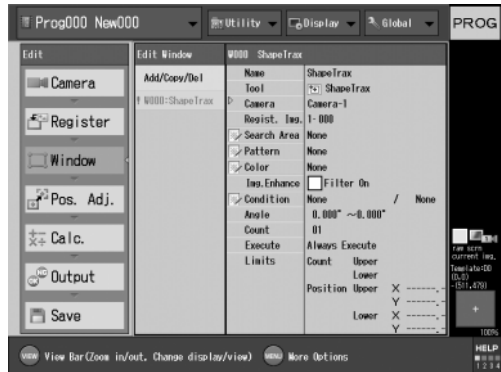
The necessary settings for the ShapeTrax window are added next.

Selecting a Camera to Take Images

1 Select [Window] and then select a ShapeTrax measurement window.
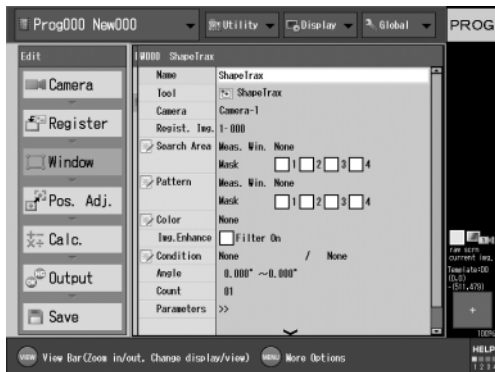
The window setting menu appears.

2 Select [Camera], then selecting a camera to take images

Reference

Unconnected cameras can be selected. However, if the selected camera is not connected at the time of imaging, an error will occur.

Specifying a Registered Image to Use

Specify a registered image to use for processing.

Reference

The image to be used must have been previously saved to an image number in the [Register Image] screen (Page 4-18).

Select [Regist. Img.], then specify the number of the registered image to be used.

The registered image number will be displayed as "Camera-xxx."

Specifying a Measurement Window

Set a range (search area) in the image to search for the model recorded in the pattern region (next page).
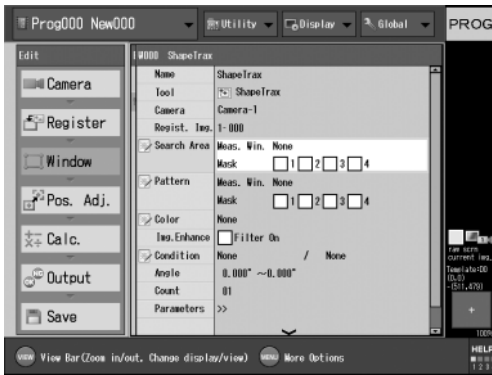
Reference

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

1 Select [Search Area].

The [Search Area] menu appears.

2 Select [Edit] in the [Measurement window] field.

The [Select] menu appears.

3 Select a region, then select [OK].

► **Note**

Auto-adjust rectangle and Auto-adjust circle cannot be selected.

4 Draw the search area.

See "Drawing a Measurement Window" (Page 3-13) for details.

5 After completing the drawing, select [Close] in the [Edit] field.

Clearing the measurement area

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

1 Select [Delete] in the [Measurement window] field.

A confirmation screen appears.

2 Select [OK].

Exclude an unwanted area (mask window)

You can set up to 4 areas (mask windows) that will not be measured inside the measurement area. This is useful when the measurement target has a complicated shape or when you want to hide a part that is not necessary.

Select [Add] in the [Mask window] field.

The [Add mask window] menu appears.
See "Exclude Part of the Measurement Window (Mask Window)" (Page 3-25) for details on the following information.

Registering the Pattern to Detect

Record the image of the model you wish to search as a [Pattern].

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, see "Exclude an unwanted area (mask window)" located after "Setting the Measurement Area".

1 Select [Pattern].

The [Pattern] menu appears.

2 Select [Edit] in the [Measurement window] field.

The [Select] menu appears.

3 Select a region, then select [OK].

► Note

Auto-adjust rectangle and Auto-adjust circle cannot be selected.

4 Draw the pattern area.

See "Drawing a Measurement Window" (Page 3-13) for details.

5 After completing the drawing, select [Close] in the [Edit] field.

Clearing the measurement area

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

1 Select [Delete] in the [Pattern] field.

A confirmation screen appears.

2 Select [OK].

Exclude an unwanted area (mask window)

You can set up to 4 areas (mask windows) that will not be measured inside the pattern area. This is useful when the measurement target has a complicated shape or when you want to hide a part that is not necessary.

Select [Add] in the [Mask window] field.

The [Add mask window] menu appears.
See Exclude Part of the Measurement Window (Mask Window)(Page 3-25) for details on the following information.

Specifying the Windows for Inspection and Measurement

Extracting a Color

When using a color camera, color images can be converted to black and white through an extraction process.

► Note

This feature is not available when using a black and white camera.
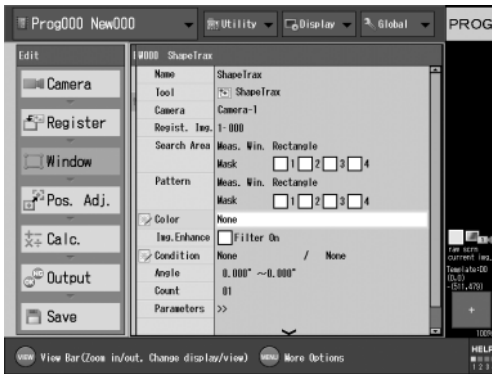
Select [Color].
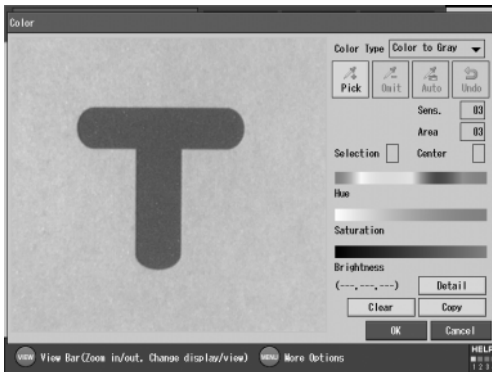
The [Color] menu appears.

See Processing a Color Image [Color](Page 13-1) for details on color extraction.

Selecting an Image Enhancement

Specify a appropriate filter handling for the image. When using a color camera, the filter is applied to pixels of the extracted color.
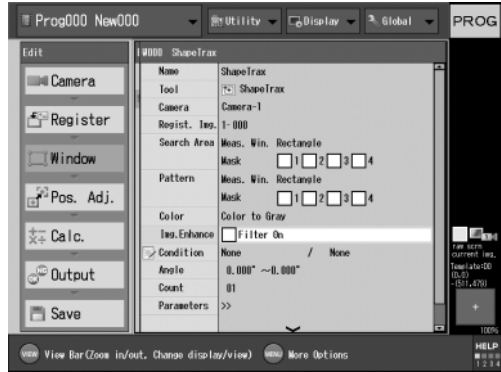
1 Select [Img. Enhance].

The [Image Enhance] menu appears.
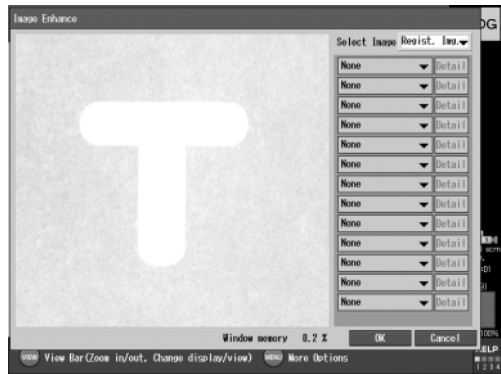
2 Select a filter to use, then select [OK].

See Filter List(Page 13-9) for details on the individual filters.

► Note

The subtraction filter is not available in measurement mode.

Reference

• More advanced filter settings can also be made by selecting [Detail].

• Up to 13 filters can be set according to the application needs. When multiple filters are set, they are executed starting from the filter specified in the top portion of the screen.

Setting the Search Settings

Set the conditions for registered image or current image edge searching. High-resolution measurement is made possible by making sure that edge information can be properly searched from registered images and the current image.
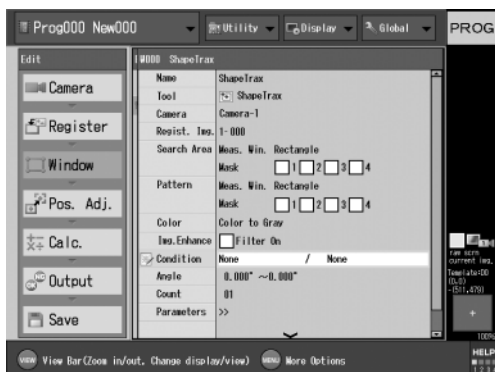
1 Select [Condition].

The [Select Extract Level of Edges] menu appears.
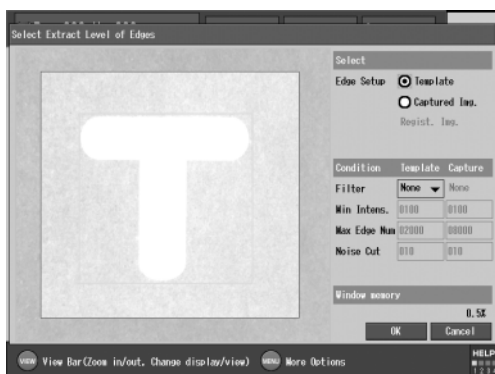
2 Select the object to set detection conditions for.

- **Template:** Set search conditions for edge patterns in registered images.
- **Captured Img.:** Set search conditions for extracting edge patterns from the current image.

Select [Captured Img] to set the current image or a registered image as the displayed image.

Reference

Press the [SCREEN] button on the console to switch to D1 or D2 (Page 5-6) to confirm the settings and extracted edges on the screen.

3 Set the edge detect conditions.

To make only the special features of the target to be extracted as edges, make settings while confirming them on the displayed image on the screen

- **Filter:** Set edge detection filters. (Default: None)
  - **Number:** Searches for edges above the minimum edge intensity limit and orders them by intensity up to the upper count limit.
  - **Intens:** Searches for edges above the minimum edge intensity limit.
- **Min Intens:** Sets the minimum edge intensity (contrast) for edge detection (40: Weak - 8000: Strong).
- **Max Edge Num** (Available only when [Number] is selected)**:** Sets the maximum number of edges that can be found in an edge search (100-60000).
- **Noise Cut:** Sets the strength of noise reduction during edge detection (0: Weak - 200: Strong).

► Note

- Search is not available when the filters are not active
- Make settings so that unneeded edges are not detected. Because unnecessary edges are found frequently, especially when [Template] is selected, it is possible that edge patterns may be registered incorrectly or that the search may become unstable. It is even possible that target memory may be erased, removing the ability to make settings.

4 After completing the settings, select [OK].

Specifying the Windows for Inspection and Measurement

Setting the Angle Range

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

1 Select [Angle].

The [Select Angle Range] menu appears.

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

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

4 After completing the settings, select [OK].
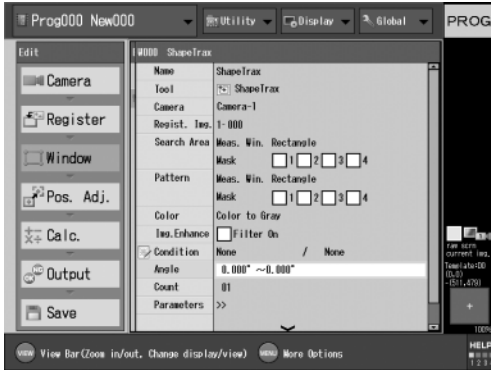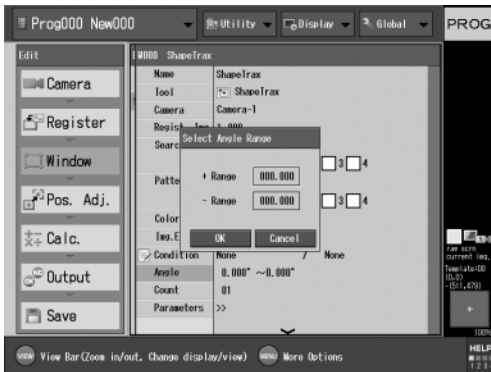
Setting the Number of Patterns to Search for

The number of searchable patterns in ShapeTrax measurement can be set from 1 to 99. For example, when [3] is set, the pattern search will search for up to 3 targets.
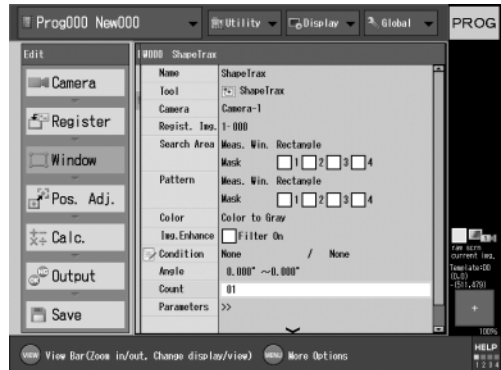
▶ **Note**

The maximum number of patterns that can actually be detected changes depending on the settings.

Reference

Even if there is only one pattern in the search range, setting the count to a number higher than one will boost the search process and make the results more reliable.

1 Select [Count].

The [Count] menu appears.
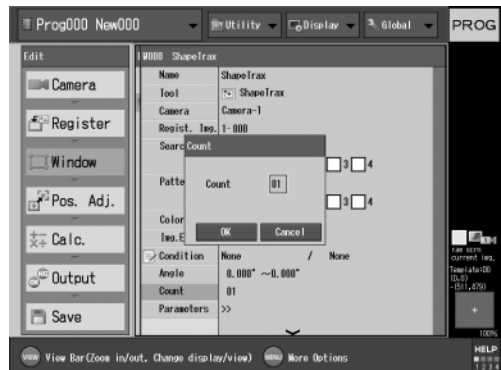
2 Select [Count] and set the maximum number of patterns to search for.

3 After completing the settings, select [OK].

Setting Other Detection Conditions

Set other ShapeTrax conditions as necessary.
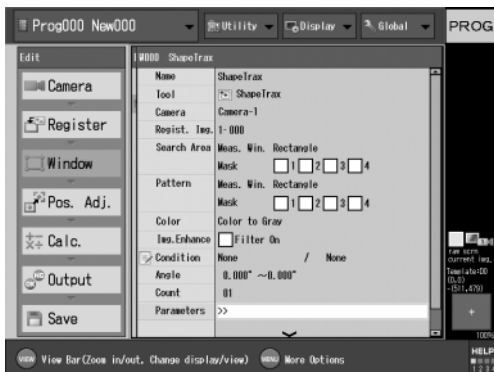
1 Select [Parameters].

Select [Tool Parameters]. The [Tool Parameters] menu appears.
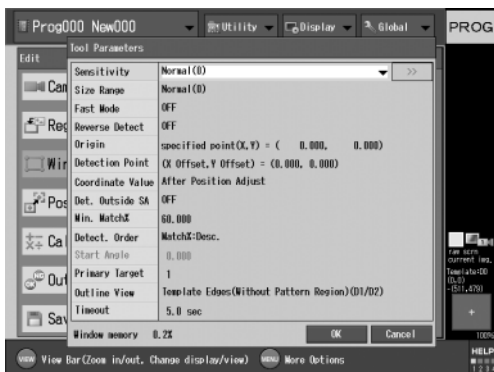
2 Make the necessary settings.

After completing the settings, select [OK].

Selecting the search sensitivity

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

Search sensitivity	Low −3	Normal 0	High +3
Stability	Low	← →	High
Process time	Fast	← →	Slow
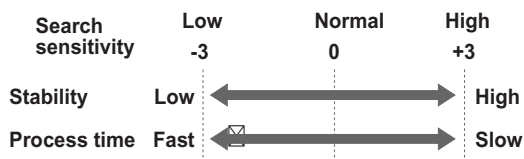
Increasing the level of search sensitivity may improve the stability of detection, but the processing time will become longer.

Adjusting search sensitivity manually (Custom)
If searching is difficult with current search settings, select [Custom] in search sensitivity to manually adjust sensitivity. For ShapeTrax, follow steps 1 through 5 (first search through final search) for compressed images repeatedly to find a desired location. Select [Custom] and then [>>] to make detailed search settings.

- **Reset Default:** Loads default settings for the current operations
- **Num. Found:** Sets the number of candidates for measurement results from steps 1 through 5. Search mistakes decrease as step 1 candidates increase. However, the increase in processing means an increase in processing time.
  When conducting multiple searches, the number of candidates for each search must be at least as high as the number of search results.
- **First Step:** Sets which step the first search starts from. The larger the first step, the more likely mistakes caused by running the first step with a detailed, low compression image will be resolved. However, as the amount of data to be handled grows, the time required to perform a search at any setting may become extremely long.
- **First Step Compress:** When [ON], speeds first search by culling results. This is most effective for comparatively large patterns.
- **First Step Angle:** Sets the culling width for angles found in the first search. Decreasing the first step angle will decrease angle errors but will increase the amount of data that must be handled and thus increase the amount of time needed to perform the search.

- **Min. Distance, Min. Angle:** Sets the minimum angle and number of pixels that a candidate must be from a detection point to be removed from search results. Candidates that meet all conditions are removed. If a large number of candidates are removed, there is the possibility that search errors involving returning the same target more than once or returning similar targets will be resolved. However, when running multiple searches, there is the possibility that two targets close to each other will not be found.

► **Note**

When "Fast Mode" is selected, step 4 may be the final search with step 5 not being displayed.

Changing settings related to the size of the search target

You can specify it using [Size Range] on the [Tool Parameters] menu.

To reduce the effects of changing the target size in the current image, set the size range to [Highest].

Size tolerance	Low -3	Normal 0	High +3
Tolerance	Low ◄────────────►		High
Process time	Fast ◄────────────►		Slow
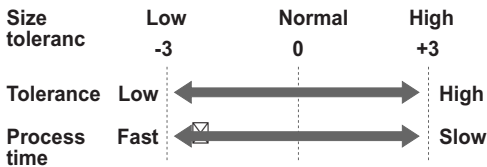
► **Note**

- Increasing the size range will reduce the effects of size changes, but the processing time will become longer.
- The available size range settings vary with the current image and settings.

Speeding up processing time

Set [Fast Mode] on the [Tool Parameters] menu.
Use this feature when speed is more important than resolution or stability.

- **OFF** (Default)**:** Fast mode is turned off.
- **ON:** Processing is sped up by using compressed images. This often results in a relative loss of accuracy in comparison with the [OFF] setting.

► **Note**

The effects of fast mode vary with the current image and settings.

Reference

When fast mode is ON, step 5 of "Custom" search sensitivity is not displayed.

Selecting processing related to the reverse image of the search target

Set [Reverse Detect] on the [Tool Parameters] menu.
Set this to search images that that have had black and white reversed.

- **OFF** (Default)**:** Reversed images are not returned.
- **ON:** Reversed images are returned as if they had not been reversed.

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

You can change the position of the detection point using [Origin/Detection point] on the [Tool Parameters] menu.
Make the necessary settings on the [Origin] menu.

- **specified point** (Default): The origin point is set at the top left of the screen by default. 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 [Pos. X] and [Pos. Y] fields.
- **registered point**: The position of the "Detection point" in the pattern area is used as the origin point. The present origin point is displayed in the [Pos. X] and [Pos. Y] fields.

Reference

- To measure the amount of error (deviation) from the reference position where the image is registered, select [registered point].
- If [specified point] has been selected, the origin point can be set outside the process area. The available range for the origin is from -9600 to 9600 (X), -7200 to 7200 (Y).

Changing the position of the detection point

You can change the position of the detection point using [Origin/Detection point] on the [Tool Parameters] menu.

- **specified point** (Default)**:** Creates a detection point at a specified X and Y offset from the center of the set pattern. When setting directly at the top of the screen, select [Edit], just as for setting the origin.
- **center of gravity.:** Sets the center of a group of points fromt the template of a registered image as a detection point. Sets the a template point group in a registered image as a detection point, the relationship between detection points and target becomes equal, with no relationship to pattern window settings. If template extraction conditions are favorable, this means that detection points are the same no matter where in the pattern window the target is registered.

Reference

Normally, the default offset of 0 is used, but it can be set outside of the detection point range. The range of detection points you can set is from -9600-9600(X) and -7200 - 7200 (Y).

Selecting the coordinates system for position adjustment

You can select the coordinate system using [Coordinate Value] on the [Tool Parameters] menu. If a position correction (Page 4-249) is not being done, this setting will have no effect on the output.

- **[After Position Adjust]** (Default): 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.
- **[Before Position Adjust]**: The distance from the position of the "Origin point" is measured.

Reference

These settings are reflected when the window measurement area position from the calculation is referenced.

Selecting handling for targets outside the search range

Set [Det. Outside SA] on the [Tool Parameters] menu. Set this when search targets outside the search range will cause errors.

- **OFF** (Default)**:** Allows the search to continue as much as possible even when search targets are found outside the search range.
- **ON:** Sets all output to 0 (search error) when a search target is found outside the search range

► Note

Protrusions of the pattern range outside of the search range cannot be detected.

Eliminating patterns based on correlation value

You can specify this item using [Min. Match%] on the [Tool Parameters] menu (Default: 60). 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.

The detected patterns can be sorted using the following methods:
You can select the blob sorting conditions using the [Detect. Order] on the [Tool Parameters] menu.
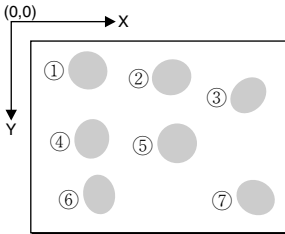
• **Y>X ascending order:**
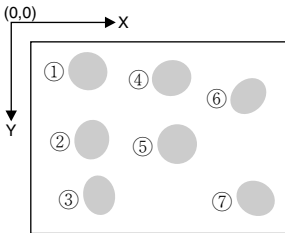
• **X>Y ascending order:**

• **X ascending order**
• **X descending order**
• **Y ascending order**
• **Y descending order**
• **Correlation value- descending** (Default)**:**
  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
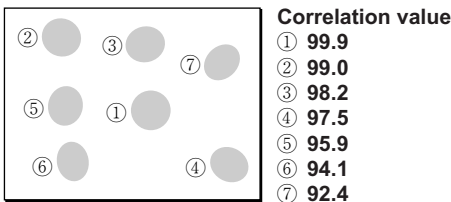
• **Correlation value ascending order**
• **Clockwise**: Reorders based on angle, clockwise from the start angle.
• **Counter CW**: Reorders based on angle, counter-clockwise from the start angle.

Specify the starting angle when setting pattern numbers by clockwise/counter-clockwise order.
You can specify the [Starting Angle] on the [Tool Parameters] menu.
Specify the starting angle and position when the [Detect. Order] setting is [Clockwise] or [Counter CW].

► **Note**

These cannot be specified if the [Detect. Order] is not [Clockwise] or [Counter CW].

Specifying the pattern to be evaluated
You can specify which pattern will use the set tolerances for judgment using the [Primary Target] on the [Tool Parameters] menu.
Up to 99 can be set, but [1] is the default value.

► **Note**

Only data for the pattern set here can be used for judgment (excluding number of pattern measurements).

Selecting a way to display returned outlines
Set [Outline View] on the [Tool Parameters] menu.
You can select template display pattern D1 or D2 for use during operation and when making settings.

• **None:** Outlines are not displayed
• **Template Edges (D1/D2):** Displays outlines and pattern ranges fitted to display points. Couples changes in target size to changes in outline display if size range (Page 4-70) is active.
• **Captured Edges (D1/D2):** Displays outlines from current image.
• **Template Edges (Without Pattern Region) (D1/D2):** (Default) **:** Displays outlines fitted to display points.
• **Template Edges (D1/D2) and Captured Edges (D3):** Displays outlines and pattern range fitted to display points. Press the SCREEN button on the console to switch to display pattern D3: contrast view(Page 5-6), which allows you to confirm the outline of the current image.

► **Note**

Defaults are set to use result data storage memory to display outlines. This means that a maximum of 10 ShapeTrax windows can be set for each Program No. Note also that [Template Edges (D1/D2) and Captured Edges (D3)] requires twice the memory of other settings and so only allows five windows per Program No. Other measurement window settings may further limit the number of ShapeTrax windows that can be set.

To increase the number of windows that can be set, select [None], which doesn't use memory. ShapeTrax settings are carried over as long as there is sufficient memory.

Setting a maximum processing time

Set [Timeout] on the [Tool Parameters] menu. Depending on the state of the captured image, when the processing time for a given window exceeds the limit set for it (from 0.5 to 60 seconds- Default: 5 seconds), the window will return a timeout error and all output will be set to 0.

► **Note**

Setting values are only rough targets. There is a small possibility of error until the actual timeout occurs.

Setting the Execute Conditions

Set the measurement window execution conditions. Measurement can be set to execute or not based on the results of judgment of the specified window (OK or NG). This is used for swapping contents or skipping inspection. See "What are Execute Conditions?" (Page 4-247) for details.

1 Select [Execute].

The [Window Execute Condition] menu appears.
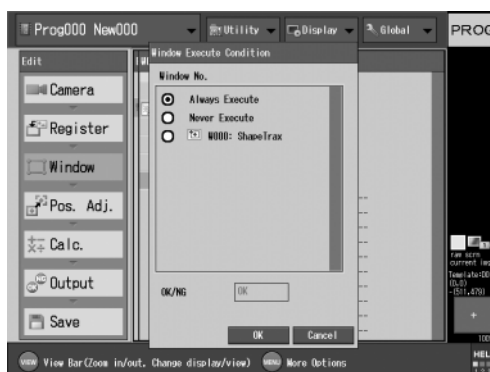
2 Select an appropriate item from those displayed.

- **Always Execute** (Default) **:** Always execute on trigger input.
- **Never Execute:** Do not execute even with trigger input (skip)
- **Window Number (Measurement, Calculation):** Skips or measures depending on the judgment results of the current window.

If measurement is skipped, measurement and judgment results for that window become 0 and are not reflected in the final results.

► **Note**
- If the reference window is set to itself, a circular reference error will result If this happens, all windows in the same Program No. will have their settings invalidated (set to Always Execute).
- If a circular reference error occurs, a "!" will appear before the window number and the execution conditions to indicate an error.

3 **If window number is selected, measurement can be skipped or carried out depending on the judgment results of the current window.**
- **OK:** Measures if the judgment result of the current window is OK.
- **NG:** Measures if the judgment result of the current window is NG.

Reference
If no tolerance is set for the selected window,

4 **After completing the settings, select [OK].**

Setting the Limit Settings

You can set the tolerance (upper and lower limits) for the measurement value as follows. If the measurement value meets or exceeds the specified tolerance, an [NG] message appears. If it is within the specified tolerance, an [OK] message appears.
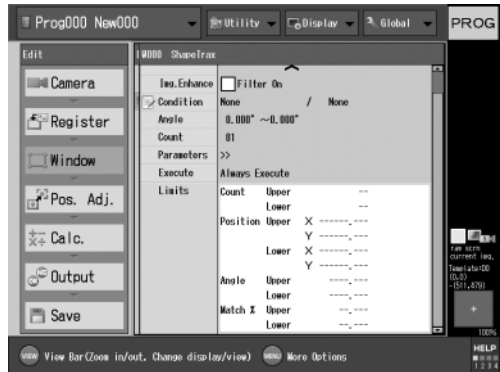
1 **Select [Limits].**
The [Enter Limits] menu appears.
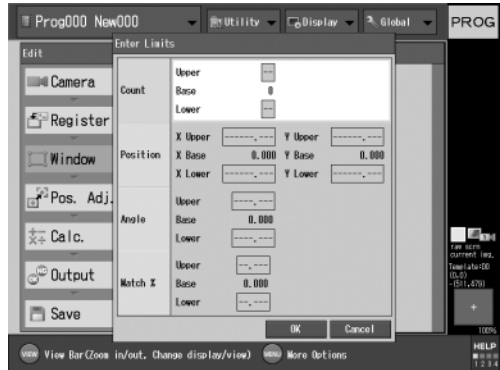
2 **Select an item to set tolerance for.**

3 **Select [Upper] or [Lower] and set the tolerance.**
The units of tolerance change depending on the type of measurement value.
- **Count(Number of detected patterns)** :
  Number of patterns
- **Position (Detected coordinates of the pattern)**: Pixels
- **Angle (Tilt angle of the pattern)**: Degrees

- **Match% (correlation value of patterns)**:Numerical value in the range of 0 to 99.999.

Reference

Tolerance can be entered by selecting [Direct Input] and specifying a tolerance or by selecting [Calc Ref] and using the results of a chosen calculation window.

4 **To specify the tolerance of another measurement value, repeat Steps 2 and 3.**

5 **After completing the settings, select [OK].**

Reference

- [-----] indicates that no tolerance has been set and no judgment will take place after measurement.
- Press [Clear] to clear the value.

Specifying the Windows for Inspection and Measurement

Edge position

What is the [Edge Position] Measurement Tool?

You can scan a target in the desired direction within a specified measurement area to detect the edge. The [Edge position] measurement tool 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 fluctuations.

Measurement image

Example: When the measurement area is a rectangle

- [Primary Target]: 1
- [Scan Dir.]: →
- [Edge Dir.]: Bright → Dark
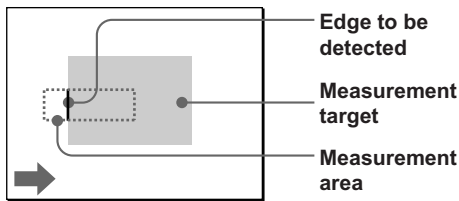
- [Primary Target]: 2
- [Scan Dir.]: →
- [Edge Dir.]: Bright → Dark
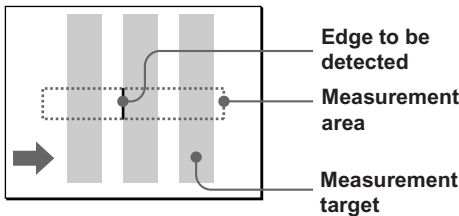
Example: When the measurement area is an arc

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

- [Primary Target]: 1
- [Scan Dir.]: (clockwise)
- [Edge Dir.]: Bright → Dark
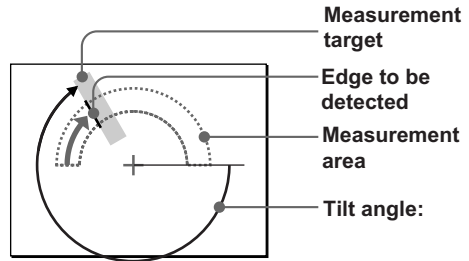
Example: When the measurement is a circle

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

- [Primary Target]: 1
- [Scan Dir.]: (counter-clockwise)
- [Edge Dir.]: Dark → Bright
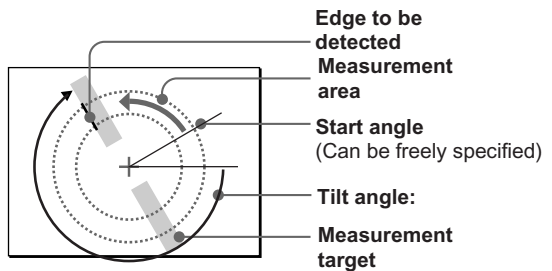
Measurement results

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

When the measurement area is not a circle or an arc

- **Number**: Outputs the number of detected edges. (Available in the limits menu)
- **Edge position coordinates (X,Y)[ ]**: The coordinates count of all detected edge positions are output (in pixels). (Available in the limits menu) (Labeled)
- **Distance [ ]**: Outputs the distance from the start of the measurement range to the edge position point in pixels. (Available through outputs)
- **Intensity[ ]**: Outputs the intensity value of all edges. (Available through outputs)
- **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.
- **Measurement Area Position**: Outputs the measurement window position in pixels (available as a reference after calculation)

When the measurement area is a circle or an arc

- **Number**: Outputs the number of detected edges. (Available in the limits menu)
- **Edge position coordinates (X,Y) [ ]**: Outputs the coordinates where the centerline of the region and the edge intersect. (Available through outputs)
- **Angle[ ]**: Outputs the angle of all edges. (Available in the limits menu) (Available through outputs)
- **Distance [ ]**: Outputs the angle from the start of the measurement range to the to the edge position. (Available through outputs)
- **Intensity [ ]**: Outputs the maximum edge intensity value of all edges returned in the search. (Available through outputs)
- **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.

- **Measurement Area Position**: Outputs the measurement window position in pixels (available as a reference after calculation). Note that polygon measurement area information is not output.

Measurement sample

When the measurement area is a rectangle
Example showing the results of a measurement performed under the following conditions:

- [Primary Target]: 2
- [Scan Dir.]: →
- [Edge Dir.]: Bright → Dark
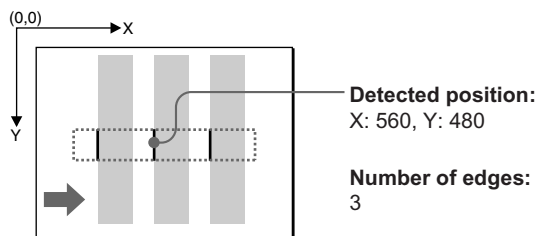
(0,0) X

Y

Detected position:
X: 560, Y: 480

Number of edges:
3

Example: When the measurement area is an arc
Example showing the results of a measurement performed under the following conditions:

- [Primary Target]: 1
- [Scan Dir.]: (clockwise)
- [Edge Dir.]: Bright → Dark

Number of edges:
1

Distance:
+60˚

Angle:
+240˚

Specifying the Windows for Inspection and Measurement

Selecting Measurement Tools

1 **Select [Add/Copy/Del] from the [Edit Window] menu.**

2 **Select [Add].**

The [Add Window] menu appears.

3 **Select [Window Number], then specify the measurement window number.**

Window numbers can be freely set at any value from 0 to 127 .

4 **Select [Measurement tool] and then select [Edge position].**
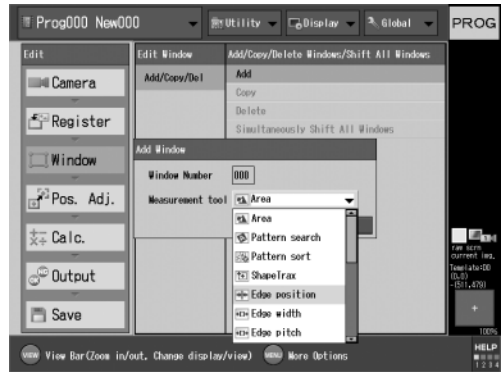
5 **Select [OK].**

The window with the specified number is added as an edge position measurement window. The current window setting list is then displayed.

The necessary settings for the edge position window are added next.

Selecting a Camera to Take Images

1 Select [Window] and then select an edge position measurement window.
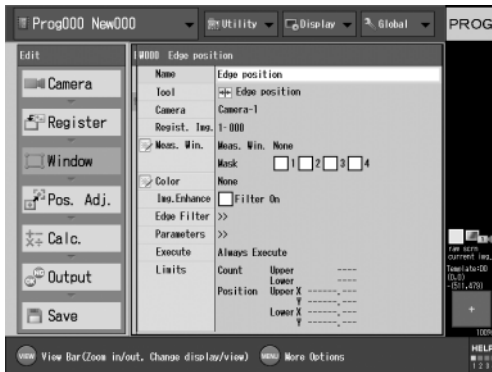
The window setting menu appears.

2 Select [Camera], then selecting a camera to take images

Reference

Unconnected cameras can be selected. However, if the selected camera is not connected at the time of imaging, an error will occur.

Specifying a Registered Image to Use

Specify a registered image to use for processing.
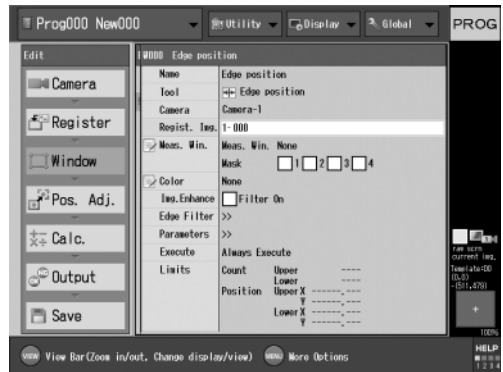
Reference

The image to be used must have been previously in the [Register Image] menu (Page 4-19).

Select [Regist. Img.], then specify the number of the registered image to be used.

The registered image number will be displayed as "Camera number-xxx."

Specifying a Measurement Window

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, see "Exclude an unwanted area (mask window)" located after "Setting the Measurement Area".

1 **Select [Meas. Win].**

The [Measurement window] menu appears.

2 **Select [Edit] in the [Measurement window] field.**

The [Select] menu appears.

3 **Select a shape, then select [OK].**

4 **Draw the measurement area.**

See "Drawing a Measurement Window" (Page 3-13) for details.

5 **After completing the drawing, select [Close] in the [Edit] field.**

Clearing the measurement area

The measurement area can be cleared by following the procedure below.

1 **Select [Delete] in the [Measurement window] field.**

A confirmation screen appears.

2 **Select [OK].**

Exclude an unwanted area (mask window)

You can set up to 4 areas (mask windows) that will not be measured inside the measurement area. This is useful when the measurement target has a complicated shape or when you want to hide an unnecessary part of the target.

Select [Add] in the [Mask window] field.

The [Add mask window] menu appears.
See Exclude Part of the Measurement Window (Mask Window) (Page 3-25) for details.

Extracting a Color

When using a color camera, color images can be converted to black and white through an extraction process.

► **Note**

This feature is not available when using a monochrome camera.

Select [Color].

The [Color] menu appears.

See Processing a Color Image [Color](Page 13-1) for details on color extraction.

Selecting an Image Enhancement

Specify an appropriate filter for the image. When using a color camera, the filter is applied to pixels of the extracted color.

1 Select [Img. Enhance].

The [Image Enhance] menu appears.

2 Select a filter to use, then select [OK].

See Filter List (Page 13-9) for details on the individual filters.

Reference

• More advanced filter settings can also be made by selecting [Detail].
• Up to 13 filters can be used. When multiple filters are set, they are executed starting from the filter specified in the top portion of the screen.

Specifying the Windows for Inspection and Measurement

Setting the Detection Conditions

Specify conditions for edge search, including search direction and edge direction

1 Select [Edge Filter].

The [Select Detection Conditions of Edges] menu appears.

The Edge graph results are displayed to the side of the measurement window on the display screen (but not when the window is a rotated rectangle).

2 Select [Display Image], and then specify an image to display on the [Select Detection Conditions of Edges] menu.

- **Regist. Img.**: Displays the image selected in [Specifying a registered image to use] (Page 4-79).
- **Current Img.**: Displays the current image from the camera selected in "Selecting a Camera to Take Images"(Page 4-79).

Reference

- Displays the intensity level selected in the [Select Detection Conditions of Edges] menu and the highest contrast if [Regist. Img.] is selected. Display graph must be on to show this when "Current Img." is selected.
- See "What is an Edge ?" (Page 13-15) for details on graphs.

3 Select [Scan Dir.] and then select the direction the edges will be detected in.

- **When the measurement area is a rectangle, circle, ellipse or polygon**: →, ←, ↑, ↓
- **If the measurement window is a rotated rectangle**:

  Forward: Scans in the direction of the arrow in the measurement window.

  Reverse: Scans in the opposite direction of the arrow in the measurement window.

- **When the measurement area is a circle or an arc**: (Clockwise), (Counter-clockwise)

4 Select [Edge Dir.] and then select the contrast change that will signify an edge.

- **[Lght to Drk]**: Detects an edge that changes from a bright area to a dark area.
- **[Drk to Lght]**: Detects an edge that changes from a dark area to a bright area.
- **Both** (Default): Detects edges that change from a bright area to a dark area, or from a dark area to a bright area.

5 If the measurement window is a circle, select [Start Angle], then specify a position to start the edge scan.

The range of values you can specify is from 0 to 359.999°.

Reference

Even if the start angle is changed, the detection angle is fixed at the 3 o'clock position.

6 **If necessary, adjust the settings in the [Edge Strength] field.**

The items in the [Strength Strength] field allow you to set the conditions that indicate what will be considered an edge inside the measurement window.

- **Edge Sensitivity (%)**:Specifies the relative threshold value for recognizing edges (0 to 100) (Default: 30).
- **Edge Filter Width**: Specifies the width of the smoothing filter applied to the derivative wave to detect edges (0 to 100) (Default: 5).
- **Upper Edge Intensity (%)**:Specifies the upper limit for the absolute intensity of edges (0.000 to 255.000) (Default: 255.000).
- **Lower Edge Intensity (%)**:Specifies the upper limit for the absolute intensity of edges (0.000 to 255.000) (Default: 5.000).

Reference

Adjusting the highest and lowest edge intensities, which are shown to the left of the graph, based on the highest intensity in the segment currently being displayed allows noisy edges to be excluded. See "What is an Edge ?" (Page 13-15) for details.

7 **If necessary, adjust the settings in the [Counting Options] field.**

- **Primary Target**: Specifies the number of the edge to be judged. Maximum: 3600 (Default: 1). Edge numbers are assigned in order based on search direction (If the primary target is not found, the result for the primary target is 0).
- **Count**: Specifies the maximum number of the edge to be returned. Maximum: 3600 (Default: 1).
- **Angled Edge Det.**: Set this to [ON] to stabilize angled edge detection (Default: OFF). This feature may impact measurement accuracy if left on regularly.

▶ Note

The maximum number of edges that can actually be detected changes depending on the settings.

8 **After completing the settings, select [OK].**

Setting Other Detection Conditions

Use other edge position detection conditions as necessary.

1 **Select [Parameters].**

Select [Tool Parameters]. The [Tool Parameters] menu appears.

2 **Make the necessary settings.**

After completing the settings, select [OK].

You can change the reference position of the origin using [Origin] in the [Tool Parameters] menu.

Specify the reference position of the origin in [Origin] in the [Tool Parameters] menu.

Make the necessary settings in the [Origin] menu.

- **specified point** (Default): The origin point is set at the top left of the screen by default. 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 [Pos. X] and [Pos. Y] fields.
- **registered point**: Uses the detected primary target position in the registered image as an origin. The present origin point is displayed in the [Pos. X] and [Pos. Y] fields.

| Reference |

- To measure the amount of error (deviation) from the reference position where the image is registered, select [Registered position].
- If [specified point] has been selected, the origin point can be set outside the process area. The available range for the origin is from -9600 to 9600 (X), -7200 to 7200 (Y).

Selecting the coordinate system for position adjustment

You can select the coordinate system using [Coordinate Value] in the [Tool Parameters] menu. If a position correction (Page 4-249) is not being done, this setting will have no effect on the output.

- **[After Position Adjustment]** (Default): If the position of the window used as the source of correction has shifted, the amount of this error is reflected on the measurement.
- **[Before Position Adjustment]**: The distance from the position of the "Origin point" is measured.

| Reference |

These settings are reflected when the measurement window area position from the calculation is referenced.

Displaying edge graph (differential wave) with the measurement window

You can specify this using [Display Graph] on the [Tool Parameters] menu. If [Display Graph] is set to [ON], edge search conditions can be set from the current image and the edge graph displays in the [Select Detection Conditions of Edges] menu.

- **ON**: Displays the edge graph with the measurement window (Note that measurement time will increase).
- **OFF** (Default): Hides the edge graph.

Selecting an out-of-range measurement area

Select [Out of image] in the [Tool Parameters] menu. Specify whether to incorporate data that falls outside of the measurement area.This may occur when position adjustment is used.

- **Normal** (Default)**:** Excludes areas outside of the measurement area. Depending on settings, having areas outside the measurement area may increase the measurement time.
- **Fast:** Simplifies and this speeds exclusion processing, reducing the time effects of having data outside the read area. However, measurement results may change depending on the state of the current image.

Setting the Execute Conditions

The measurement window can be set to execute or not, based on the results of an OK or NG judgment of a specified window. This can be useful for instances where inspections need to be skipped. See "What are Execute Conditions?" (Page 4-247) for details.

1 Select [Execute].

The [Window Execute Condition] menu appears.

2 Select an appropriate condition.

- **Always Execute** (Default) **:** Always execute on trigger input.
- **Never Execute:** Do not execute even with trigger input (skip).
- **Window Number (Measurement, Calculation):** Skips or measures depending on the judgment results of the selected window.

Reference

If measurement is skipped, measurement and judgment results for that window become 0 and are not reflected in the final results.

► Note

- If the reference window is set to itself, a circular reference error will result. If this happens, all windows in the same Program No. will have their settings invalidated (set to Always Execute).
- If a circular reference error occurs, a "!" will appear before the window number and the execution conditions to indicate an error.

3 If window number is selected, measurement can be skipped or carried out depending on the judgment results of the specified window.

- **OK:** Executes if the judgment result of the specified window is OK.
- **NG:** Executes if the judgment result of the specified window is NG.

Reference

If no tolerance is set for the selected window, the judgment result is always OK.

4 After completing the settings, select [OK]

Setting the Limits Settings

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

1 **Select [Limits].**

The [Enter Limits] menu appears.

2 **Select an item to set limits for.**

3 **Select [Upper] or [Lower] and set the tolerance.**

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

- **Count**: Number of edges
- **Position (Edge Measurement Value)**:
  Number of pixels (not including circles or arcs)
- **Angle (Tilt angle)**: Degrees (For circles and arcs only)

> **Reference**
> Tolerance can be entered by selecting [Direct Input] and specifying a tolerance or by selecting [Calc Ref] and using the results of a chosen calculation window.

4 **To specify the tolerance of another measurement value, repeat Steps 2 and 3.**

5 **After completing the settings, select [OK].**

> **Reference**
> - [-----] indicates that no tolerance has been set and no judgment will take place after measurement.
> - Press [Clear] to clear the value.

Edge Width

What is the [Edge width] Measurement Tool?

You can scan a target in the desired direction within the specified measurement area to detect multiple edges. The [Edge width] 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 fluctuations.

Measurement image

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

• When [Outer Gap] is the selected mode
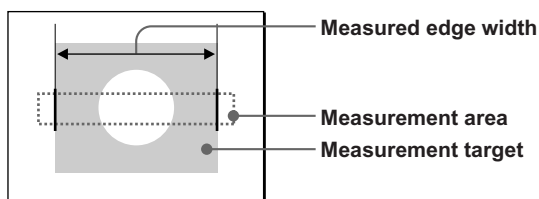
• When [Inner gap] is the selected mode
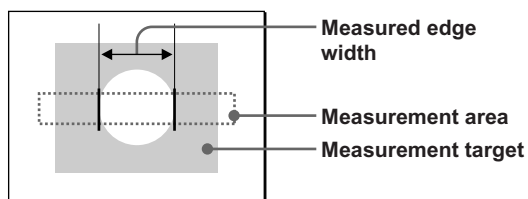
• When [Specified Edges] (example: 2→3) is the selected mode
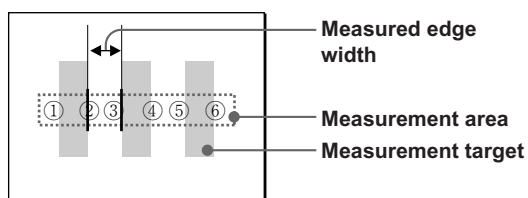
When the measurement area is a circle or an arc

• When [Outer Gap] is the selected mode
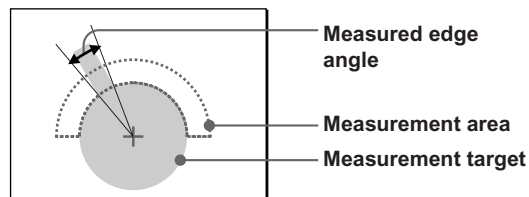
• When [Inner Gap] is the selected mode
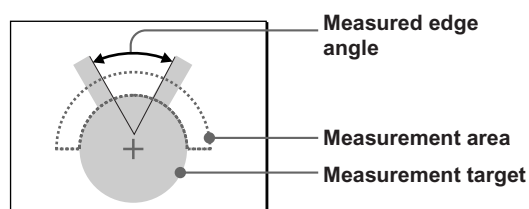
• When [Specified Edges] (example: 4→5) is the selected mode

Specifying the Windows for Inspection and Measurement
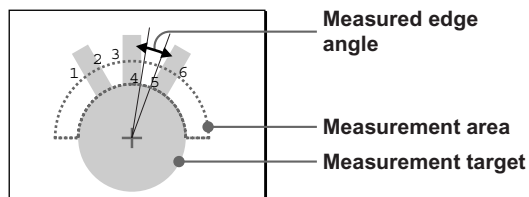
Measurement results

The measurement results that can be output in the [Edge width] tool are shown below.

When the measurement area is not a circle or an arc

- **Edge Width**: Outputs the edge width in pixels. (Available in the Limits menu)
- **Number**: Outputs the number of detected pairs (1 or 0).
- **Edge Position 1 (X,Y)**: Outputs the coordinates of the side nearest the measurement start point of one edge in a pair.
- **Distance 1**: Outputs the distance from the start of the measurement range to the start of edge position 1 point in pixels.
- **Intensity 1**: Outputs the intensity of edge position 1.
- **Edge Position 2 (X,Y)**: Outputs the coordinates of the side farthest from the measurement start point of one edge in a pair.
- **Distance 2**: Outputs the distance from the start of the measurement range to the start of edge position 2 point in pixels.
- **Intensity 2**: Outputs the intensity of edge position 2.
- **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.
- **Measurement Area Position**: Outputs the measurement window position in pixels (available as a reference after calculation) Note that polygon measurement area information is not output.

When the measurement area is a circle or an arc

- **Edge Width**: Outputs the edge pitch in degrees. (Subject to tolerance test)
- **Number**: Outputs the number of detected pairs (1 or 0).
- **Edge Position 1 (X,Y)**: Outputs the coordinates of the intersection of the side nearest the measurement start point of one edge in a pair and the center line.
- **Angle 1**: Outputs the angle of edge position 1.
- **Distance 1**: Outputs the distance from the start of the measurement range to the start of edge position 1 point in degrees.
- **Intensity 1**: Outputs the intensity of edge position 1.
- **Edge Position 2 (X,Y)**: Outputs the coordinates of the intersection of the side farthest from the measurement start point of one edge in a pair and the center line.
- **Angle2**: Outputs the angle of edge position 2.
- **Distance 2**: Outputs the distance from the start of the measurement range to the start of edge position 2 point in degrees.
- **Intensity 2**: Outputs the intensity of edge position 2.
- **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.
- **Measurement Area Position**: Outputs the measurement window position in pixels (available as a reference after calculation) Note that polygon measurement area information is not output.

Measurement sample

When the measurement area is a rectangle

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

- [Scan Dir.]: →
- [Edge Dir.]: Both
- [Specified Edge 1]: 2
- [Specified Edge 2]: 3
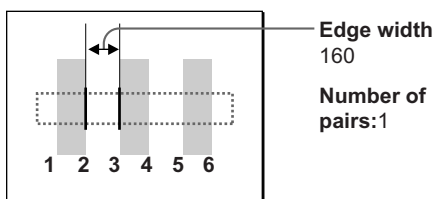
Edge width 160

Number of pairs: 1

Example: When the measurement area is an arc

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

- [Scan Dir.]: (clockwise)
- [Edge Dir.]: Both
- [Specified Edge 1]: 2
- [Specified Edge 2]: 3
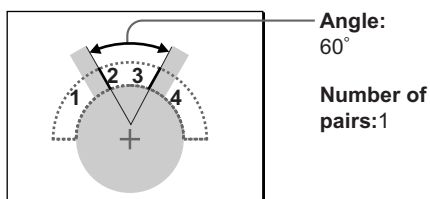
Angle: 60°

Number of pairs: 1

Selecting Measurement Tools

1 **Select [Add/Copy/Del] from the [Edit Window] menu.**
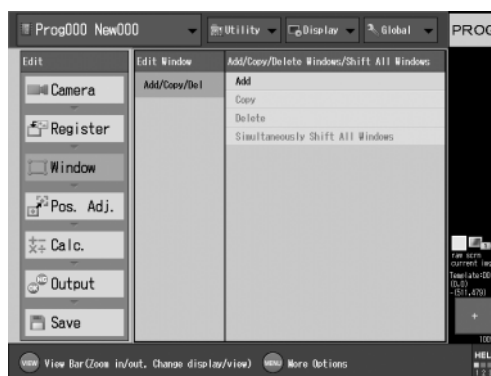
2 **Select [Add].**

The [Add Window] menu appears.

3 **Select [Window Number], then specify the measurement window number.**
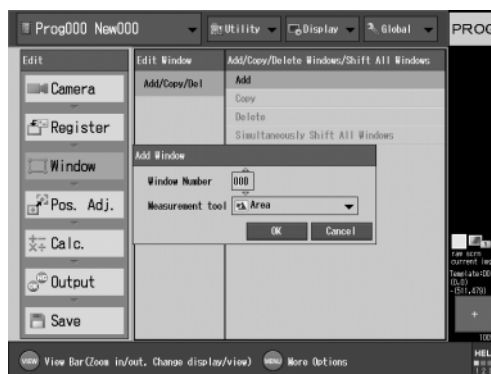
Window numbers can be freely set at any value from 0 to 127 .

4 **Select [Measurement tool] and then select [Edge width].**
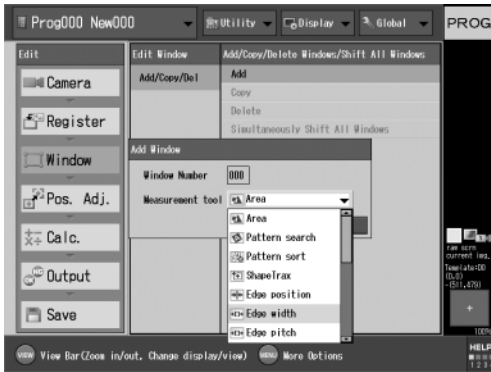
5 **Select [OK].**

A window with the specified number is added as an edge width measurement window. The current window setting list is then displayed.

The necessary settings for the edge width measurement window are added next.

Selecting a Camera to Take Images

1 **Select [Window] and then select an edge width measurement window.**

The window setting menu appears.

2 **Select [Camera], then selecting a camera to take images**

Reference

Unconnected cameras can be selected. However, if the selected camera is not connected at the time of imaging, an error will occur.

Specifying a Registered Image to Use

Specify a registered image to use for processing.

The image to be used must have been previously saved in the [Register Image] menu (Page 4-19).

Select [Regist. Img.], then specify the number of the registered image to be used.

The registered image number will be displayed as "Camera number-xxx."

Specifying a Measurement Window

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, see "Exclude an unwanted area (mask window)" located after "Setting the Measurement Area".

1 Select [Meas. Win].

The [Measurement window] menu appears.

2 Select [Edit] in the [Measurement window] field.

The [Select] menu appears.

3 **Select a shape, then select [OK].**

4 **Draw the measurement area.**

See "Drawing a Measurement Window" (Page 3-13) for details.

5 **After completing the drawing, select [Close] in the [Edit] field.**

Clearing the measurement area

The measurement area can be cleared by following the procedure below.

1 **Select [Delete] in the [Measurement window] field.**

A confirmation screen appears.

2 **Select [OK].**

Exclude an unwanted area (mask window)

You can set up to 4 areas (mask windows) that will not be measured inside the measurement area. This is useful when the measurement target has a complicated shape or when you want to hide an unnecessary part of the traget.

> **Select [Add] in the [Mask window] field.**
>
> The [Add mask window] menu appears.
> See Exclude Part of the Measurement Window (Mask Window) (Page 3-25) for details.

Extracting a Color

When using a color camera, color images can be converted to black and white through an extraction process.

► Note

This feature is not available when using a monochrome camera.

Select [Color].

The [Color] menu appears.

See Processing a Color Image [Color](Page 13-1) for details on color extraction.

Selecting an Image Enhancement

Specify an appropriate filter for the image.
When using a color camera, the filter is applied to pixels of the extracted color.

1 Select [Img. Enhance].

The [Img. Enhance] menu appears.
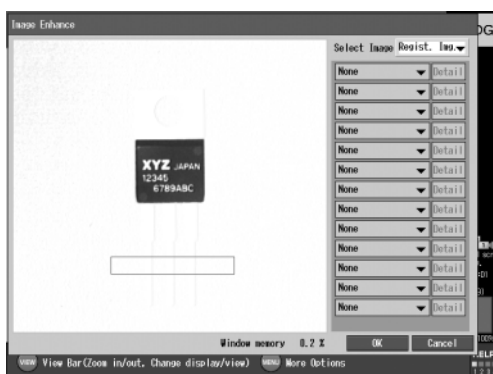
2 Select a filter to use, then select [OK].

See Filter List(Page 13-9) for details on the individual filters.

Reference

- More advanced filter settings can also be made by selecting [Detail].
- Up to 13 filters can be used. When multiple filters are set, they are executed starting from the filter specified in the top portion of the screen.

Selecting the Type of Edge Width to Measure

Select [Measure] and then select the type of edge width to measure.
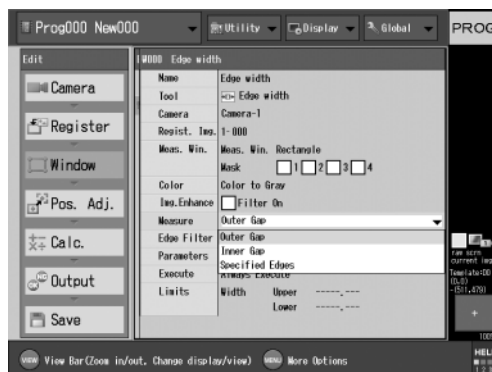
- **Outer Gap** (Default): Measures the distance between the outermost edges within the window.
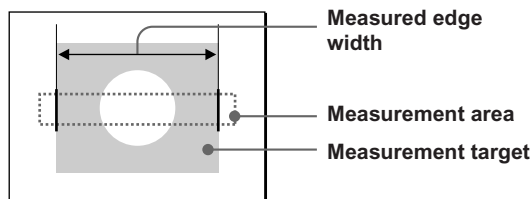
- **Inner Gap**: Measures the distance between the innermost edges within the window.

- **Specified Edges**: Measure the gap between the specified edges.

Setting the Detection Conditions

Specify conditions for edge search, including search direction and edge direction

1 Select [Edge Filter].

The [Select Detection Conditions of Edges] menu appears.

The Edge graph results are displayed to the side of the measurement window on the display screen (but not when the window is a rotated rectangle).

2 Select [Display Image], and then specify an image to display on the [Select Detection Conditions of Edges] menu.

- **Regist. Img.**: Displays the image selected in [Specifying a registered image to use] (Page 4-79).
- **Current Img.**: Displays the current image from the camera selected in "Selecting a Camera to Take Images"(Page 4-79).

Reference

- Displays the intensity level selected in the [Select Detection Conditions of Edges] menu and the highest contrast if [Regist. Img.] is selected. Display graph must be on to show this when "Current Img." is selected.
- See "What is an Edge ?" (Page 13-15) for details on graphs.

3 Select [Scan Dir.] and then select the direction the edges will be detected in.

- **When the measurement area is a rectangle, circle, ellipse or polygon**: →, ←, ↑, ↓
- **If the measurement window is a rotated rectangle**:
  Forward: Scans in the direction of the arrow in the measurement window.
  Reverse: Scans in the opposite direction of the arrow in the measurement window.
- **When the measurement area is a circle or an arc**: (Clockwise), (Counter-clockwise)

4 Select [Edge Dir.] and then select the contrast change that will signify an edge.

- **[Lght to Drk]**: Detects an edge that changes from a bright area to a dark area.
- **[Drk to Lght]**: Detects an edge that changes from a dark area to a bright area.
- **Both** (Default): Detects edges that change from a bright area to a dark area, or from a dark area to a bright area.

5 If the measurement window is a circle, select [Start Angle], then specify a position to start the edge scan.

The range of values you can specify is from 0 to 359.999°.

Reference

Even if the start angle is changed, the detection angle is fixed at the 3 o'clock position.

6 **If [Specified Edge] is selected under [Measurement tool] (Page 4-93) select [Specified Edge 1], then specify the start point of the edge width to measure.**

Next, select [Specify Edge 2], then specify the end point of the edge width to measure.

> **Reference**
>
> When a negative value is specified in [Specified Edge 2], you can specify the number in the reverse direction starting from the last edge or reference angle. This technique is convenient when the number of edges is variable.
>
> Example: If "-2" is specified in [Specified Edge 2] when the detection direction is "→", the second edge from the right is specified as the end point. In this case, even if there is an extra edge in this space, the specified edges do not change.

Normal

Scan direction
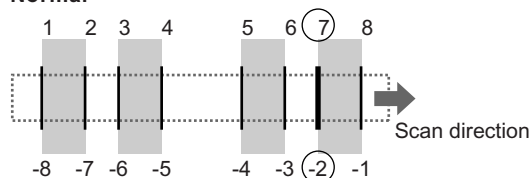
When an extra edge is generated

Scan direction
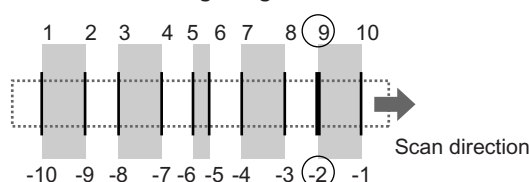
When the specified edge 2 is set to "7", there is an influence from noise-like edges, but when set to "-2", there is no influence.

7 **If necessary, adjust the settings in the [Edge Strength] field.**

The items in the [Edge Strength] field allow you to set the conditions that indicate what will be considered an edge inside the measurement window.

- **Edge Sensitivity (%)**:Specifies the relative threshold value for recognizing edges (0 to 100) (Default: 30).
- **Edge Filter Width**: Specifies the width of the smoothing filter applied to the derivative wave to detect edges (0 to 100) (Default: 5).

- **Upper Edge Intensity (%)**:Specifies the upper limit for the absolute intensity of edges (0.000 to 255.000) (Default: 255.000).
- **Lower Edge Intensity (%)**:Specifies the upper limit for the absolute intensity of edges (0.000 to 255.000) (Default: 5.000).

> **Reference**
>
> Adjusting the highest and lowest edge intensities, which are shown to the left of the graph, based on the highest intensity in the segment currently being displayed allows noisy edges to be excluded. See "What is an Edge ?" (Page 13-15) for details.

8 **If necessary, adjust the settings in the [Counting Options] field.**

- **Angled Edge Det.**: Set this to [ON] to stabilize angled edge detection (Default: OFF). This feature may impact measurement accuracy if left on regularly.

9 **After completing the settings, select [OK].**

Specifying the Windows for Inspection and Measurement

Setting Other Detection Conditions

Use other edge width measurement conditions as necessary.

1 Select [Parameters].

Select [Tool Parameters]. The [Tool Parameters] menu appears.

2 Make the necessary settings.

After completing the settings, select [OK].

You can change the reference position of the origin using [Origin] in the [Tool Parameters] menu.
Specify the reference position of the origin in [Origin] in the [Tool Parameters] menu.
Make the necessary settings in the [Origin] menu.

- **specified point** (Default): The origin point is set at the top left of the screen by default. 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 [Pos. X] and [Pos. Y] fields.

Reference

If [specified point] has been selected, the origin point can be set outside the process area. The range of points you can set is from -9600 to 9600 (X) and -7200 to 7200 (Y).

Selecting the coordinate system for position adjustment
You can select the coordinate system using [Coordinate Value] in the [Tool Parameters] menu.
If a position correction (Page 4-249) is not being done, this setting will have no effect on the output.

- **[After Position Adjustment]** (Default): If the position of the window used as the source of correction has shifted, the amount of this error is reflected on the measurement.
- **[Before Position Adjustment]**: The distance from the position of the "Origin point" is measured.

Reference

These settings are reflected when the measurement window area position from the calculation is referenced.

Displaying edge graph (differential wave) with the measurement window
You can specify this using [Display Graph] on the [Tool Parameters] menu. If [Display Graph] is set to [ON], edge search conditions can be set from the current image and the edge graph displays in the [Select Detection Conditions of Edges] menu.

- **ON**: Displays the edge graph with the measurement window (Note that measurement time will increase).
- **OFF** (Default): Hides the edge graph.

Selecting an out-of-range measurement area

Select [Out of image] in the [Tool Parameters] menu.

Specify whether to incorporate data that falls outside of the measurement area. This may occur when position adjustment is used.

- **Normal** (Default)**:** Excludes areas outside of the measurement area. Depending on settings, having areas outside the measurement area may increase the measurement time.
- **Fast:** Simplifies and this speeds exclusion processing, reducing the time effects of having data outside the read area. However, measurement results may change depending on the state of the current image.

Setting the Execute Conditions

The measurement window can be set to execute or not, based on the results of an OK or NG judgment of a specified window. This can be useful for instances where inspections need to be skipped. See "What are Execute Conditions?" (Page 4-247) for details.

1 Select [Execute].

The [Window Execute Condition] menu appears.

2 Select an appropriate condition.

- **Always Execute** (Default) **:** Always execute on trigger input.
- **Never Execute:** Do not execute even with trigger input (skip).
- **Window Number (Measurement, Calculation):** Skips or measures depending on the judgment results of the selected window.

Specifying the Windows for Inspection and Measurement

If measurement is skipped, measurement and judgment results for that window become 0 and are not reflected in the final results.

► Note

- If the reference window is set to itself, a circular reference error will result. If this happens, all windows in the same Program No. will have their settings invalidated (set to Always Execute).
- If a circular reference error occurs, a "!" will appear before the window number and the execution conditions to indicate an error.

3 **If window number is selected, measurement can be skipped or carried out depending on the judgment results of the specified window.**

- • **OK:** Executes if the judgment result of the specified window is OK.
- • **NG:** Executes if the judgment result of the specified window is NG.

■ Reference┐

If no tolerance is set for the selected window, the judgment result is always OK.

4 **After completing the settings, select [OK].**

Setting the Limits Settings

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

1 **Select [Limits].**

The [Enter Limits] menu appears.

2 **Select an item to set limits for.**

3 **Select [Upper] or [Lower] and set the tolerance.**

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

- **Width (Edge Width)**: Number of pixels (not including circles or arcs)
- **Angle Width (Edge Width)**: Degrees (For circles and arcs only)

Reference

Tolerance can be entered by selecting [Direct Input] and specifying a tolerance or by selecting [Calc Ref] and using the results of a chosen calculation window.

4 **To specify the tolerance of another measurement value, repeat Steps 2 and 3.**

5 **After completing the settings, select [OK].**

Reference

- [-----] indicates that no tolerance has been set and no judgment will take place after measurement.
- Press [Clear] to clear the value.

Specifying the Windows for Inspection and Measurement

Edge Pitch

What is the [Edge Pitch] Measurement Tool?

You can scan a target in the desired direction within a specified measurement area to detect the edge. The [Edge pitch] measurement tool 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 fluctuations.

Measurement image

When the measurement area is a rectangle

• Example of measuring the gap pitch

Gap pitch
Detected edge
Measurement area
Measurement target

• Example of measuring the center pitch

Center pitch
Detected edge
Measurement area
Measurement target

When the measurement area is a circle or an arc

• Example of measuring the gap pitch

Gap pitch
Detected edge
Measurement area
Measurement target

• Example of measuring the center pitch

Center pitch
Detected edge
Measurement area
Measurement target
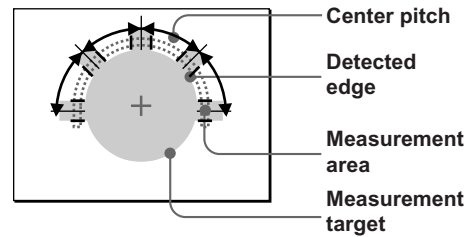
Measurement results

The measurement results that can be output in the Edge pitch measurement mode are shown below.

When the measurement area is not a circle or an arc

- **Number**: Outputs the number of detected pitches. (Available in the limits menu)
- **Maximum Edge Pitch**: Outputs the edge pitch in pixels. (Available in the limits menu)
- **Minimum Edge Pitch**: Outputs the edge pitch in pixels. (Available in the limits menu)
- **Average Edge Pitch**: Outputs the edge pitch in pixels.
- **Pitch [ ]**: Outputs the pitch of each edge in pixels. (Available through outputs)
- **Edge Position 1 (X,Y)[ ]**: Outputs the coordinates of the side nearest the measurement start point of each edge in a pitch. (Available through outputs)
- **Distance 1 [ ]**: Outputs the distance from the start of the measurement range to the start of each edge position 1 point in pixels. (Available through outputs)
- **Intensity 1 [ ]**: Outputs all intensities of edge position 1. (Available through outputs)
- **Edge Position 2 (X,Y)[ ]**: Outputs the coordinates of the side farthest from the measurement start point of each edge in a pitch. (Available through outputs)
- **Distance 2 [ ]**: Outputs the distance from the start of the measurement range to the start of each edge position 2 point in pixels. (Available through outputs)
- **Intensity 2 [ ]**: Outputs all intensities of edge position 2. (Available through outputs)
- **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.

> **Reference**
> For edge pitch, the maximum edge pitch is used as the upper limit and the minimum edge pitch is used as the lower limit.

- **Measurement Area Position**: Outputs the measurement window position in pixels (available as a reference after calculation) Note that polygon measurement area information is not output.

When the measurement area is a circle or an arc

- **Number**: Outputs the number of detected pitches. (Available in the limits menu)
- **Maximum Edge Pitch**: Outputs the edge pitch in degrees. (Available in the limits menu)
- **Minimum Edge Pitch**: Outputs the edge pitch in degrees. (Available in the limits menu)
- **Average Edge Pitch**: Outputs the edge pitch in degrees.
- **Pitch [ ]**: Outputs the pitch of each edge in degrees. (Available through outputs)
- **Edge Position 1 (X,Y) [ ]**: Outputs the all of the coordinates of the intersection of the side nearest the measurement start point of the edges in a pitch and the center line. (Available through outputs)
- **Angle 1 [ ]** : Outputs each angle of edge position 1. (Available through outputs)
- **Distance 1 [ ]**: Outputs the distance from the start of the measurement range to the start of each edge position 1 point in degrees. (Available through outputs)
- **Intensity 1 [ ]**: Outputs all intensities of edge position 1. (Available through outputs)
- **Edge Position 2 (X,Y) [ ]**: Outputs the all of the coordinates of the intersection of the side farthest from the measurement start point of the edges in a pitch and the center line. (Available through outputs)
- **Angle 2 [ ]** : Outputs each angle of edge position 2. (Available through outputs)
- **Distance 2 [ ]**: Outputs the distance from the start of the measurement range to the start of each edge position 2 point in degrees. (Available through outputs)
- **Intensity 2 [ ]**: Outputs all intensities of edge position 2. (Available through outputs)
- **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.

> **Reference**
> For edge pitch, the maximum edge pitch is used as the upper limit and the minimum edge pitch is used as the lower limit.

- **Measurement Area Position**: Outputs the measurement window position in pixels (available as a reference after calculation) Note that polygon measurement area information is not output.

Specifying the Windows for Inspection and Measurement

Measurement sample

When the measurement area is a rectangle or
[Auto-Adjust Rectangle]
Example showing the results of a measurement
performed under the following conditions:

- Detection of pitch: Gap pitch
- [Detect dir]: →
- [Edge dir.]: Both
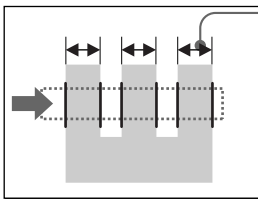
Pitch width
Maximum value:200
Minimum value:180
Average value:190

Number of pitches
:3

When the measurement area is a circle or an arc

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

- Detection of pitch: Center pitch
- [Detect dir]: (counter-clockwise)
- [Edge dir.]: Both
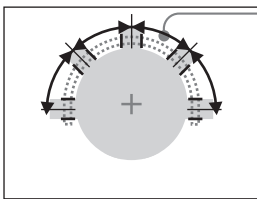
Pitch width angle
Maximum value:47˚
Minimum value:44˚
Average value:45˚

Number of pitches
:4

Selecting Measurement Tools

1 **Select [Add/Copy/Del] from the [Edit Window] menu.**

2 **Select [Add].**

The [Add window] menu appears.

3 **Select [Window Number], then specify the measurement window number**
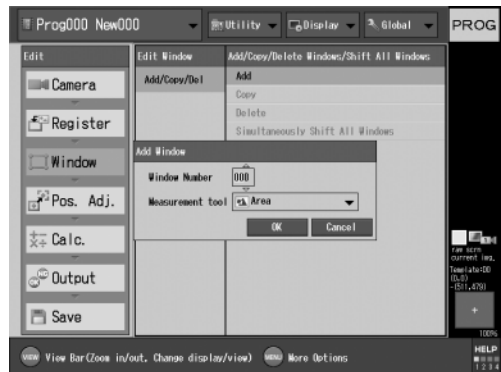
Window numbers can be freely set at any value from
0 to 127 .

4 Select [Measurement tool] and then select [Edge pitch].
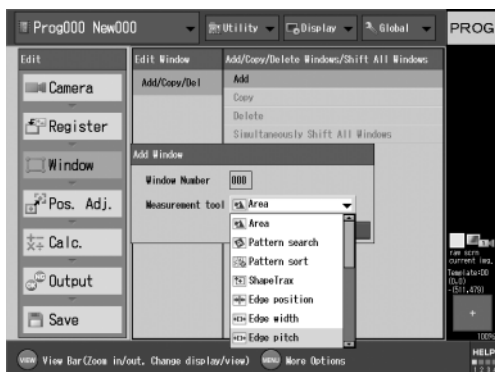
5 Select [OK].

A window with the specified number is added as an edge pitch measurement window. The current window setting list is then displayed.

The necessary settings for the edge pitch window are added next.

Selecting a Camera to Take Images

1 Select [Window] and then select an edge pitch window.

The window setting menu appears.
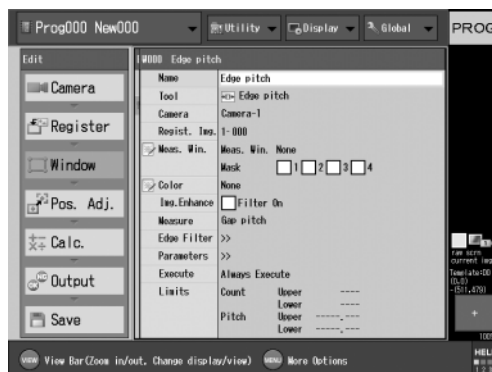
2 Select [Camera], then selecting a camera to take images

Reference

Unconnected cameras can be selected. However, if the selected camera is not connected at the time of imaging, an error will occur.

Specifying a Registered Image to Use

Specify a registered image to use for processing.
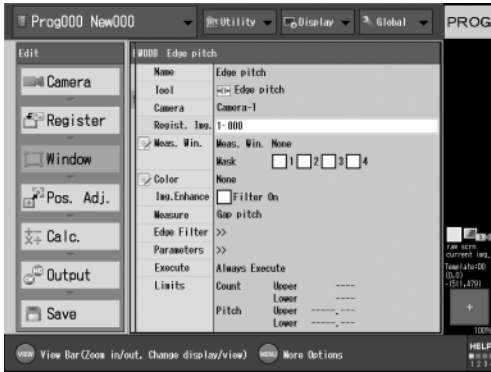
The image to be used must have been previously saved [Register Image] menu (Page 4-19).

Select [Regist. Img.], then specify the number of the registered image to be used.

The registered image number will be displayed as "Camera number-xxx."

Specifying a Measurement Window

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

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, see "Exclude an unwanted area (mask window)" located after "Setting the Measurement Area".

1 **Select [Meas. Win].**

The [Measurement window] menu appears.

2 **Select [Edit] in the [Measurement window] field.**

The [Select] menu appears.

3 Select a shape, then select [OK].

4 Draw the measurement area.

See "Drawing a Measurement Window" (Page 3-13)
for details.

5 After completing the drawing, select [Close] in the [Edit] field.

Clearing the measurement area

The measurement area can be cleared by following
the procedure below.

1 Select [Delete] in the [Measurement window] field.
A confirmation screen appears.

2 Select [OK].

Exclude an unwanted area (mask window)

You can set up to 4 areas (mask windows) that will
not be measured inside the measurement area.
This is useful when the measurement target has a
complicated shape or when you want to hide an
unnecessary part of the target.

Select [Add] in the [Mask window] field.

The [Add mask window] menu appears.
See Exclude Part of the Measurement Window
(Mask Window)(Page 3-25) for details.

Extracting a Color

When using a color camera, color images can be
converted to black and white through an extraction
process.

► Note

This feature is not available when using a monochrome
camera.

Select [Color].

The [Color] menu appears.

See Processing a Color Image [Color](Page 13-1) for
details on color extraction.

Selecting an Image Enhancement

Specify an appropriate filter for the image.
When using a color camera, the filter is applied to pixels of the extracted color.

1 Select [Img. Enhance].

The [Image Enhance] menu appears.

2 Select a filter to use, then select [OK].

See Filter List (Page 13-9) for details on the individual filters.

Reference
- More advanced filter settings can also be made by selecting [Detail].
- Up to 13 filters can be used. When multiple filters are set, they are executed starting from the filter specified in the top portion of the screen.

Selecting the Type of Edge Pitch to Measure
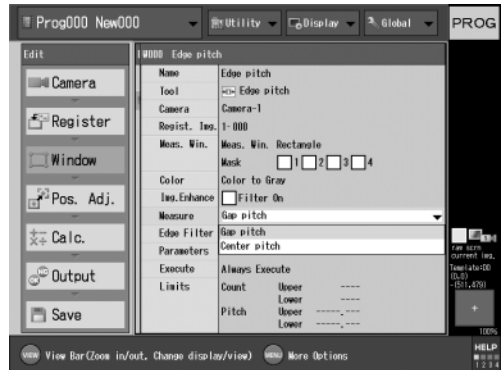
Select [Measure] and then select the type of edge pitch to be used for detection.

- **Gap pitch** (Default): Searches in the specified detection direction and outputs the maximum, minimum and average distances between odd edges and even edges.
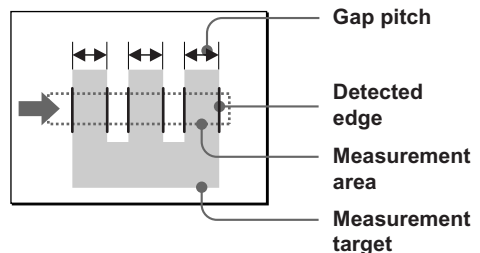
- **Center pitch**: Measures the maximum, minimum, and average distance between the center points of an odd to even pair of edges.

Setting the Detection Conditions

Specify conditions for edge search, including search direction and edge direction

1 Select [Edge Filter].

The [Select Detection Conditions of Edges] menu appears.

The Edge graph results are displayed to the side of the measurement window on the display screen (but not when the window is a rotated rectangle).

2 Select [Display Image], and then specify an image to display on the [Select Detection Conditions of Edges] menu.

- **Regist. Img.**: Displays the image selected in [Specifying a registered image to use] (Page 4-79).
- **Current Img.**: Displays the current image from the camera selected in "Selecting a Camera to Take Images"(Page 4-79).

- Displays the intensity level selected in the [Select Detection Conditions of Edges] menu and the highest contrast if [Regist. Img.] is selected. Display graph must be on to show this when "Current Img." is selected.
- See "What is an Edge ?" (Page 13-15) for details on graphs.

3 Select [Scan Dir.] and then select the direction the edges will be detected in.

- **When the measurement area is a rectangle, circle, ellipse or polygon**: →, ←, ↑, ↓
- **If the measurement window is a rotated rectangle**:
  Forward: Scans in the direction of the arrow in the measurement window.
  Reverse: Scans in the opposite direction of the arrow in the measurement window.
- **When the measurement area is a circle or an arc**: (Clockwise), (Counter-clockwise)

4 Select [Edge Dir.] and then select the contrast change that will signify an edge.

- **[Lght to Drk]**: Detects an edge that changes from a bright area to a dark area.
- **[Drk to Lght]**: Detects an edge that changes from a dark area to a bright area.
- **Both** (Default): Detects edges that change from a bright area to a dark area, or from a dark area to a bright area.

5 Select [First edge] and then specify the type of pitch for starting the edge pitch measurement (only when the [Edge Dir.] is set to [both]).

- **[None]** (Default): Starts measuring edges from the one that change either from a bright area to a dark area, or from a dark area to a bright area.
- **[Lght to Drk]**: Starts measuring edges from the one that changes from a dark area to a bright area.
- **[Drk to Lght]**: Starts measuring edges from the one that changes from a bright area to a dark area.

6 **If the measurement window is a circle, select [Start Angle], then specify a position to start the edge scan.**

The range of values you can specify is from 0 to 359.999°.

> **Reference**
>
> Even if the start angle is changed, the detection angle is fixed at the 3 o'clock position.

7 **If necessary, adjust the settings in the [Edge Strength] field.**

The items in the [Edge Strength] field allow you to set the conditions that indicate what will be considered an edge inside the measurement window.

- **Edge Sensitivity (%)**:Specifies the relative threshold value for recognizing edges (0 to 100) (Default: 30).
- **Edge Filter Width**: Specifies the width of the smoothing filter applied to the derivative wave to detect edges (0 to 100) (Default: 5).
- **Upper Edge Intensity (%)**:Specifies the upper limit for the absolute intensity of edges (0.000 to 255.000) (Default: 255.000).
- **Lower Edge Intensity (%)**:Specifies the upper limit for the absolute intensity of edges (0.000 to 255.000) (Default: 5.000).

> **Reference**
>
> Adjusting the highest and lowest edge intensities, which are shown to the left of the graph, based on the highest intensity in the segment currently being displayed allows noisy edges to be excluded. See "What is an Edge ?" (Page 13-15) for details.

8 **If necessary, adjust the settings in the [Counting Options] field.**

- **Primary Target**: Specifies the number of the edge to be judged. Maximum: 3600 (Default: 1). Edge numbers are assigned in order based on search direction (If the primary target is not found, the result for the primary target is 0).
- **Count**: Specifies the maximum number of the edge to be returned. Maximum: 3600 (Default: 1).
- **Angled Edge Det.**: Set this to [ON] to stabilize angled edge detection (Default: OFF). This feature may impact measurement accuracy if left on regularly.

> **► Note**
>
> The maximum number of pitches that can actually be detected changes depending on the settings.

9 **After completing the settings, select [OK].**

Setting Other Detection Conditions

Use other edge position detection conditions as necessary.

1 **Select [Parameters].**

Select [Tool Parameters]. The [Tool Parameters] menu appears.

2 **Make the necessary settings.**

After completing the settings, select [OK].

You can change the reference position of the origin using [Origin] in the [Tool Parameters] menu.

Specify the reference position of the origin in [Origin] in the [Tool Parameters] menu.

Make the necessary settings in the [Origin] menu.

• **specified point** (Default): The origin point is set at the top left of the screen by default. 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 [Pos. X] and [Pos. Y] fields.

Reference

If [specified point] has been selected, the origin point can be set outside the process area. The available range for the origin is

from -9600 to 9600 (X), -7200 to 7200 (Y).

Selecting the coordinate system for position adjustment

You can select the coordinate system using [Coordinate Value] in the [Tool Parameters] menu. If a position correction (Page 4-249) is not being done, this setting will have no effect on the output.

• **[After Position Adjustment]** (Default): If the position of the window used as the source of correction has shifted, the amount of this error is reflected on the measurement.

• **[Before Position Adjustment]**: The distance from the position of the "Origin point" is measured.

Reference

These settings are reflected when the measurement window area position from the calculation is referenced.

Displaying edge graph (differential wave) with the measurement window

You can specify this using [Display Graph] on the [Tool Parameters] menu. If [Display Graph] is set to [ON], edge search conditions can be set from the current image and the edge graph displays in the [Select Detection Conditions of Edges] menu.

• **ON**: Displays the edge graph with the measurement window (Note that measurement time will increase).

• **OFF** (Default): Hides the edge graph.

Selecting an out-of-range measurement area

Select [Out of image] in the [Tool Parameters] menu. Specify whether to incorporate data that falls outside of the measurement area.This may occur when position adjustment is used.

• **Normal** (Default)**:** Excludes areas outside of the measurement area. Depending on settings, having areas outside the measurement area may increase the measurement time.

• **Fast:** Simplifies and this speeds exclusion processing, reducing the time effects of having data outside the read area. However, measurement results may change depending on the state of the current image.

Specifying the Windows for Inspection and Measurement

Setting the Execute Conditions

he measurement window can be set to execute or not, based on the results of an OK or NG judgment of a specified window. This can be useful for instances where inspections need to be skipped. See "What are Execute Conditions?" (Page 4-247) for details.

1 Select [Execute].

The [Window Execute Condition] menu appears.

2 Select an appropriate condition.

- **Always Execute** (Default) **:** Always execute on trigger input.
- **Never Execute:** Do not execute even with trigger input (skip).
- **Window Number (Measurement, Calculation):** Skips or measures depending on the judgment results of the selected window.

Reference

If measurement is skipped, measurement and judgment results for that window become 0 and are not reflected in the final results.

► Note

- If the reference window is set to itself, a circular reference error will result. If this happens, all windows in the same Program No. will have their settings invalidated (set to Always Execute).
- If a circular reference error occurs, a "!" will appear before the window number and the execution conditions to indicate an error.

3 If window number is selected, measurement can be skipped or carried out depending on the judgment results of the specified window.

- **OK:** Executes if the judgment result of the specified window is OK.
- **NG:** Executes if the judgment result of the specified window is NG.

Reference

If no tolerance is set for the selected window, the judgment result is always OK.

4 After completing the settings, select [OK].

Setting the Limits Settings

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

1 **Select [Limits].**
The [Enter Limits] menu appears.

2 **Select an item to set limits for.**

3 **Select [Upper] or [Lower] and set the tolerance.**
The contents of the limit setup and units of tolerance are different depending on the shape of the measurement area that has been set.
   • **Count**: The number of edge pitches
   • **Pitch**: Pixels (When measurement area is not a ring or an arc), Degrees (when the measurement area is a circle or an arc)

Reference
• Tolerance can be entered by selecting [Direct Input] and specifying a tolerance or by selecting [Calc Ref] and using the results of a chosen calculation window.
• For edge pitch, the maximum edge pitch is used as the upper limit and the minimum edge pitch is used as the lower limit.

4 **To specify the tolerance of another measurement value, repeat Steps 2 and 3.**

5 **After completing the settings, select [OK].**

Reference
• [-----] indicates that no tolerance has been set and no judgment will take place after measurement.
• Press [Clear] to clear the value.

Edge Counting

What is the [Edge counting] Measurement Tool?

You can scan a target in the desired direction within a specified measurement area to detect the edge. The [Edge counting] measurement tool enables the number of edges to be counted.

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 fluctuations.

Measurement image

Detected edge

Measurement area

Measurement target
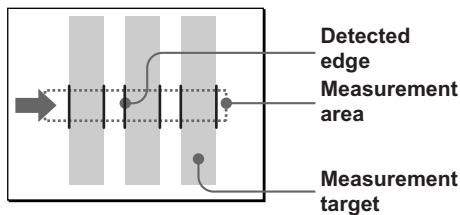
Measurement results

The measurement results that can be output in the edge counting measurement tool are shown below.

- **Number**: Outputs the number of detected edges. (Available in the limits menu)
- **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.
- **Measurement Area Position**: Outputs the measurement window position in pixels (available as a reference after calculation) Note that polygon measurement area information is not output.

Measurement sample

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

- **Edge Dir.**: →
- **Edge Detection Direction**: Bright → Dark
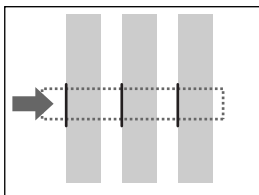
Number of edges:3

Selecting Measurement Tools

1 **Select [Add/Copy/Del] from the [Edit Window] menu.**

2 **Select [Add].**

The [Add Window] menu appears.

3 **Select [Window Number], then specify the measurement window number.**
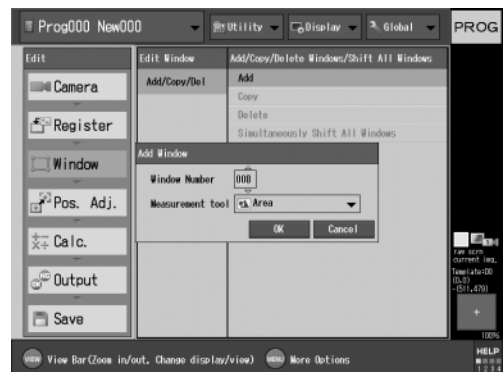
Window numbers can be freely set any value from 0 to 127 .

4 Select [Measurement tool] and then select [Edge counting].
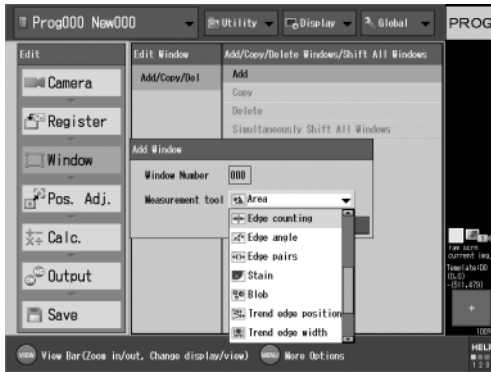
5 Select [OK].

A window with the specified number is added as an edge count measurement window. The current window setting list is then displayed.
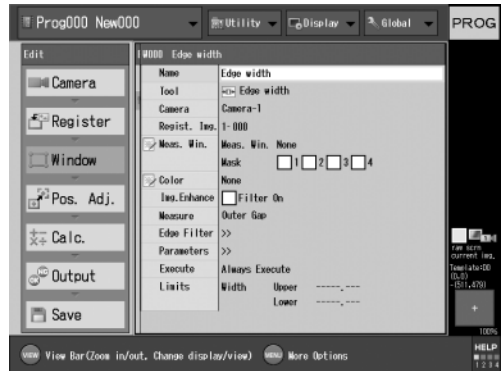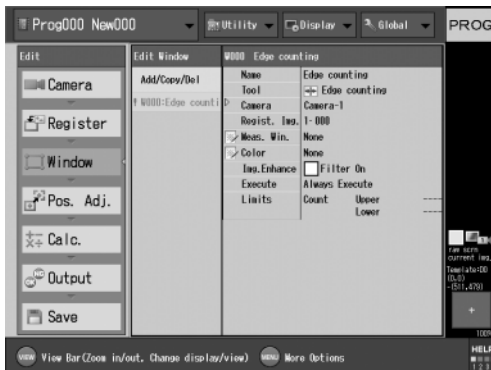

The necessary settings for the edge count window are added next.

Selecting a Camera to Take Images

1 Select [Window] and then select an edge count measurement window.

The window setting menu appears.
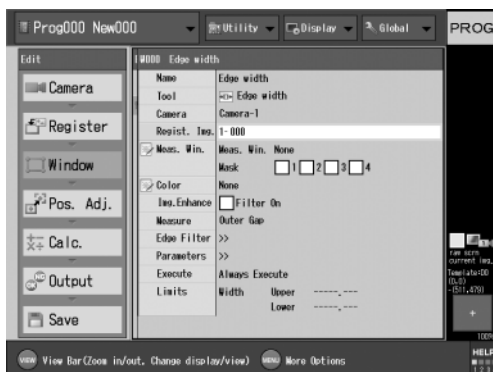

2 Select [Camera], then selecting a camera to take images

Reference

Unconnected cameras can be selected. However, if the selected camera is not connected at the time of imaging, an error will occur.

Specifying a Registered Image to Use

Specify a registered image to use for processing.

Reference

The image to be used must have been previously saved in the [Register Image] menu (Page 4-19).

Select [Regist. Img.], then specify the number of the registered image to be used.

The registered image number will be displayed as "Camera number-xxx."

Specifying a Measurement Window

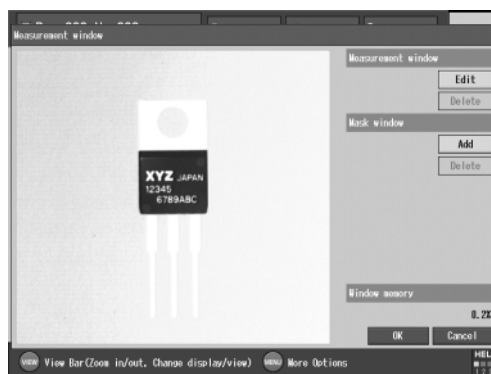Within the captured image, the measurement window is set as follows:

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, see "Exclude an unwanted area (mask window)" located after "Setting the Measurement Area".

1 Select [Meas. Win].

The [Measurement window] menu appears.

2 Select [Edit] in the [Measurement window] field.

The [Select] menu appears.

3 Select a shape, then select [OK].

4 Draw the measurement area.

See "Drawing a Measurement Window" (Page 3-13) for details.

5 After completing the drawing, select [Close] in the [Edit] field.

Clearing the measurement area

The measurement area can be cleared by following the procedure below.

1 Select [Delete] in the [Measurement window] field.

A confirmation screen appears.

2 Select [OK].

Exclude an unwanted area (mask window)

You can set up to 4 areas (mask windows) that will not be measured inside the measurement area. This is useful when the measurement target has a complicated shape or when you want to hide an unnecessary part of the target.
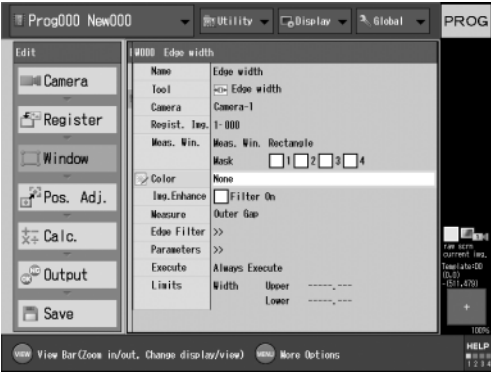
Select [Add] in the [Mask window] field.

The [Add mask window] menu appears.
See Exclude Part of the Measurement Window (Mask Window)(Page 3-25) for details.

Extracting a Color

When using a color camera, color images can be converted to black and white through an extraction process.

► Note

This feature is not available when using a monochrome camera.
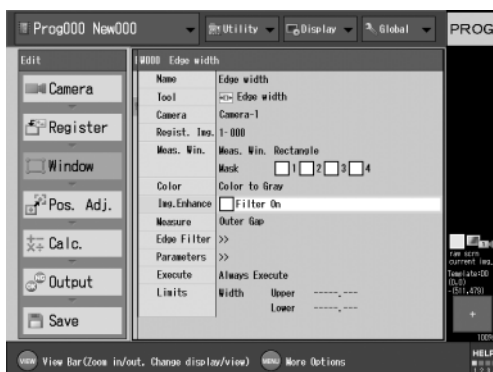

Select [Color].

The [Color] menu appears.

See Processing a Color Image [Color](Page 13-1) for details on color extraction.

Specifying the Windows for Inspection and Measurement

Selecting an Image Enhancement

Specify an appropriate filter for the image.
When using a color camera, the filter is applied to pixels of the extracted color.

1 Select [Img. Enhance].

The [Image Enhance] menu appears.


2 Select a filter to use, then select [OK].

See Filter List(Page 13-9) for details on the individual filters.

> **Reference**
> • More advanced filter settings can also be made by selecting [Detail].
> • Up to 13 filters can be used. When multiple filters are set, they are executed starting from the filter specified in the top portion of the screen.
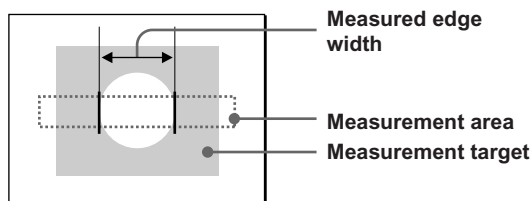
Setting the Detection Conditions

Specify conditions for edge search, including search direction and edge direction

1 Select [Edge Filter].

The [Select Detection Condition of Edges] menu appears.

2 Select [Display Image], and then specify an image to display on the [Select Detection Condition of Edges] menu.

• **Regist. Img.**: Displays the image selected in [Specifying a registered image to use] (Page 4-114).
• **Current Img.**: Displays the current image from the camera selected in "Selecting a Camera to Take Images"(Page 4-113).

- Displays the intensity level selected in the [Select Detection Condition of Edges] menu and the highest contrast if [Regist. Img.] is selected. Display graph must be on to show this when "Current Img." is selected.
- See "What is an Edge ?" (Page 13-15) for details on graphs.

3 **Select [Scan Dir.] and then select the direction the edges will be detected in.**
  - **When the measurement area is a rectangle, circle, ellipse or polygon**: →, ←, ↑, ↓
  - **If the measurement window is a rotated rectangle**:
    Forward: Scans in the direction of the arrow in the measurement window.
    Reverse: Scans in the opposite direction of the arrow in the measurement window.
  - **When the measurement area is a circle or an arc**: (Clockwise), (Counter-clockwise)

4 **Select [Edge Dir.] and then select the contrast change that will signify an edge.**
  - **[Lght to Drk]**: Detects an edge that changes from a bright area to a dark area.
  - **[Dghk to Lrt]**: Detects an edge that changes from a dark area to a bright area.
  - **Both** (Default): Detects edges that change from a bright area to a dark area, or from a dark area to a bright area.

5 **If the measurement window is a circle, select [Start Angle], then specify a position to start the edge scan.**
The range of values you can specify is from 0 to 359.999°.

Reference
Even if the start angle is changed, the detection angle is fixed at the 3 o'clock position.

6 **If necessary, adjust the settings in the [Edge Strength] field.**
The items in the [Edge Strength] field allow you to set the conditions that indicate what will be considered an edge inside the measurement window.
  - **Edge Sensitivity (%)**:Specifies the relative threshold value for recognizing edges (0 to 100) (Default: 30).
  - **Edge Filter Width**: Specifies the width of the smoothing filter applied to the derivative wave to detect edges (0 to 100) (Default: 5).
  - **Upper Edge Intensity (%)**:Specifies the upper limit for the absolute intensity of edges (0.000 to 255.000) (Default: 255.000).
  - **Lower Edge Intensity (%)**:Specifies the upper limit for the absolute intensity of edges (0.000 to 255.000) (Default: 5.000).

Reference
Adjusting the highest and lowest edge intensities, which are shown to the left of the graph, based on the highest intensity in the segment currently being displayed allows noisy edges to be excluded. See "What is an Edge ?" (Page 13-15) for details.

7 **If necessary, adjust the settings in the [Counting Options] field.**
  - **Primary Target**: Specifies the number of the edge to be judged. Maximum: 3600 (Default: 1). Edge numbers are assigned in order based on search direction (If the primary target is not found, the result for the primary target is 0).
  - **Count**: Specifies the maximum number of the edge to be returned. Maximum: 3600 (Default: 1).
  - **Angled Edge Det.**: Set this to [ON] to stabilize angled edge detection (Default: OFF). This feature may impact measurement accuracy if left on regularly.
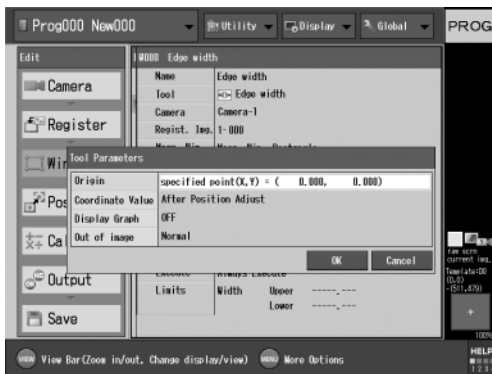
8 **After completing the settings, select [OK].**

Setting Other Detection Conditions

Set other edge count conditions as necessary.

1 Select [Parameters].

Select [Tool Parameters]. The [Tool Parameters] menu appears.

2 Make the necessary settings.

After completing the settings, select [OK].

You can change the reference position of the origin using [Origin] in the [Tool Parameters] menu.

Specify the reference position of the origin in [Origin] in the [Tool Parameters] menu.

Make the necessary settings in the [Origin] menu.

- **specified point** (Default): The origin point is set at the top left of the screen by default. 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 [Pos. X] and [Pos. Y] fields.

Reference

If [specified point] has been selected, the origin point can be set outside the process area. The available range for the origin is

from -9600 to 9600 (X), -7200 to 7200 (Y).

Selecting the coordinate system for position adjustment

You can select the coordinate system using [Coordinate Value] in the [Tool Parameters] menu. If a position correction (Page 4-249) is not being done, this setting will have no effect on the output.

- **[After Position Adjustment]** (Default): If the position of the window used as the source of correction has shifted, the amount of this error is reflected on the measurement.
- **[Before Position Adjustment]**: The distance from the position of the "Origin point" is measured.

Reference

These settings are reflected when the measurement window area position from the calculation is referenced.

Displaying edge graph (differential wave) with the measurement window

You can specify this using [Display Graph] on the [Tool Parameters] menu. If [Display Graph] is set to [ON], edge search conditions can be set from the current image and the edge graph displays in the [Select Detection Conditions of Edges] menu.

- **ON**: Displays the edge graph with the measurement window (Note that measurement time will increase).
- **OFF** (Default): Hides the edge graph.
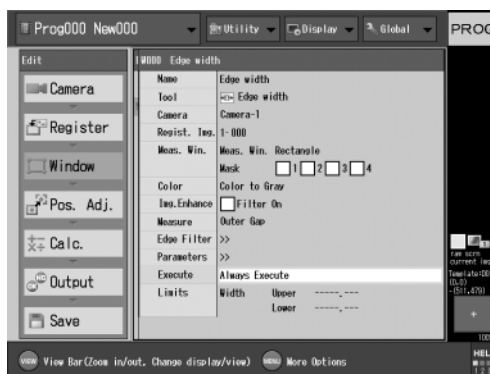
Selecting an out-of-range measurement area

Select [Out of image] in the [Tool Parameters] menu. Specify whether to incorporate data that falls outside of the measurement area.This may occur when position adjustment is used.

- **Normal** (Default)**:** Excludes areas outside of the measurement area. Depending on settings, having areas outside the measurement area may increase the measurement time.
- **Fast:** Simplifies and this speeds exclusion processing, reducing the time effects of having data outside the read area. However, measurement results may change depending on the state of the current image.

Setting the Execute Conditions

The measurement window can be set to execute or not, based on the results of an OK or NG judgment of a specified window. This can be useful for instances where inspections need to be skipped. See "What are Execute Conditions?" (Page 4-247) for details.

1 Select [Execute].

The [Window Execute Condition] menu appears.

2 Select an appropriate condition.

- **Always Execute** (Default) **:** Always execute on trigger input.
- **Never Execute:** Do not execute even with trigger input (skip).
- **Window Number (Measurement, Calculation):** Skips or measures depending on the judgment results of the selected window.

> **Reference**
>
> If measurement is skipped, measurement and judgment results for that window become 0 and are not reflected in the final results.

> **► Note**
>
> • If the reference window is set to itself, a circular reference error will result. If this happens, all windows in the same Program No. will have their settings invalidated (set to Always Execute).
> • If a circular reference error occurs, a "!" will appear before the window number and the execution conditions to indicate an error.

3 **If window number is selected, measurement can be skipped or carried out depending on the judgment results of the specified window.**

- **OK:** Executes if the judgment result of the specified window is OK.
- **NG:** Executes if the judgment result of the specified window is NG.

> **Reference**
>
> If no tolerance is set for the selected window, the judgment resolt is always OK.

4 **After completing the settings, select [OK].**

Setting the Limits Settings

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

1 **Select [Limits].**

The [Enter Limits] menu appears.

2 **Select [Upper] or [Lower] and set the limit.**

> **Reference**
>
> Tolerance can be entered by selecting [Direct Input] and specifying a tolerance or by selecting [Calc Ref] and using the results of a chosen calculation window.

3 **After completing the settings, select [OK].**

> **Reference**
>
> • [-----] indicates that no tolerance has been set and no judgment will take place after measurement.
> • Press [Clear] to clear the value.

Edge Angle

What is the [Edge Angle] Measurement Tool?

The [Edge angle] measurement tool enables the measurement of the tilt angle of the target by setting two segments in the measurement area and detecting the edges within the respective windows. The tilt angle has a negative (-) value when it is in the counterclockwise direction, and a positive (+) value when it is in the clockwise direction. Because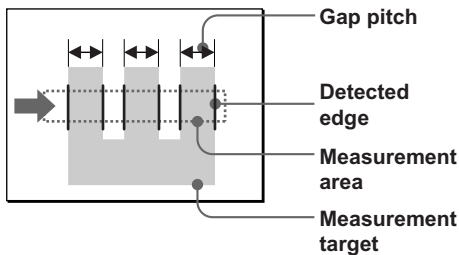 edge detection is based on transitions from light to dark (or dark to light), not on the absolute value of the intensity, it is less affected by illumination fluctuations.
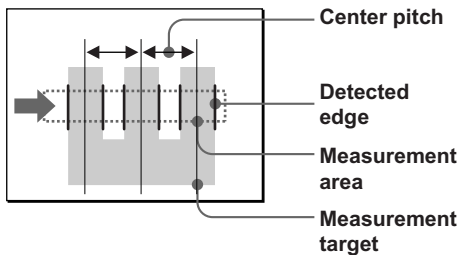
Reference

- You can specify the edge detection direction or edge direction for each segment. This makes it easier to detect the tilt angle of the target in a single measurement window when measuring a target with a complicated shape.
- A line can also be drawn by the edges that are detected in the two segments. The distance between the line and any specified point on the image can be calculated by using the calculation function (Page 4-253).
- The coordinates (X, Y) of the edges detected in the two segments or the center coordinates can also be used in the calculation function.

Measurement image

When the edge angle = "+75°"

Segment
Detection position
(Midpoint of the detected edge)
Measurement area
Tilt angle
Measurement target
Detected edge
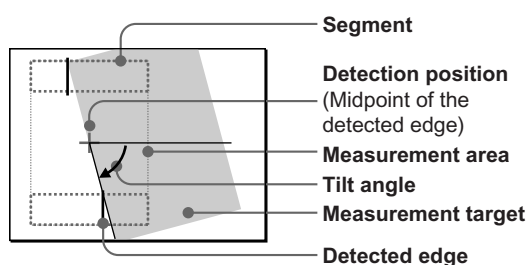
When the edge angle = "-20°"

Measurement area
Detected edge
Tilt angle
Segment
Detection position
(Midpoint of the detected edge)
Measurement target

Measurement results

The measurement results that can be output in the [Edge angle] mode are shown below.

- **Angle**: Outputs the angle of the two detected edges (-179.999° to 180.000°). (Available in the limits menu)
- **Edge Position 1 (X,Y)**: Outputs the coordinates of the detected edge (Using 0 degrees as the standard angle of rotation).
- **Distance 1**: Outputs the distance from the start of the measurement range to the start of edge position 1 point in pixels.
- **Intensity 1**: Outputs the intensity of edge position 1.
- **Edge Position 2 (X,Y)**: Outputs the coordinates of the second edge (Using 0 degrees as the standard angle of rotation).
- **Distance 2**: Outputs the distance from the start of the measurement range to the start of edge position 2 point in pixels.
- **Intensity 2**: Outputs the intensity of edge position 2.
- **Center Position (X,Y)**: Outputs the coordinates of the center position of edge position 1 and edge position 2.
- **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.
- **Measurement Area Position**: Outputs the measurement window position in pixels (available as a reference after calculation). Note that polygon measurement area information is not output.

Specifying the Windows for Inspection and Measurement

Measurement sample

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

• [Edge Dir.]: Both
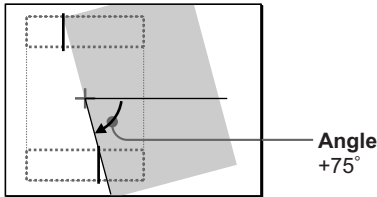
Angle
+75°

Reference

The edge angle measurement value is the angle between a straight line connecting edge position 1 to edge position 2 and the horizontal.

Definition of edge position 1 and edge position 2

This device labels edges found in segment 1 of as edge position 1 and edges found in segment 2 as edge position 2. Taking the angle of rotation of the window as 0 degrees (default), the rectangle on top is segment 1 and the rectangle on the bottom is segment 2.

When the angle of rotation is 0 degrees

Segment 1

Segment 1
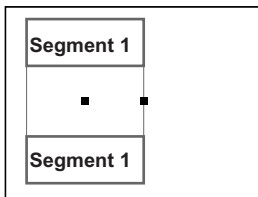
When the angle of rotation is 270 degrees
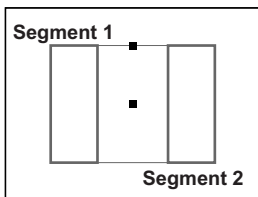
Segment 1

Segment 2

Selecting Measurement Tools

1 **Select [Add/Copy/Del] from the [Edit Window] menu.**

2 **Select [Add].**

The [Add Window] menu appears.

3 **Select [Window Number], then specify the measurement window number.**

Window numbers can be freely set at any value from 0 to 127.

4 Select [Measurement tool] and then select [Edge angle].
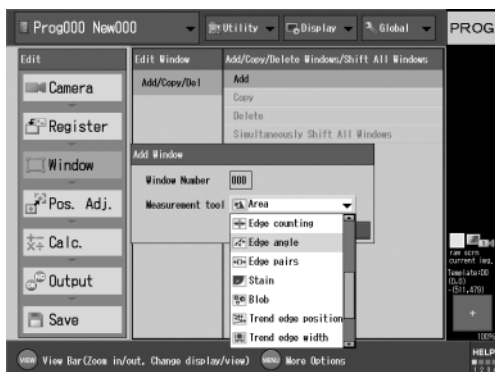
5 Select [OK].

A window with the specified number is added as an edge angle measurement window. The current window setting list is then displayed.
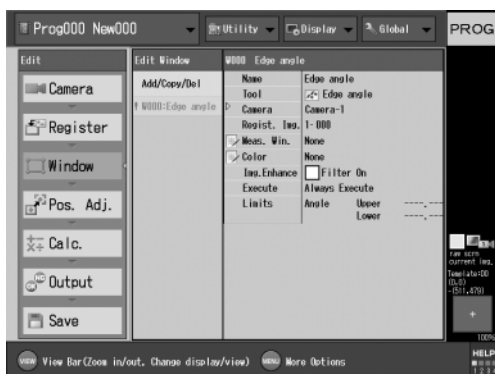
The necessary settings for the edge angle measurement window are added next.

Selecting a Camera to Take Images

1 Select [Window] and then select the [Edge angle] measurement window.

The window setting menu appears.

2 Select [Camera], then selecting a camera to take images

Reference

Unconnected cameras can be selected. However, if the selected camera is not connected at the time of imaging, an error will occur.

Specifying a Registered Image to Use

Specify a registered image to use for processing.

Reference

The image to be used must have been previously saved to an image number in the [Register Image] screen (Page 4-19).

Select [Regist. Img.], then specify the number of the registered image to be used.

The registered image number will be displayed as "Camera number-xxx."

Specifying a Measurement Window

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

► Note

[Edge angle] measurements only use rotated rectangles.

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, see "Excluding an unwanted area (mask window)" located after "Setting the Measurement Area".

1 **Select [Meas. Win.].**

The [Measurement window] menu appears.
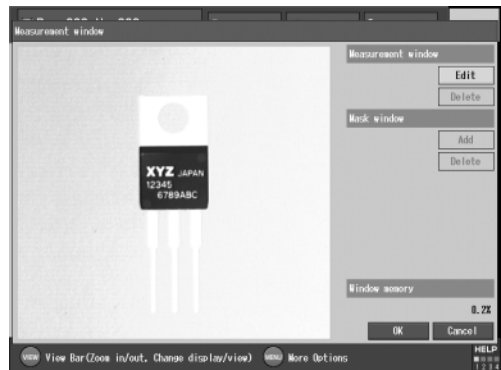
2 **Select [Edit] in the [Measurement window] field.**

3 **Draw the measurement area.**
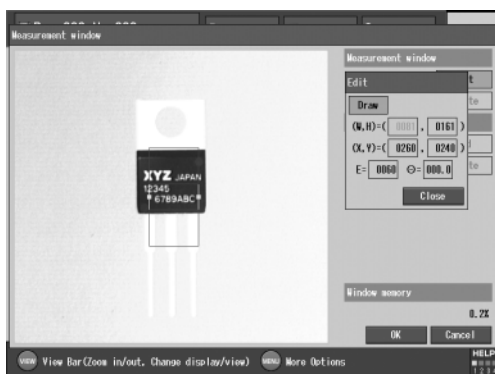
The segment areas are depicted by the blue
rectangles. See "Drawing a Measurement Window"
(Page 3-13) for details.

► **Note**

The sizes of the two segments cannot be different.

4 **After completing the drawing, select [Close]
in the [Edit] field.**

Clearing the measurement area

The measurement area can be cleared by following
the procedure below.

1 **Select [Delete] in the [Measurement window] field.**
A confirmation screen appears.

2 **Select [OK].**

Extracting a Color

When using a color camera, color images can be
converted to black and white through an extraction
process.

► **Note**

This feature is not available when using a monochrome
camera.

Select [Color].

The [Color] menu appears.

See "Processing a Color Image [Color]" (Page 13-1)
for details on color extraction.

Selecting an Image Enhancement

Specify an appropriate filter for the image.
When using a color camera, the filter is applied to pixels of the extracted color.

1 Select [Img. Enhance].

The [Image Enhance] menu appears.

2 Select a filter to use, then select [OK].

See "Filter List" (Page 13-9) for details on the individual filters.

Reference

• More advanced filter settings can also be made by selecting [Details].

• Up to 13 filters can be used. When multiple filters are set, they are executed starting from the filter specified in the top portion of the screen.

Setting the Detection Conditions

Specify conditions for edge search, including search direction and edge direction
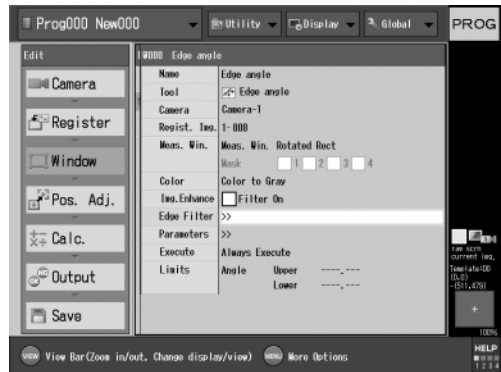
1 Select [Edge Filter].

The [Select Detection Conditions of Edges] menu appears.
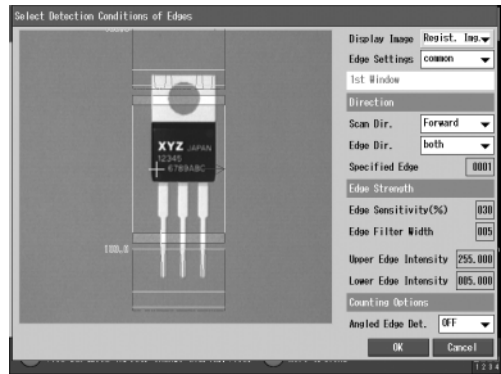
2 Select [Display Image], and then specify an image to display on the [Select Detection Conditions of Edges] menu.

• **Regist. Img.**: Displays the image selected in [Specifying a registered image to use] (Page 4-124).

• **Current Img.**: Displays the current image from the camera selected in [Selecting a Camera to Take Images] (Page 4-123).

Reference

- Displays the extract level selected on the [Select Detection Conditions of Edges] menu and the highest contrast if [Display Image] is selected. Display graph must be on to show this when [Current Img.] is selected.
- See "What is an Edge ?" (Page 13-15) for details on graphs.

3 **Select [Edge Settings] to specify the edge detection conditions for each segment. Select [common] (default) if you want to use common conditions for both segments.**

Select [Individual] when measuring a complexly shaped region. This allows you to set edge search conditions for each segment and thus have a much more accurate search.

4 **If [Individual] is selected, select [1st Window] in step 2.**

If [Common] is selected, these procedures are not necessary.

5 **Select [Scan Dir.] and then select the direction the edges will be detected in.**

- **Forward**: Scans in the durection of the arrow in the measurement window.
- **Reverse**: Scans in the opposite direction of the arrow in the measurement window.

6 **Select [Edge Dir.] and then select the contrast change that will signify an edge.**

- **Lght to Drk**: Detects an edge that changes from a bright area to a dark area.
- **Drk to Lght**: Detects an edge that changes from a dark area to a bright area.
- **both** (Default): Detects edges that change from a bright area to a dark area, or from a dark area to a bright area.

7 **Select [Specified Edge] and then specify the edge to be evaluated when multiple edges are detected.**

The edge numbers are given in the order of detection direction. If you specify a negative value for the Detection direction, the edges are numbered in the reverse order of the specified edge.

8 **If necessary, adjust the settings in the [Edge Strength] field.**

The items in the [Edge Strength] field allow you to set the conditions that indicate what will be considered an edge inside the measurement window.

- **Edge Sensitivity (%)**:Specifies the relative threshold value for recognizing edges (0 to 100) (Default: 30).
- **Edge Filter Width**: Specifies the width of the smoothing filter applied to the derivative wave to detect edges (0 to 100) (Default: 5).
- **Upper Edge Intensity (%)**:Specifies the upper limit for the absolute intensity of edges (0.000 to 255.000) (Default: 255.000).
- **Lower Edge Intensity (%)**:Specifies the upper limit for the absolute intensity of edges (0.000 to 255.000) (Default: 5.000).

Reference

Adjusting the highest and lowest edge intensities, which are shown to the left of the graph, based on the highest intensity in the segment currently being displayed allows noisy edges to be excluded. See "What is an Edge ?" (Page 13-15) for details.

9 **If necessary, adjust the settings in the [Angled Edge Det.] field.**

Set this to [ON] to stabilize angled edge detection (Default: OFF). This feature may impact measurement accuracy if left on regularly.

10 **After completing the settings, select [OK].**

Setting Other Detection Conditions

Set other edge angle conditions as necessary.

1 **Select [Parameters].**

Select [Tool Parameters]. The [Tool Parameters] menu appears.

2 **Make the necessary settings.**

After completing the settings, select [OK].

You can change the reference position of the origin using [Origin] in the [Tool Parameters] menu.

Specify the reference position of the origin in [Origin] in the [Tool Parameters] menu.

Make the necessary settings in the [Origin] menu.

• **specified point** (Default): The origin point is set at the top left of the screen by default. 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 [Pos. X] and [Pos. Y] fields.

Reference

If [specified point] has been selected, the origin point can be set outside the process area. The available range for the origin is
from -9600 to 9600 (X), -7200 to 7200 (Y).

Selecting the coordinate system for position adjustment

You can select the coordinate system using [Coordinate Value] in the [Tool Parameters] menu. If a position correction (Page 4-249) is not being done, this setting will have no effect on the output.

• **[After Position Adjustment]** (Default): If the position of the window used as the source of correction has shifted, the amount of this error is reflected on the measurement.

• **[Before Position Adjustment]**: The distance from the position of the "Origin point" is measured.

Reference

These settings are reflected when the measurement window area position from the calculation is referenced.

Displaying edge graph (differential wave) with the measurement window

You can specify this using [Display Graph] on the [Tool Parameters] menu. If [Display Graph] is set to [ON], edge search conditions can be set from the current image and the edge graph displays in the [Select Detection Conditions of Edges] menu.

- **ON**: Displays the edge graph with the measurement window (Note that measurement time will increase).
- **OFF** (Default): Hides the edge graph.

Selecting an out-of-range measurement area

Select [Out of image] in the [Tool Parameters] menu. Specify whether to incorporate data that falls outside of the measurement area.This may occur when position adjustment is used.

- **Normal** (Default)**:** Excludes areas outside of the measurement area. Depending on settings, having areas outside the measurement area may increase the measurement time.
- **Fast:** Simplifies and this speeds exclusion processing, reducing the time effects of having data outside the read area. However, measurement results may change depending on the state of the current image.

Setting the Execute Conditions

The measurement window can be set to execute or not, based on the results of an OK or NG judgment of a specified window. This can be useful for instances where inspections need to be skipped. See "What are Execute Conditions?" (page 4-247) for details.

1 Select [Execute].

The [Window Execute Condition] menu appears.

2 Select an appropriate condition.

- **Always Execute** (Default) **:** Always execute on trigger input.
- **Never Execute:** Do not execute even with trigger input (skip).
- **Window Number (Measurement, Calculation):** Skips or measures depending on the judgment results of the selected window.

Reference

If measurement is skipped, measurement and judgment results for that window become 0 and are not reflected in the final results.

► Note

- If the reference window is set to itself, a circular reference error will result. If this happens, all windows in the same Program No. will have their settings invalidated (set to Always Execute).
- If a circular reference error occurs, a "!" will appear before the window number and the execution conditions to indicate an error.

3 **If window number is selected, measurement can be skipped or carried out depending on the judgment results of the specified window.**

- • **OK:** Executes if the judgment result of the specified window is OK.
- • **NG:** Executes if the judgment result of the specified window is NG.

Reference

If no tolerance is set for the selected window, the judgment result is always OK.

4 **After completing the settings, select [OK].**

Setting the Limits Settings

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

If the measurement value meets or exceeds the specified tolerance, [NG] is returned. If it is within the specified tolerance, [OK] is returned.

1 **Select [Limits].**

The [Enter Limits] menu appears.

2 **Select [Uppper] or [Lower] and set the limit.**

Reference

Tolerance can be entered by selecting [Direct Input] and specifying a tolerance or by selecting [Calc Ref] and using the results of a chosen calculation window.

3 **After completing the settings, select [OK].**

Reference

- [-----] indicates that no tolerance has been set and no judgment will take place after measurement.
- Press [Clear] to clear the value.

Edge Pairs

What is the [Edge Pairs] Measurement Tool?

Edge pairs measurement mode uses 2 scans to match edges by the selected conditions, then measures their width and pitch. Unlike edge width measurement and edge pitch measurement, pair search conditions and scan-by-scan edge search conditions can be set at a detailed level, allowing a more stable search.

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 fluctuations.

Measurement image

When the measurement area is a rectangle or rotated rectangle

• Example of measuring gap pitch
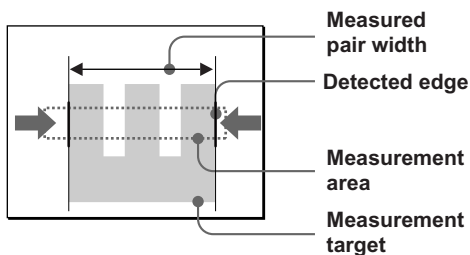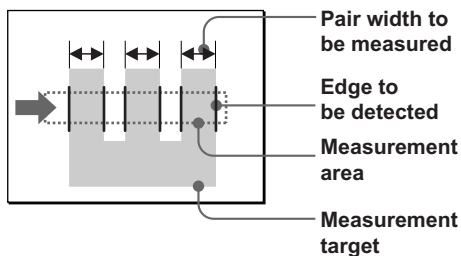
• Example of measuring the center pitch

When the measurement area is a circle or an arc
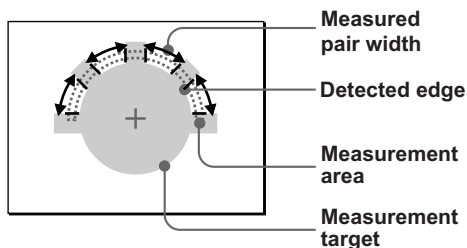
• Example of measuring gap pitch

• Example of measuring the center pitch

Specifying the Windows for Inspection and Measurement
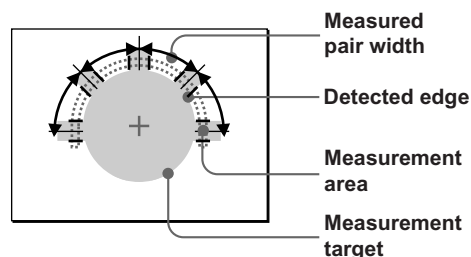
Measurement results

The measurement results that can be output in the gap pitch measurement mode are shown below.

When the measurement area is not a circle or an arc

- **Number**: Outputs the number of detected pairs. (Available in the limits menu)
- **Maximum Pair Width**: Outputs the gap pitch in pixels. (Available in the limits menu)
- **Minimum Pair Width**: Outputs the gap pitch in pixels. (Available in the limits menu)
- **Avereage Pair Width**: Outputs the gap pitch in pixels.
- **Pair Width [ ]:** Outputs the width of each pair in pixels. (Available in the Limits menu) (Available through outouts)
- **Edge Position 1 (X,Y):** Outputs all coordinates of the side nearest the measurement start point of one edge in a pair. (Available through outouts)
- **Distance 1 [ ]:** Outputs the distance from the start of the measurement range to the start of each edge position 1 point in pixels. (Available through outouts)
- **Intensity 1 [ ]:** Outputs all intensities of edge position 1. (Available through outouts)
- **Edge Position 2 (X,Y):** Outputs all coordinates of the side farthest from the measurement start point of one edge in a pair. (Available through outouts)
- **Distance 2 [ ]:** Outputs the distance from the start of the measurement range to the start of each edge position 2 point in pixels. (Available through outouts)
- **Intensity 2 [ ]:** Outputs all intensities of edge position 2. (Available through outouts)
- **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.

> **Reference**
> When primary target (Page 4-140) is set to [All] (Default), the maximum pair width is used as the upper limit and the minimum pair width is used as the lower limit.

- **Measurement Area Position**: Outputs the measurement window position in pixels (available as a reference after calculation) Note that polygon measurement area information is not output.

When the measurement area is a circle or an arc

- **Number**: Outputs the number of detected pairs. (Available in the limits menu)
- **Maximum Pair Width**: Outputs the gap pitch in degrees. (Available in the limits menu)
- **Minimum Pair Width**: Outputs the gap pitch in degrees. (Available in the limits menu)
- **Average Pair Width**: Outputs the gap pitch in degrees.
- **Pair Width [ ]:** Outputs the width of each pair in degrees. (Available in the limits menu) (Available through outouts)
- **Edge Position 1 (X,Y) [ ]:** Outputs the all of the coordinates of the intersection of the side nearest the measurement start point of one of the edges in a pair and the center line. (Available through outouts)
- **Angle 1 [ ]** : Outputs each angle of edge position 1. (Available through outouts)
- **Distance 1 [ ]:** Outputs the distance from the start of the measurement range to the start of each edge position 1 point in degrees. (Available through outouts)
- **Intensity 1 [ ]:** Outputs all intensities of edge position 1. (Available through outouts)
- **Edge Position 2 (X,Y) [ ]:** Outputs the all of the coordinates of the intersection of the side farthest from the measurement start point of one of the edges in a pair and the center line. (Available through outouts)
- **Angle 2 [ ]** : Outputs each angle of edge position 1. (Available through outouts)
- **Distance 2 [ ]:** Outputs the distance from the start of the measurement range to the start of each edge position 2 point in degrees. (Available through outouts)
- **Intensity 2 [ ]:** Outputs all intensities of edge position 2. (Available through outouts)
- **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.

> **Reference**
> When primary target (Page 4-140) is set to [All] (Default), the maximum pair width is used as the upper limit and the minimum pair width is used as the lower limit.

- **Measurement Area Position**: Outputs the measurement window position in pixels (available as a reference after calculation) Note that polygon area information is not output.

Measurement sample

When the measurement area is a rectangle or rotated rectangle

Example 1: showing the results of a gap pitch measurement performed under the following conditions:

- Detection of pitch: gap pitch
- Scan direction (1st scan): →
- Scan direction (2nd scan): →
- Edge direction (1st scan): Bright → Dark
- Edge direction (2nd scan): Dark → Bright
- Pair width maximum: 9999.000
- Pair width minimum: 0050.000

Pair width
Maximum value: 100
Minimum value: 70
Average value: 80

Number of pairs:
4
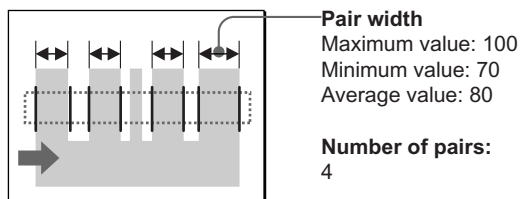
Reference

The central pin is below the pair width minimum and is therefore excluded from the search.

Example 2: showing the results of a center pitch measurement performed under the following conditions:

- Detection of pitch: Center pitch
- Scan direction (1st scan): →
- Scan direction (2nd scan): →
- Edge direction (1st scan): Bright → Dark
- Edge direction (2nd scan): Dark → Bright
- Pair width maximum: 9999.000
- Pair width minimum: 0050.000

Pair width
Maximum value: 120
Minimum value: 100
Average value: 110

Number of pairs:
3
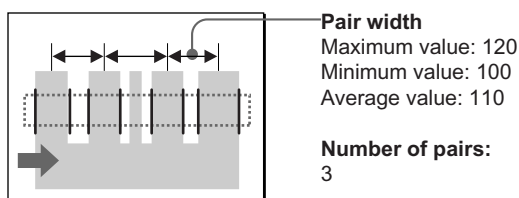
When the measurement area is a circle or an arc

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

- Detection of pitch: Center pitch
- Scan (1st scan): Clockwise
- Scan (2nd scan): Clockwise
- Edge direction (1st scan): Bright → Dark
- Edge direction (2nd scan): Dark → Bright
- Pair width maximum: 9999.000
- Pair width minimum: 0005.000

Pair width angle
Maximum value: 90
Minimum value: 44
Average value: 60

Number of pitches:
3
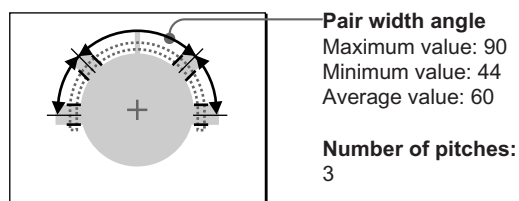
Reference

The 3rd pin is below the pair width minimum and is therefore excluded from the search.

Specifying the Windows for Inspection and Measurement

Selecting Measurement Tools

1 **Select [Add/Copy/Del] from the [Edit Window] menu.**
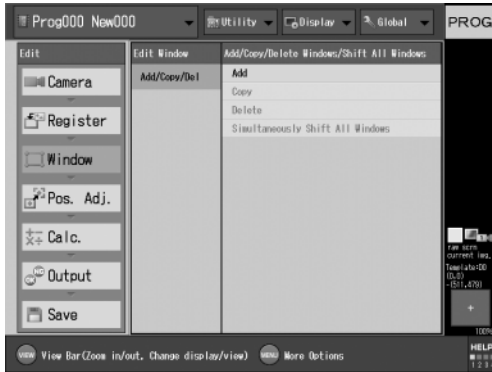
2 **Select [Add].**

The [Add Window] menu appears.

3 **Select [Window Number], then specify the measurement window number.**

Window numbers can be freely set at any value from 0 to 127 .

4 **Select [Measurement tool] and then select [Edge pairs].**
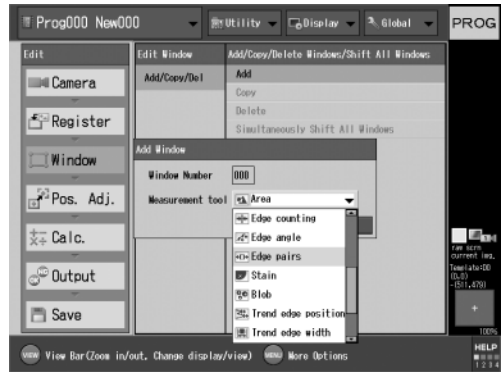
5 **Select [OK].**

A window with the specified number is added as an edge pair measurement window. The current window setting list is the displayed.

The necessary settings for the gap pitch window are added next.

Selecting a Camera to Take Images

1 Select [Window] and then select the [Edge pairs] window.

The window setting menu appears.

2 Select [Camera], then selecting a camera to take images

Reference

Unconnected cameras can be selected. However, if the selected camera is not connected at the time of imaging, an error will occur.

Specifying a Registered Image to Use

Specify a registered image to use for processing.

Reference

The image to be used must have been previously saved to an image number in the [Register Image] screen (Page 4-19).

Select [Regist. Img.], then specify the number of the registered image to be used.

The registered image number will be displayed as "Camera number-xxx."

Specifying a Measurement Window

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, see "Excluding an unwanted area (mask window)" located after "Setting the Measurement Area".

1 **Select [Meas. Win.].**

The [Measurement window] menu appears.

2 **Select [Edit] in the [Measurement window] field.**

The [Select] menu appears.

3 **Select a shape, then select [OK].**

4 **Draw the measurement area.**

See "Drawing a Measurement Window" (Page 3-13) for details.

5 **After completing the drawing, select [Close] in the [Edit] field.**

Clearing the measurement area

The measurement area can be cleared by following the procedure below.

1 **Select [Delete] in the [Measurement window] field.**

A confirmation screen appears.

2 **Select [OK].**

Excluding an unwanted area (mask window)

You can set up to 4 areas (mask windows) that will not be measured inside the measurement area. This is useful when the measurement target has a complicated shape or when you want to hide an unnecessary part of the target.

Select [Add] in the [Mask window] field.

The [Add mask window] menu appears.
See "Exclude Part of the Measurement Window (Mask Window)" (Page 3-25) for details.

Extracting a Color

When using a color camera, color images can be converted to black and white through an extraction process.

► Note

This feature is not available when using a monochrome camera.

Select [Color].

The [Color] menu appears.

See "Processing a Color Image [Color]" (Page 13-1) for details on color extraction.

Selecting an Image Enhancement

Specify an appropriate filter for the image. When using a color camera, the filter is applied to pixels of the extracted color.

1 Select [Img. Enhance].

The [Image Enhance] menu appears.

2 Select a filter to use, then select [OK].

See "Filter List" (Page 13-9) for details on the individual filters.

Reference

• More advanced filter settings can also be made by selecting [Detail].
• Up to 13 filters can be used. When multiple filters are set, they are executed starting from the filter specified in the top portion of the screen.

Selecting the Type of Edge Pairs to Measure

Select [Measure] and then select the type of pair pitch to be used for detection.

- **Gap pitch** (Default): Searches in the specified detection direction and outputs the maximum, minimum and average distances between odd edges and even edges.

Measured pair width

Detected edge

Measurement area

Measurement target

- **Center pitch**:Measures the maximum, minimum, and average distance between the center points of an odd to even pair of edges.

Measured pair width

Detected edge

Measurement area

Measurement target

Setting the Detection Conditions

Specify conditions for edge search, including search direction and edge direction

1 **Select [Edge Filter].**

The [Select Detection Conditions of Edges] menu appears.

2 **Select [Display Image], and then specify an image to display on the [Select Detection Conditions of Edges] menu.**

- **Regist. Img.**: Displays the image selected in [Specifying a registered image to use] (Page 4-135).
- **Current Img.**: Displays the current image from the camera selected in [Selecting a Camera to Take Images](Page 4-135).

Reference
- Displays the intensity level selected in the [Select Detection Conditions of Edges] menu and the highest contrast if [Regist. Img] is selected. Display graph must be set to something other than [OFF] to show this when [Current Img.] is selected.
- See "What is an Edge ?" (Page 13-15) for details on graphs.

3 Select [1st scan].

Continuously made settings apply to the 1st scan.

4 Select [Scan Dir.] and then select the direction the edges will be detected in.
- **When the measurement area is a rectangle, circle, ellipse or polygon**: → , ← , ↑ , ↓
- **If the measurement window is a rotated rectangle**:

  Forward: Scans in the direction of the arrow in the measurement window.

  Reverse: Scans in the opposite direction of the arrow in the measurement window when making settings.
- **When the measurement area is a circle or an arc**: (Clockwise), (Counter-clockwise)

5 Select [Edge Dir.] and then select the contrast change that will signify an edge.
- **Lght to Drk** (2nd scan Default): Detects an edge that changes from a bright area to a dark area.
- **Drk to Lght** (1st scan Default): Detects an edge that changes from a dark area to a bright area.
- **both**: Detects edges that change from a bright area to a dark area, or from a dark area to a bright area.

6 If the measurement window is a circle, select [Start Angle], then specify a position to start the edge scan.

The range of values you can specify is from 0 to 359.999°.

Reference
Even if the start angle is changed, the detection angle is fixed at the 3 o'clock position.

7 If necessary, adjust the settings in the [Edge Strength] field.

The items in the [Edge Strength] field allow you to set the conditions that indicate what will be considered an edge inside the measurement window.
- **Edge Sensitivity (%)**:Specifies the relative threshold value for recognizing edges (0 to 100) (Default: 30).
- **Edge Filter Width**: Specifies the width of the smoothing filter applied to the derivative wave to detect edges (0 to 100) (Default: 5).
- **Upper Edge Intensity (%)**:Specifies the upper limit for the absolute intensity of edges (0.000 to 255.000) (Default: 255.000).
- **Lower Edge Intensity (%)**:Specifies the upper limit for the absolute intensity of edges (0.000 to 255.000) (Default: 5.000).

Reference
Adjusting the highest and lowest edge intensities, which are shown to the left of the graph, based on the highest intensity in the segment currently being displayed allows noisy edges to be excluded. See "What is an Edge ?" (Page 13-15) for details.

8 To skip the first edges detected. specify a number of edges to skip under [Skip Edges].

9 Select [2nd scan] from the top of the screen, then repeat settings for steps 3-7 in for the 2nd scan.

10 **If necessary, adjust the setting of the [Counting Options] field.**

- **Max Edge Gap**: Specifies the maximum distance between edges in a pair. Edge pairs that exceed the maximum distance will not be returned as pairs.
- **Min Edge Gap**: Specifies the minimum distance between edges in a pair. Edge pairs with a pitch below the minimum distance will not be returned as pairs.
- **Primary Target**: Select [All] to scan all pairs and determine the minimum and maximum pitch. To use only specific pairs, select [Specified] and specify the number of the pair you wish to work with. Only the pair that is specified here becomes the target of judgment.
- **Count**: Specifies the maximum number of pairs to be measured Maximum: 3600 (Default: 30).
- **Angled Edge Det.**: Set this to [ON] to stabilize angled edge detection (Default: OFF) This feature may impact measurement accuracy if left on regularly.

▶ **Note**

Depending on settings, the maximum number of pairs may not be detected.

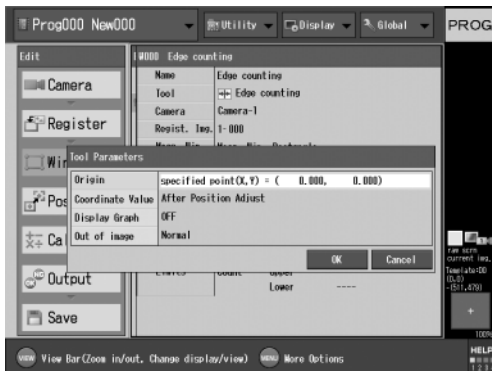**11** **After completing the settings, select [OK].**

Specifying Other Detection Conditions

Set other edge pair conditions as necessary.

1 **Select [Parameters].**

Select [Tool Parameters]. The [Tool Parameters] menu appears.

2 **Make the necessary settings.**

After completing the settings, select [OK].

Changing the reference position of the origin
Specify the reference position of the origin in
[Origin] in the [Tool Parameters] menu.
Make the necessary settings in the [Origin] menu.
• **specified point** (Default): The origin point is set
at the top left of the screen by default. 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 [Pos. X] and [Pos. Y] fields.

Reference

If [specified point] has been selected, the origin point can be
set outside the process area. The range of points you can set
is from -9600 to 9600 (X) and -7200 to 7200 (Y).

**Selecting the coordinate system for position
adjustment**
You can select the coordinate system using
[Coordinate Value] in the [Tool Parameters] menu.
If a position correction (Page 4-249) is not being
done, this setting will have no effect on the output.
• **[After Position Adjust]** (Default): If the position
of the window used as the source of correction
has shifted, the amount of this error is reflected
on the measurement.
• **[Before Position Adjust]**: The distance from the
position of the "Origin point" is measured.

Reference

These settings are reflected when the measurement window
area position from the calculation is referenced.

**Displaying edge graph (differential wave) with the
measurement window**
You can specify this using [Display Graph] in the
[Tool Parameters] menu. If [Display Graph] is set to
[ON], edge search conditions can be set from the
current image and the edge graph displays in the
[Select Detection Conditions of Edges] menu.
• Both **1st** and **2nd scan**: Select Both to display
graphs for both scans 1 and 2 (Note that this will
increase measurement time).
• **1st scan only**: Displays the edge graph for the
1st scan with the measurement window (Note
that measurement time will increase).
• **2nd scan only**: Displays the edge graph for the
2nd scan with the measurement window (Note
that measurement time will increase).
• **OFF** (Default): Hides the edge graph.

Selecting an out-of-range measurement area
Select [Out of image] in the [Tool Parameters]
menu.
Specify whether to incorporate data that falls
outside of the measurement area. This may occur
when position adjustment is used.
• **Normal** (Default)**:** Excludes areas outside of the
measurement area. Depending on settings,
having areas outside the measurement area may
increase the measurement time.
• **Fast:** Simplifies and this speeds exclusion
processing, reducing the time effects of having
data outside the read area. However,
measurement results may change depending on
the state of the current image.

Specifying the Windows for Inspection and Measurement

Setting the Execute Conditions

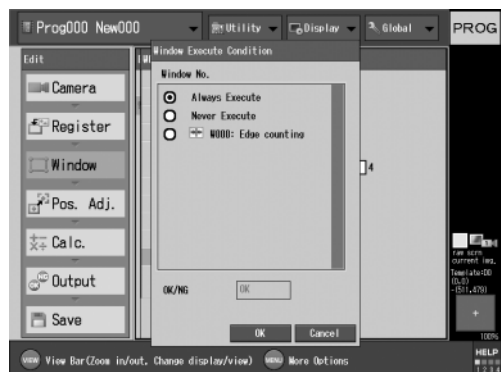The measurement window can be set to execute or not, based on the results of an OK or NG judgment of a specified window. This can be useful for instances where inspections need to be skipped. See "What are Execute Conditions?" (page 4-247) for details.

1 Select [Execute].

The [Window Execute Condition] menu appears.

2 Select an appropriate condition.

- **Always Execute** (Default) **:** Always execute on trigger input.
- **Never Execute:** Do not execute even with trigger input (skip).
- **Window Number (Measurement, Calculation):** Skips or measures depending on the judgment results of the selected window.

Reference

If measurement is skipped, measurement and judgment results for that window become 0 and are not reflected in the final results.

► Note

- If the reference window is set to itself, a circular reference error will result. If this happens, all windows in the same Program No. will have their settings invalidated (set to Always Execute).
- If a circular reference error occurs, a "!" will appear before the window number and the execution conditions to indicate an error.

3 If window number is selected, measurement can be skipped or carried out depending on the judgment results of the specified window.

- **OK:** Executes if the judgment result of the specified window is OK.
- **NG:** Executes if the judgment result of the specified window is NG.

Reference

If no tolerance is set for the selected window, the judgment result is always OK.

4 After completing the settings, select [OK].

Setting the Limits Settings

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

1 Select [Limits].

The [Enter Limits] menu appears.

2 Select an item to set limits for.

3 Select [Uppper] or [Lower] and set the tolerance.

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

- **Count**: The number of edge pitches
- **Width**: Pixels (When measurement area is not a ring or an arc), Degrees (when the measurement area is a ring or an arc)

Reference

- Tolerance can be entered by selecting [Direct Input] and specifying a tolerance or by selecting [Calc Ref] and using the results of a chosen calculation window.
- When primary target (Page 4-140) is set to [All], the maximum pair width is used as the upper limit and the minimum pair width is used as the lower limit.

4 To specify the tolerance of another measurement value, repeat Steps 2 and 3.

5 After completing the settings, select [OK].

Reference

- [-----] indicates that no tolerance has been set and no judgment will take place after measurement.
- Press [Clear] to clear the value.

Specifying the Windows for Inspection and Measurement

Stain

What is the [Stain] Measurement Tool?

Within a specified measurement area, a small area can be defined (element). Within this element, the average intensity is calculated. An area having an intensity more than the threshold level is detected as a stain. This function is convenient when you want to detect flaws on a target. Also, segments with differences in intensity above a certain level are grouped. The number of groups and their positions are measured (stain grouping function), and a subtraction filter is applied. Cracked or stained areas are then extracted. See "What is the Stain Grouping Function ?" (Page 13-17) or "Extracting Defects and Stains with the Subtraction Filter" (Page 4-156) for details.

Reference

- Because stain 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 fluctuations.
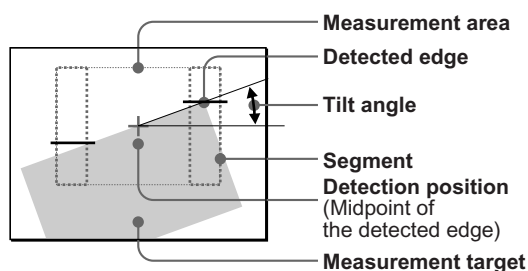- The subtraction filter can be applied to extract defects or stains from the target. For more details, see "Extracting Defects and Stains with the Subtraction Filter" (Page 4-156).

| **Registered image (OK product)** | **Burr (NG product)** | **Crack (NG product)** |
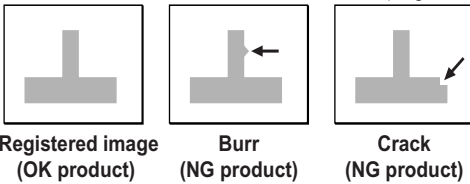
Measurement image

The stain measurement window in stain measurement tool moves in the search direction of in steps of size specified by the segment shift and measures the average intensity of the segment.

Segment size

Segment size

Shift direction

Shift distance
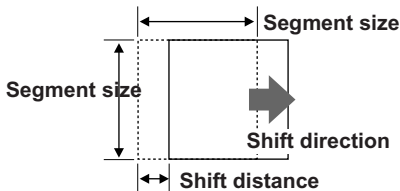
Difference between stain level and stain area

The [Stain Level] is the difference between the maximum and minimum intensities across the last 4 segments, including the current segment.

In the following example, the stain level is the maximum intensity of 120 (current segment + 3 positions) minus the minimum intensity of 80 (current segment + 1 position) for a total of 40 (stain level).

Current segment (average intensity 95)

Current segment +1 (average intensity 80)

Current segment +2 (average intensity 100)

Current segment +3 (average intensity 120)
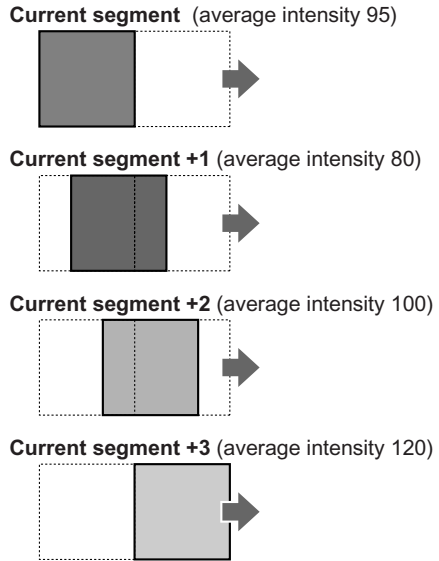
If the threshold set in the [Stain Level] is exceeded, the current segment is judged to be a stain and is added to the [Stain Area] ([Stain Area] is the number of segments that are exceed the stain level).

Example when the detection direction is either X or Y or XY

- Segment
- Detected stain
- Measurement area
- Measurement target
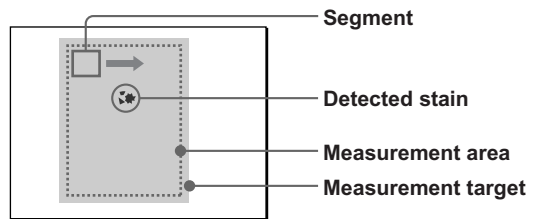
Example when the detection direction is circular

- Segment Moves along the circumference
- Measurement area
- Measurement target
- Detected stain
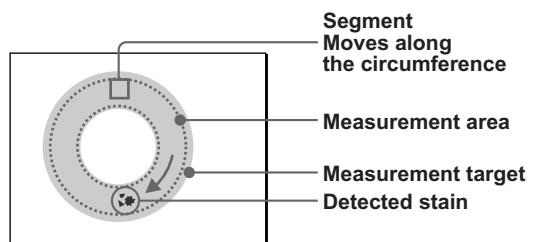
Measurement results

The measurement results that can be output in the stain measurement tool are shown below.

- **Detected Stain Level**: Outputs the intensity difference in the segment with the highest stain level.
- **Total Area**: Outputs the total number of segments with stain levels exceeding the stain level value. (Available in the limits menu)
- **Groups**: Outputs the number of groups detected by the stain grouping function. (Available in the limits menu) (When stain grouping function is ON)
- **Stain Area [ ]**: Creates groups and outputs the total number of segments within the group with stain levels exceeding the stain level value. (Available through outouts) (Available in the limits menu) (When stain grouping function is ON)
- **Center (X,Y) [ ]**: Outputs the coordinate of all groups. The general location of a stain can be measured. When a stain measurement window is specified for position correction (Page 4-249), this value is used as a reference. (Available through outouts) (Available in the limits menu) (When stain grouping function is ON)
- **Position (X,Y)**: Outputs the coordinates of the segment with the highest stain level (available as a reference after calculation or output settings)
- **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.

> **Reference**
> Stain area and group center tolerance are set by the primary target (Default: Label 1).

- **Measurement Area Position**: Outputs the measurement window position in pixels (available as a reference after calculation) Note that polygon measurement area information is not output.

Measurement sample

When a stain on the surface of a target is detected
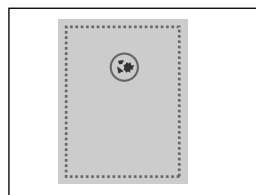
- [Scan Dir.]: XY

Total Area: 20

When a crack or burr on the surface of a target is detected
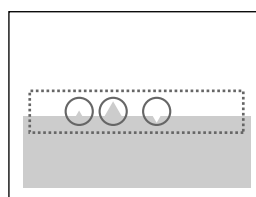
- [Scan Dir.]: X

Total Area: 55

When a crack or burr on the round surface of a target is detected

- [Scan Dir.]: Circular
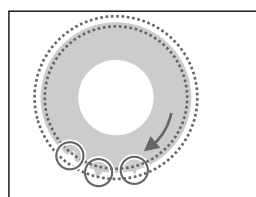
Total Area: 35

When the position of a stain on the surface of a target is detected

- [Scan Dir.]: XY
- Stain Grouping Function: ON
- Number of detected targets: 2
- Detect. Order: Y>X ascending order
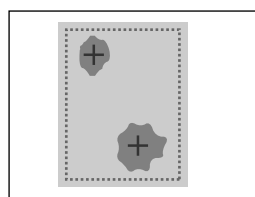
First result
Stain area: 70
Center of gravity
X100, Y100

Second result
Stain area: 100
Center of gravity
X200, Y400
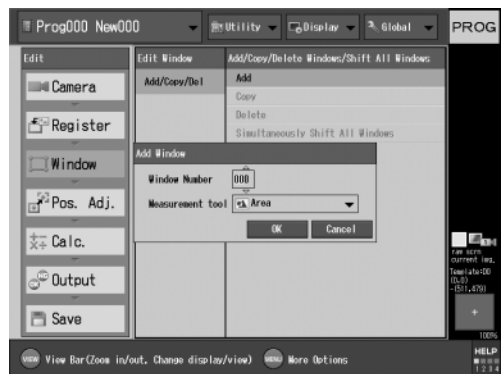
Selecting Measurement Tools

1 **Select [Add/Copy/Del] from the [Edit Window] menu.**


2 **Select [Add].**

The [Add Window] menu appears.

3 **Select [Window Number], then specify the measurement window number.**
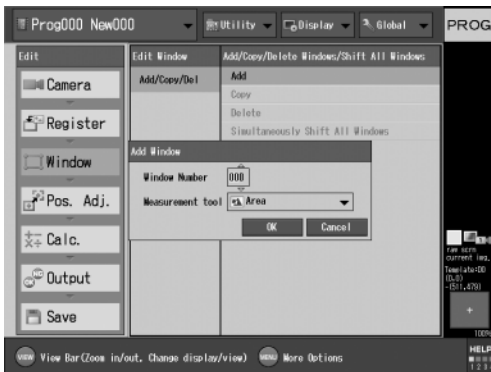

Window numbers can be freely set at any value from 0 to 127 .

4 **Select [Measurement tool] and then select [Stain].**
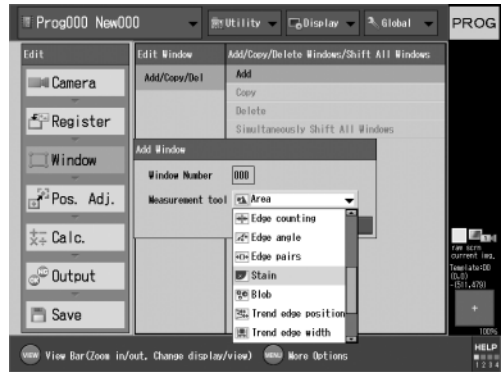
5 **Select [OK].**

A window with the specified number is added as a stain measurement window. The current window setting list is then displayed.

The necessary settings for the stain window are added next.

Selecting a Camera to Take Images

1 Select [Window] and then select the [Stain] measurement window.

The window setting menu appears.

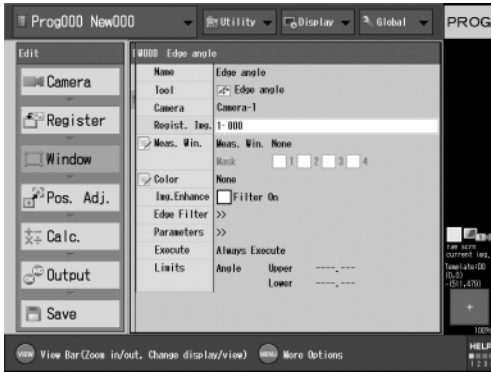### 2 Select [Camera], then selecting a camera to take images

Reference

Unconnected cameras can be selected. However, if the selected camera is not connected at the time of imaging, an error will occur.
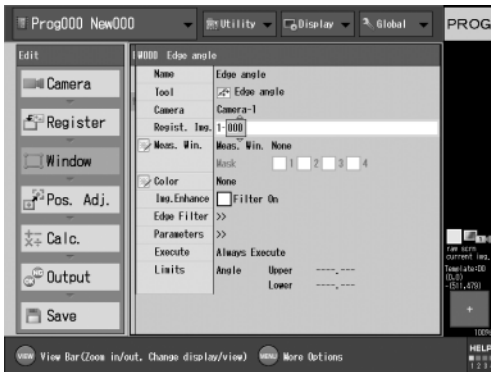
Specifying a Registered Image to Use

Specify a registered image to use for processing.

Reference

The image to be used must have been previously saved to an image number in the [Register Image] menu (Page 4-19).
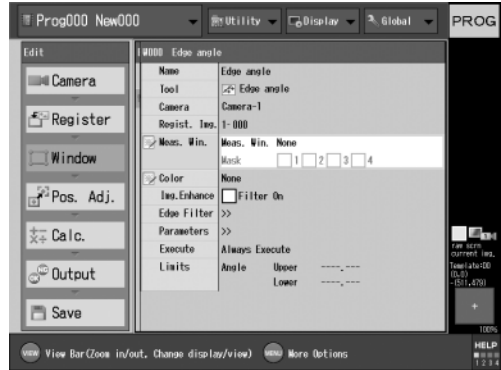
Select [Regist. Img.], then specify the number of the registered image to be used.

The registered image number will be displayed as "Camera number-xxx."

Specifying a Measurement Window

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, see "Excluding an unwanted area (mask window)" located after "Setting the Measurement Area".

1 Select [Meas. Win.].

The [Measurement window] menu appears.

2 Select [Edit] in the [Measurement window] field.

The [Select] menu appears.

3 Select a shape, then select [OK].

► Note

When using the subtraction filter, the edge search area cannot be a rectangle or a ring.

4 Draw the measurement area.

See "Drawing a Measurement Window" (Page 3-13) for details.

5 After completing the drawing, select [Close] in the [Edit] field.

Clearing the measurement area

The measurement area can be cleared by following the procedure below.

1 Select [Delete] in the [Measurement window] field.
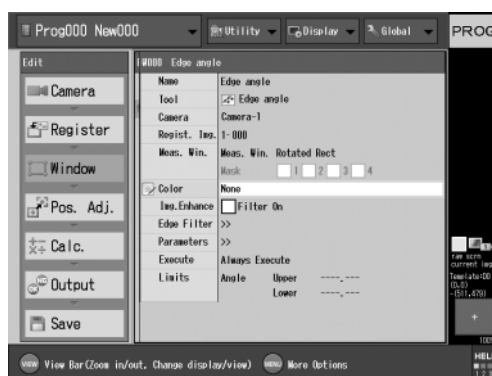
A confirmation screen appears.

2 Select [OK].

Excluding an unwanted area (mask window)

You can set up to 4 areas (mask windows) that will not be measured inside the measurement area. This is useful when the measurement target has a complicated shape or when you want to hide a part an unnecessary part of the target.

Select [Add] in the [Mask window] field.

The [Add mask window] menu appears.
See "Exclude Part of the Measurement Window (Mask Window)" (Page 3-25) for details.

Extracting a Color

When using a color camera, color images can be converted to black and white through an extraction process.
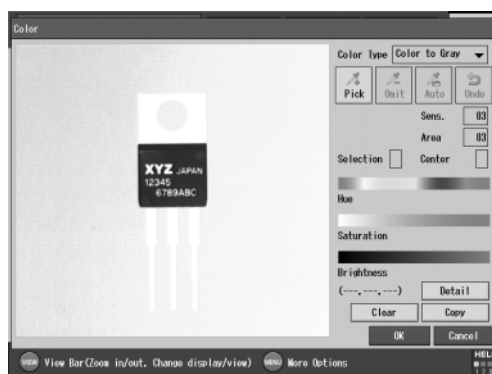
► Note

This feature is not available when using a monochrome camera.
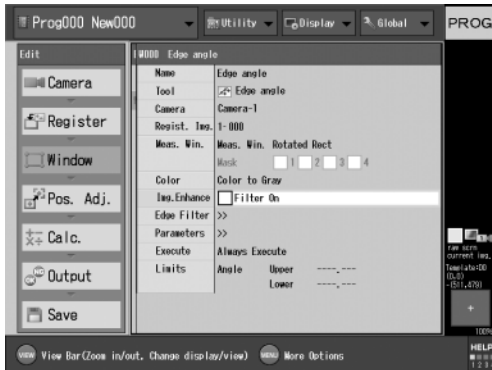

Select [Color].

The [Color] menu appears.

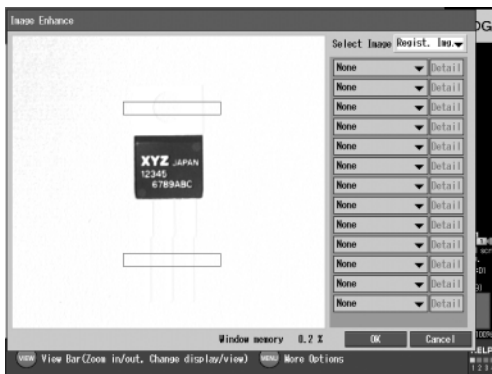See "Processing a Color Image [Color]" (Page 13-1) for details on color extraction.

Selecting an Image Enhancement

Specify an appropriate filter for the image.
When using a color camera, the filter is applied to pixels of the extracted color.

1 Select [Img. Enhance].

The [Image Enhance] menu appears.

## 2 Select a filter to use, then select [OK].

See "Filter List" (Page 13-9) for details on the individual filters.

Reference

• More advanced filter settings can also be made by selecting [Detail].
• Up to 13 filters can be used. When multiple filters are set, they are executed starting from the filter specified in the top portion of the screen.

Setting the Stain Detection Conditions

Specify conditions for stain search, including search direction and segment size

1 Select [Condition].

The [Select Detection Condition] menu appears.
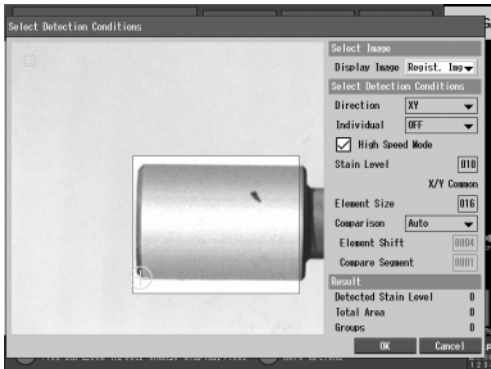
The element that detects the stain is displayed on the upper left of the screen as an outline.

- **Orange Outline**: Represents the size of the segment.
- **Purple Outline**: Represents the movement of the segment.
- **Light Blue Outline**: Represents the relative shift distance of the segment.

Reference

By changing the display template to [D3: Contrast View] on the VIEW bar, segments found to have stain levels that exceed the threshold can be displayed in descending order by level, red→yellow→green→blue. It is convenient to apply this template when setting the detection conditions as it shows the contrast of the detected stains.

2 Select [Display Image], and then specify an image to display in the stain search condition setting menu.

- **Regist. Img.**: Displays the image selected in [Specifying a Registered Image to Use]. (Page 4-147)
- **Current Img.**: Displays the current image from the camera selected in [Selecting a Camera to Take Images]. (Page 4-147)

3 Select [Scan Dir.], and then select the direction of detecting the stain.

- **XY**: Detects intensity differences in the X-direction and Y-direction.
- **X**: Detects intensity differences in the X-direction.
- **Y**: Detect intensity differences in the Y-direction.
- **Ring**: Detects intensity differences in the ring direction.
- **Radius**: Detects intensity differences radially from the inside of a ring/arc outward.

► Note

- Ring and radius search directions are only available when the search area is a ring or an arc.
- When the search region is a ring and the search direction is ring or radius, the stain grouping function is not available.
- When the search region is a rotated rectangle, the XY coordinates move with the rotation of the region.

4 To make different segment conditions each search direction, select [Individual], then select [ON].

This will allow you to set different segment sizes and movement distances in the X and Y directions (or radius and ring directions, if the search area is a ring or an arc).

5 To increase the speed of measurement, put a check in the box next to [High Speed Mode].

When fast mode is selected, segment size and movement distance must be set to multiples of 4. Also, if the measurement area extends off of the screen, a measurement error (stain area 9999999) will result and the contrast view within the measurement area will be cancelled.

6 **Select [Stain Level], then specify the difference in the average intensity that will be considered stain.**

Stains that deviate from the average by less than this amount will not be considered stains. The stain level can be specified within the range of 0 to 254 (Default: 10).

Reference

Calculated reference values can also be used in place of direct input.

7 **Select [Element Size], then specify the size of the element that moves inside the measurement window**

Specify the size of the element in the range of 1 to 256 (pixels). (Default: 16)

► Note

If the segment size is larger than the measurement window, the measurement does not take place and the stain level becomes "9999999".

8 **To record gradual changes in intensity as a greater amount of stain, select [Comparison] and then [Manual] , then make the necessary settings.**

The stain tool is initially set to detect sharp changes in contrast within the measurement area. This is because it calculates the intensity difference between 2 neighboring element scans, and by default those neighboring scans are only a few pixels apart. However, there may be cases where it is necessary to detect gradual changes in contrast, such as when trying to detect color irregularities on a target surface. In such a case, large stains can be detected by changing the settings of [Element Shift] or [Compare Segment] to allow detection of intensity differences across long distances.

• **Element Shift**: Specifies the number of pixels, 1-1600, to shift between elements when calculating the average intensity. When [Auto] is selected, this is automatically set to 1/7 of the segment size. Note also that when fast mode is selected, this must be set to a multiple of 4.

• **Compare Segment**: Specifies the number of segments, 1-1600, to use as an interval when comparing the difference in intensity between elements (Default: 1). When [Auto] is selected, this is normally set to 1.

► Note

• If the value of [Element Shift] is larger than the element size, some parts of the measurement area will not be reflected in the intensity average. To detect stains smaller than the segment size, use [Auto] or specify a segment shift smaller than the element size.

• A larger value for [Compare Segment] increases the risk of a single stain being detected more than once. When using the grouping function (Page 4-152) and measuring the number of groups, lower the value of [Compare Segment].

9 **Check the [Result] field to confirm the results from searches made under the conditions set in steps 3 to 8.**

• **Detected Stain Level**: Displays the highest stain level (0~255) in the currently displayed image.

• **Total Area**: Displays the total number of stains for the image being displayed.

• **Groups**: Displays the number of groups found in the image being displayed. Note that, when the grouping function is [OFF], this is generally displayed as [0].

10 **After completing the settings, select [OK].**

Setting Other Detection Conditions

Set other stain measurement conditions as necessary.

1   Select [Parameters].

Select [Tool Parameters]. The [Tool Parameters] menu appears.

2   Make the necessary settings.

After completing the settings, select [OK].

Changing the reference position of the origin

Specify the reference position of the origin in [Origin] in the [Tool Parameters] menu.
Make the necessary settings in the [Origin] menu.

• **specified point** (Default): The origin point is set at the top left of the screen by default. 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 [Pos. X] and [Pos. Y] fields.

> **Reference**
>
> If [specified point] has been selected, the origin point can be set outside the process area. The range of points you can set is from -9600 to 9600 (X) and -7200 to 7200 (Y).

Selecting the coordinate system for position adjustment

You can select the coordinate system using [Coordinate Value] in the [Tool Parameters] menu. If a position correction (Page 4-249) is not being done, this setting will have no effect on the output.

• **[After Position Adjust]** (Default): If the position of the window used as the source of correction has shifted, the amount of this error is reflected on the measurement.

• **[Before Position Adjust]**: The distance from the position of the "Origin point" is measured.

> **Reference**
>
> These settings are reflected when the measurement window area position from the calculation is referenced.

Grouping and managing adjacent stains

These settings can be made in [Grouping] on the [Tool Parameters] menu.When this feature is [ON], adjacent stains are grouped so that the center point and total stain of each group can be detected.

• **ON**: Groups stains.

• **OFF** (Default): Does not group stains.

> **► Note**
>
> Grouping is unavailable if the detection area is a ring and the [Scan Dir.] (Page150) is [Ring] or [Radius].

Specifying the maximum number of groups

You can set the maximum number of targets using [Count] on the [Tool Parameters] menu. The range of values you can specify is from 1 to 99 (Default: 1) Note that, when the grouping function is [OFF], this setting cannot be used.

► Note

The maximum number of groups that can actually be detected changes depending on the settings.

Specifying the upper limit and lower limit values of the groups that will be detected as stains

You can set the maximum number of targets using [Upper Stain Area] or [Lower Stain Area] on the [Tool Parameters] menu. Note that, when the grouping function is [OFF], this setting cannot be used.

- **Upper Stain Area**: Groups with stain area higher than the maximum value are not detected as stains.
- **Lower Stain Area**: Groups with stain area lower than the minimum value are not detected as stains.

Selecting the conditions for sorting groups

You can select the group sorting conditions using the [Detect. Order] on the [Tool Parameters] menu.

- If the scan window is arc or the scan direction is <u>not</u> [Ring] or [Radius], select one of the following 8 ways to sort the labels to groups.
  - **Y>X:Ascend**: Reorders in ascending Y order. When Y values are the same, reorders in ascending X order.
  - **X>Y:Ascend**: Reorders in ascending X order. When X values are the same, reorders in ascending Y order.
  - **X:Ascend**: Reorders in ascending X order.
  - **X:Descend**: Reorders in descending X order.
  - **Y:Ascend**: Reorders in ascending Y order.
  - **Y:Descend**: Reorders in descending Y order.
  - **Area:Ascend**: Reorders from lowest stain area to highest.

- **Area:Descend**: Reorders from highest stain area to lowest.

  ► Note

  When the search region is a rotated rectangle, the XY coordinates move with the rotation of the region.

- If the scan window is arc or the scan direction is [Ring] or [Radius], select one of the following 6 ways to apply labels to groups.
  - **Clockwise**: Reorders based on angle, clockwise from the measurement window.
  - **Counter CW**: Reorders based on angle, counter-clockwise from the measurement window.
  - **Out → Center**: Reorders based on distance from center of the measurement window, starting with the farthest.
  - **Center → Out**: Reorders based on distance from center of the measurement window, starting with the furthest.
  - **Area:Ascend**: Reorders from lowest stain area to highest.
  - **Area:Descend**: Reorders from highest stain area to lowest.

Note that, when the grouping function is [OFF], this setting cannot be used.

Specifying the group to be evaluated

You can specify which group will use the set tolerances for judgment using the [Primary Target] on the [Tool Parameters] menu.

Up to 99 can be set, but [1] is the default value. Note that, when the grouping function is [OFF], this setting cannot be used.

► Note

Only data for the group set in [Primary Target] will be can be used for judgment (excluding total stain area and group measurements).

Setting the Execute Conditions

The measurement window can be set to execute or not, based on the results of an OK or NG judgment of a specified window. This can be useful for instances where inspections need to be skipped. See "What are Execute Conditions?" (Page 4-247) for details.

1 **Select [Execute].**

The [Window Execute Condition] menu appears.

2 **Select an appropriate condition.**

- **Always Execute** (Default) **:** Always execute on trigger input.
- **Never Execute:** Do not execute even with trigger input (skip).
- **Window Number (Measurement, Calculation):** Skips or measures depending on the judgment results of the selected window.

Reference

If measurement is skipped, measurement and judgment results for that window become 0 and are not reflected in the final results.

► Note

- If the reference window is set to itself, a circular reference error will result. If this happens, all windows in the same Program No. will have their settings invalidated (set to Always Execute).
- If a circular reference error occurs, a "!" will appear before the window number and the execution conditions to indicate an error.

3 **If window number is selected, measurement can be skipped or carried out depending on the judgment results of the specified window.**

- **OK:** Executes if the judgment result of the specified window is OK.
- **NG:** Executes if the judgment result of the specified window is NG.

Reference

If no tolerance is set for the selected window, the judgment result is always OK.

4 **After completing the settings, select [OK].**

Setting the Limits Settings

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

1 Select [Limits].

The [Enter Limits] menu appears.

2 Select an item to set limits for.

3 Select [Uppper] or [Lower] and set the tolerance.

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

- **Total Area**: Total stain area in the measurement
  window.

- **Groups**: Number of stain groups
- **Stain Area**: Stain area of groups specified as
  primary targets.
- **Grp. Cent.**: Center position of groups specified
  as primary targets.

Reference

Tolerance can be entered by selecting [Direct Input] and
specifying a tolerance or by selecting [Calc Ref] and
using the results of a chosen calculation window.

4 To specify the tolerance of another measurement value, repeat Steps 2 and 3.

5 After completing the settings, select [OK].

Reference

- [-----] indicates that no tolerance has been set and no
  judgment will take place after measurement.
- Press [Clear] to clear the value.

Extracting Defects and Stains with the Subtraction Filter

About the subtraction filter

The subtraction filter outputs the difference picture created by aligning a registered image with the current image and determining the difference in contrast at each point. This is useful for finding changes such as dirt, cracks, and deformation, in the original registered image. Using this function together with stain measurement (Page 4-144) and position correction (Page 4-249) improves your ability to find stains and defects.

► **Note**

- The subtraction filter is unavailable if the measurement window is set to an auto-adjust rectangle or auto-adjust circle.
- The subtraction filter is unavailable for a pattern search window, a ShapeTrax window, or an OCR measurement window.
- The subtraction image only displays in display template D3 when display template D1 and stain measurement are not set.
- If the registered image required for the subtraction filter is not registered, measurement and display cannot be performed correctly.

Processed image

Registered image   Current image   Subtraction image

Hole size changed

Characters lost

Pin bent

Subtraction filter process

Registered image | Current image

Color extraction (color camera only)

Position adjustment (if position has shifted)

Subtraction filter
Calculates the definite subtraction value of the contrast between the current image and the registered image.

Subtraction image
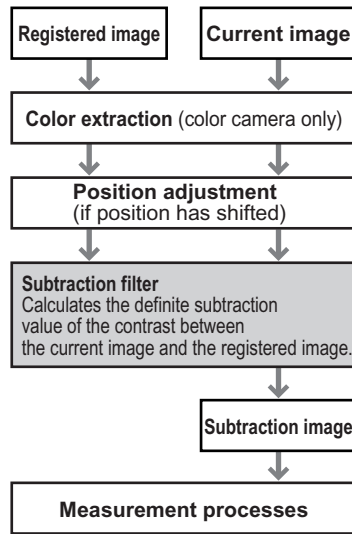
Measurement processes
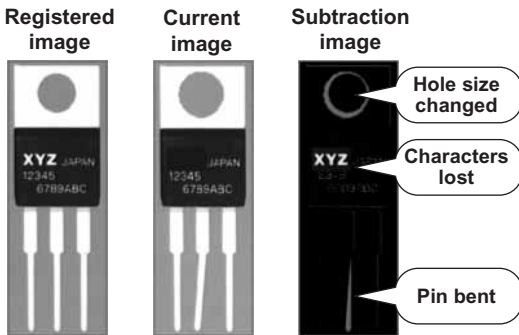
Operational flow

1 Set the stain measurement window in which to apply the subtraction filter.
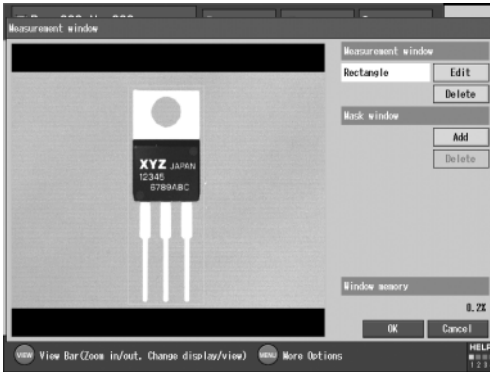
Select stain measurement as the inspection window. See stain measurement (Page 4-144) for details on how to set windows.

► Note

The image used as the basis for the subtraction filter must first be saved as a registered image. Otherwise, measurement and display cannot be performed correctly.

2 Set the image enhancement to [Subtract] for the window.
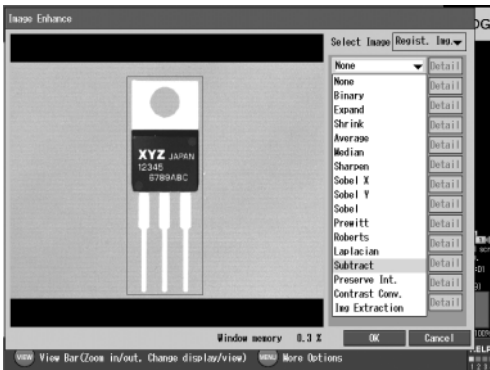
Select [Img. Enhance] under [Image Enhance], then select [Subtract].

Reference

When [Subtract] is selected, the currently displayed image is processed, sometimes causing the screen to go black.

If this happens, change the display from the registered image to the current image or use the SCREEN button on the console to change the display template to D0.

3 More advanced filter settings can also be made by selecting [Detail].

Mask Area

The mask region is generated by differences in registered image and the current image and cancels noisy subtraction information. Any number of repetitions from 0 to 9 (Default: 2) can be set. A larger number means better noise suppression, but also a loss in sensitivity to smaller defects.

Extract

Select a method for indicating intensity in the subtraction image.

- **Bright & Dark** (Default)**:** Displays regions either lighter or darker than the registered image in the subtraction image.
- **Bright** : Displays regions lighter than the registered image in the subtraction image.
- **Dark** : Displays regions darker than the registered image in the subtraction image.

Changes in the subtraction image based on extraction settings.

Registered image (OK product) / Current image (NG product)

Subtraction image (Bright & Dark) / Subtraction image (Bright) / Subtraction image (Dark)
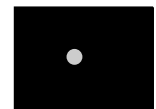
Reference

- To exclude random shiny areas and extract only black dots, chose the [Dark] setting. Shiny sections can be eliminated from the subtraction filter.
- Change the display image to [Current Img.] to view the results of the filter immediately.

Specifying the Windows for Inspection and Measurement

4 After completing the settings, select [OK].

5 Set the position adjustment window to correct for any target movement.
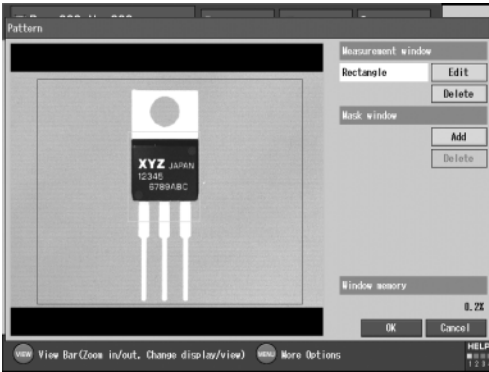
If there's a position change between the registered image and the current image, the subtraction filter will show those differences. To prevent this problem, perform position correction (Page 4-249) with features such as pattern search.
See pattern search (Page 4-33) for details on the necessary settings.

Example of error due to position mismatch
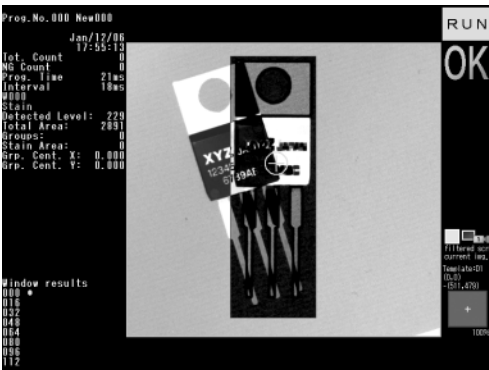
Reference
Position correction can be done with tools other than the pattern search, using the edge position (Page 4-76) or blob (Page 4-159) for example.

6 Link the stain window to the position adjustment window
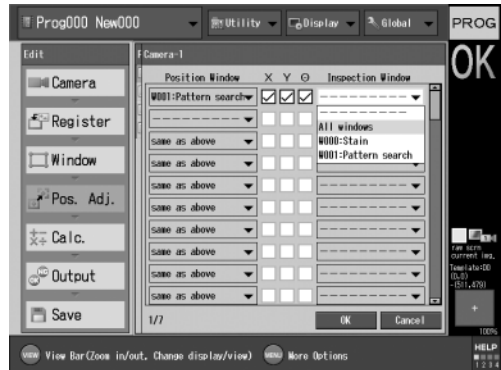
Using the inspection tool set in step 5 as the "Position Window", set the stain window to "Inspection Window" in the Pos. Adj. Menu. [All windows] can also be specified as the "Inspection Window".
See position correction (Page 4-249) for details on how to make these settings.

Reference
In addition to position correction to fix position mismatch, overall brightness correction can be applied to fix changes in brightness. To reduce the effects of overall brightness correction on the subtraction image, apply the preserve intensity filter before the subtraction filter in [Image Enhance]. See "Reducing the Impact of Intensity Change Using the Preserve Intersity Filter" (Page 13-13) for details.

Blob

What is the [Blob] Measurement Tool?

A continuous grouping of pixels that have the same intensity value (255 to 0) on the binary image is called a blob. In addition to determining the number of blobs in the measurement area, the [Blob] measurement tool can also measure the area, center of gravity, angle of major axis, feret diameter, perimeter, and roundness of each of the blobs.

Measurement image

The blobs are measured and controlled by assigning them target numbers. They can be ordered based on size or scan direction.
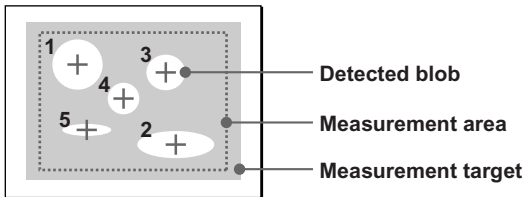
Measurement results

The measurement results that can be output in the Blob measurement tool are as follows.

- **Count**: Outputs the number of detected blobs.
- **Center (X,Y) [ ]**: Outputs the center of gravity coordinates for all of the detected blobs. (Available through outputs) (Available in the limits menu)
- **Center (X,Y) (Max, Min)**: Outputs the maximum and minimum center of gravity coordinates from the detected blobs. (Available in the limits menu)
- **External Contact (Upper Left, Lower Left, Upper Right, Lower Right) [ ]**: Outputs the coordinates of the rectangles circumscribed around any detected blobs. (available as a reference after calculation) (Available through outputs)
- **Angle (X,Y) [ ]**: Outputs the angle of major axis (in reference to the horizontal X-axis) of all the detected blobs. (Available through Outputs) (Available in the limits menu)
- **Angle (X,Y) (Max, Min)**: Outputs the maximum and minimum angle of major axis from the detected blobs. (Available in the limits menu)
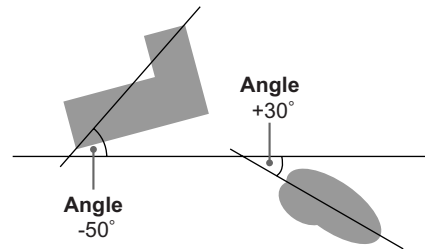
- **Feret (X,Y) [ ]**: Outputs the lengths in pixels of the sides (ferets) that are parallel with the horizontal (X) axis and vertical (Y) axis of the circumscribed rectangle of the blob. (Available through outputs) (Available in the limits menu)
- **Feret (X,Y) (Max, Min)**: Outputs the maximum or minimum value of the ferets of all detected blobs. (Available in the limits menu)

Specifying the Windows for Inspection and Measurement
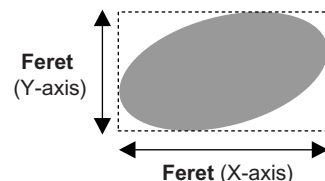
- **Round [ ]**: Outputs the roundness of all of the detected blobs using a numeric value (0.000 to 1.000). A perfect circle is output as a value of 1.000. A lower number is output as the similarity to a perfect circle decreases..
- **Round (X,Y) (Max, Min)**: Outputs the maximum and minimum value of roundness from the detected blobs. (Available in the limits menu)

Nearly perfectly circle
Roundness: 0.950

Far from circle
Roundness: 0.345

- **Area [ ]**: Area of each blob is output in pixels. (Available through outputs) (Available in the limits menu)
- **Area (Max, Min)**: Outputs the maximum or minimum value of the area from all detected blobs. (Available in the limits menu)
- **Perimeter [ ]**: Outputs the perimeter of each blob in pixels. (Available through outputs) (Available in the limits menu)
- **Perimeter (Max, Min)**: Outputs the maximum or minimum value of the perimeter from all detected blobs. (Available in the limits menu)
- **OK/NG**: If the measurement value exceeds the specified tolerance (upper and lower limits) or the specified blob does not exist, an [NG] message is displayed. If it is within the specified tolerance, an [OK] message is displayed.

> **Reference**
>
> Tolerances other than label count are set by the primary target (Default: Label 1). If the primary target is set to [All], the tolerance for each item becomes the maximum and minimum for that item.

- **Measurement Area Position**: Outputs the measurement window position in pixels (available as a reference after calculation). Note that polygon measurement area information is not output.

Measurement sample

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

- Y>X ascending
- Blob designation: 3
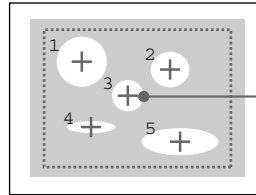
Number of blobs:
5
Blob to be measured
Center of gravity:
X:600, Y:460
Area: 20,000
Roundness: 0.85

Blob

Specifying the Windows for Inspection and Measurement

Selecting Measurement Tools

1 **Select [Add/Copy/Del] from the [Edit Window] screen.**
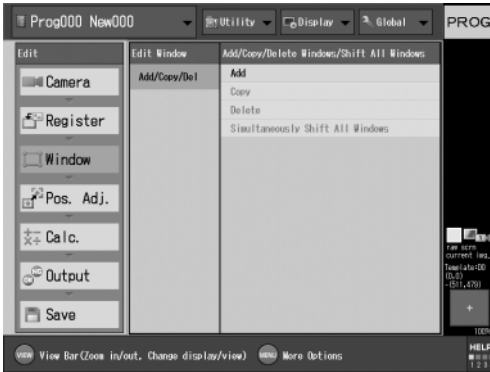
2 **Select [Add].**

The [Add window] menu appears.

3 **Select [Window Number], then specify the measurement window number.**

Window numbers can be freely set at any value from 0 to 127 .

4 **Select [Measurement tool] and then select [Blob].**
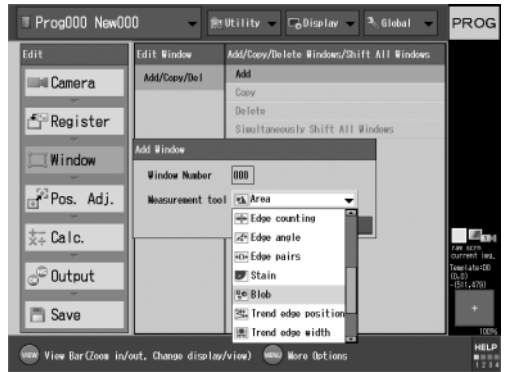
5 **Select [OK].**

A window with the specified number is added as a blob measurement window. The current window setting list is then displayed.
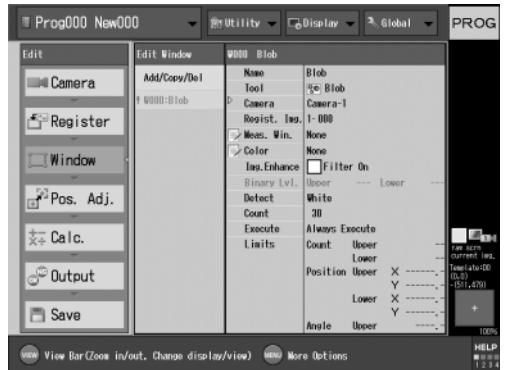
The necessary settings for the blob window are added next.

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Selecting a Camera to Take Images

1 **Select [Window] and then select the [Blob] measurement window.**

The window setting menu appears.

2 **Select [Camera], then select a camera to use for the inspection.**

Unconnected cameras can be selected. However, if the selected camera is not connected at the time of imaging, an error will occur.

Specifying a Registered Image to Use

Specify a registered image to use for processing.

The image to be used must have been previously saved in the [Register Image] menu (Page 4-19).

Select [Regist. Img.], then specify the number of the registered image to be used.

The registered image number will be displayed as "Camera-xxx."

Specifying a Measurement Window

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, see "Excluding an unwanted area (mask window)" located after "Setting the Measurement Area".

1 Select [Meas. Win.].

The [Measurement window] menu appears.

2 Select [Edit] in the [Measurement window] field.

The [Select] menu appears.

3 Select a shape, then select [OK].

4 Draw the measurement area.

See "Drawing a Measurement Window" (Page 3-13) for details.

5 After completing the drawing, select [Close] in the [Edit] field.

Clearing the measurement area

The measurement area can be cleared by following the procedure below.

1 Select [Delete] in the [Measurement window] field.

A confirmation screen appears.

2 Select [OK].

Excluding an unwanted area (mask window)

You can set up to 4 areas (mask windows) that will not be measured inside the measurement area. This is useful when the measurement target has a complicated shape or when you want to hide an unnecessary part of the target.

Select [Add] in the [Mask window] field.

The [Add mask window] menu appears.
See "Exclude Part of the Measurement Window (Mask Window)" (Page 3-25) for details on the following information.

Extracting a Color

When using a color camera, color images can be converted to black and white through an extraction process.

► **Note**

This feature is not available when using a monochrome camera.

Select [Color].

The [Color] menu appears.

See "Processing a Color Image [Color]" (Page 13-1) for details on color extraction.

Selecting an Image Enhancement

Specify an appropriate filter for the image.
When using a color camera, the filter is applied to pixels of the extracted color.

1 Select [Img. Enhance].

The [Image Enhance] menu appears.

2 Select a filter to use, then select [OK].

See "Filter List" (Page 13-9) for details on the individual filters.

Reference

- More advanced filter settings can also be made by selecting [Detail].
- If [Color to Gray] or [Gray] are selected, [Binary] will be automatically added to the front of the filter.
- Up to 13 filters can be used. When multiple filters are set, they are executed starting from the filter specified in the top portion of the screen.

Setting the Binary Level

Because blob measurements require a binary image, set a threshold and create a binary (black and white) image.

► Note

If [Color to Binary] is selected, the following procedures are required.
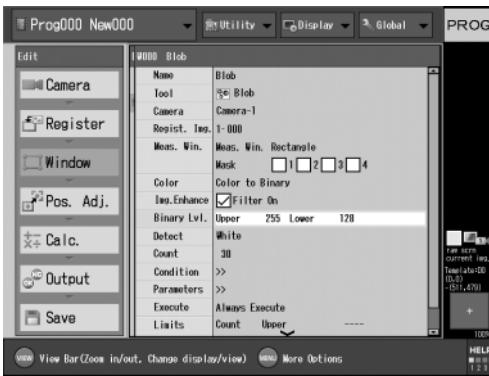
► Reference

Settings made here will be reflected in the binary filter settings.

1 Select [Binary Lvl].

The [Select Binary Lavel] menu appears.

2 Select [Upper], 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] 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 [OK].

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

You can set the upper and lower limit values of the binary level by displaying the intensity distribution of the image as a histogram.

1 In the [Select Binary Level] menu, select the LO line (lower limit) in the [Histogram] field, then move the [ENTER] button to set the lower limit line.

2 Select the UP line (upper limit) and then use the [ENTER] button to set the upper line.

► Reference

When the measurement window is not set, intensity distribution over the entire screen is shown as the histogram.

3 After completing the settings, select [OK].

Specifying the Color to Detect

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

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

- **White**(Default): White blobs are the target of measurement.
- **Black**: Black blobs are the target of measurement.

Setting the Number of Blobs to Search for

Specify the maximum number of blobs to be searched for. For example, when [3] is set, the position of up to 3 targets can be detected.
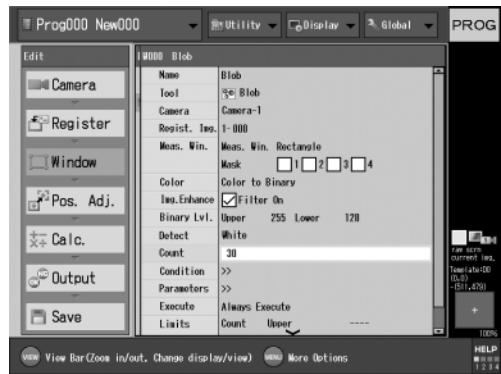
► **Note**

The maximum number of blobs that can actually be detected changes depending on the settings.

1 Select [Count].

The [Count] menu appears.
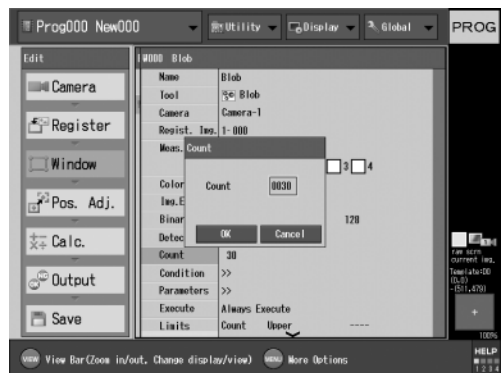
2 Select [Count] and set the maximum number of blobs (1-9999) to search for (Default: 30).

3 After completing the settings, select [OK].

Setting the Blob Detection Conditions

Specify the detailed conditions for the blob search.
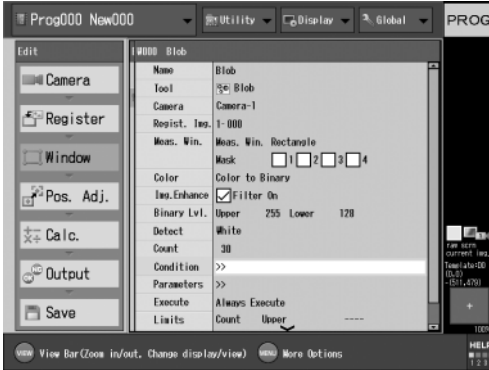
1 Select [Conditon].

The [Select Detection Condition] menu appears.

2 Select [Select Image], and then specify an image to display on the [Select detection condition] menu.

- **Regist. Img.**: Displays the image selected in [Specifying a registered image to use] (Page 4-162).
- **Current Img.**: Displays the current image from the camera selected in [Selecting a Camera to Take Images](Page 4-162).

3 In the [Area Filter], specify the upper limit and lower limit values of the areas that will be detected as blobs.

The blobs that are larger than the specified upper limit value or smaller than the specified lower limit value are not detected as blobs. Specify the upper limit and lower limit values when using

the [Area Filter]. The default setting values are 9999999 for the upper limit value and 100 for the lower limit value.

4 In the [Roundness Filter], specify the upper limit and lower limit values of the roundness that will be detected as blobs.

The blobs that have roundness values larger than the specified upper limit value (their shapes are closer to a circle) or the blobs that have roundness values smaller than the specified lower limit value are not detected as blobs. When using the roundness filter, specify [ON] for [Roundness Filter], and then specify the upper limit and lower limit values. The default setting values are 1.000 for the upper limit value and 0 for the lower limit value.

5 Specify whether the inside of the blob should be filled with the color or not

If the inside of a blob contains an area having different color than the [Detect] color, the measurement of area, center of gravity, main axis angle, or roundness could possibly be affected. In order to prevent this, the inside of the blobs can be filled by the [Detect] color as follows.

Fill holes: OFF   **Fill holes: ON**

- **OFF**: Blobs are not filled.
- **ON** (Default): Blobs are filled.

6 In [Active Border], specify whether the blobs that are touching or crossing the measurement window frame lines (Meas. Win) should be inspected or not.

- **OFF** (Default): Blobs existing on top of the frame lines of the measurement area are included as detected targets.
- **ON**: Blobs existing on top of the frame lines of the measurement area are excluded as detected targets and are not inspected.

▶ **Note**

The active border ON/OFF setting can only be specified when the measurement area is a rectangle. If any other measurement area is selected, the active border will be processed as if set to OFF.

Specifying the Windows for Inspection and Measurement

7 **Select the blob numbering order in [Detect. Order]**

The following 12 sorting methods are available for assigning numbers to blobs (Default: Area:Desc.).

- **Y>X:Ascend**: Sorts blobs in ascending Y order. When Y values are the same, reorders in ascending X order.
- **X>Y:Ascend**: Sorts blobs in ascending X order. When X values are the same, reorders in ascending Y order.
- **X:Ascend**: Sorts blobs in ascending X order.
- **X:Descend**: Sorts blobs in descending X order.
- **Y:Ascend**: Sorts blobs in ascending Y order.
- **Y:Descend**: Sorts blobs in descending Y order.
- **Area:Ascend**: Sorts blobs from lowest area to highest.
- **Area:Descend**: Sorts blobs from highest area to lowest.
- **Round.:Asc.**: Sorts blobs from lowest roundness value to highest.
- **Round.:Desc.**: Sorts blobs from highest roundness value to lowest.
- **Clockwise**: Sorts blobs based on angle, clockwise from the start angle.
- **Counter CW**: Sorts blobs based on angle, counter-clockwise from the start angle.

Specify a starting angle for use when the blob order is [Clockwise] or [Counter CW]

Specify an angle at which to start sorting under [Start Angle].

► **Note**
These cannot be specified if the [Detect. Order] is not [Clockwise] or [Counter CW].

8 **Specify a range of angles to be output under [Angle Range].**

- **None**: No main angle is specified and 0 degrees is output. (Processing is faster)
- **180°** (Default): Outputs from -89.999 to 90.000 degrees.
- **360°** : Outputs from -179.999 to 180.000 degrees.

► **Note**
The system may become unstable when symmetrical shapes are detected as blobs and 360 degrees is specified.

9 **In [Prim. Target], specify the blob(s) that will become targets of judgment (limits).**

- **When judging all blobs**: Set [Prim. Target] to [All]. The minimum and maximum values from all the detected blobs are used for the window judgment.
- **When judging a specific blob**: Set [Prim. Target] to [Specify], then enter the blob number to be judged. Only the blob that is specified here becomes the target of judgment.

The default is [Specify] and [1].

10 **After completing the settings, select [OK].**

Setting Other Detection Conditions

Set other blob conditions as necessary.

1 Select [Parameters].

The [Tool Parameters] menu appears.

2 Make the necessary settings.

After completing the settings, select [OK].

Changing the reference position of the origin

Specify the reference position of the origin in [Origin] on the [Tool Parameters] menu.
Make the necessary settings on the [Origin] menu.

- **specified point** (Default): The origin point is set at the top left of the screen by default. To change the origin, select [Edit] from the [Origin] menu. 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 [Pos. X] and [Pos. Y] fields.

- **registered point**: Uses the detected primary target position in the registered image as its center of gravity. The present origin point is displayed in the [Pos. X] and [Pos. Y] fields.

Reference

- To measure the amount of error (deviation) from the reference position where the image is registered, select [registered point].
- If [specified point] has been selected, the origin point can be set outside the process area. The range of points you can set is from -9600 to 9600 (X) and -7200 to 7200 (Y).

Selecting the coordinate system for position adjustment

You can select the coordinate system using [Coordinate Value] in the [Tool Parameters] menu. If a position correction (Page 4-249) is not being done, this setting will have no effect on the output.

- **[After Position Adjust]** (Default): If the position of the window used as the source of correction has shifted, the amount of this error is reflected on the measurement.

- **[Before Position Adjust]**: The distance from the position of the "Origin point" is measured.

Select the blobs to be displayed as targets

This can be set from [Display] on the [Tool Parameters] menu.

- **All**(Default): Outputs the detected positions of all blobs to the screen. Note that Primary targets are displayed with thick green lines.

- **Prim.** : Outputs the detected position of only the primary blob on the screen.

Setting the Execute Conditions

The measurement window can be set to execute or not, based on the results of an OK or NG judgment of a specified window. This can be useful for instances where inspections need to be skipped. See "What are Execute Conditions?" (Page 4-247) for details.

1 Select [Execute].

The [Window Execute Condition] menu appears.

2 Select an appropriate condition.

- **Always Execute** (Default) **:** Always execute on trigger input.
- **Never Execute:** Do not execute even with trigger input (skip).
- **Window Number (Measurement, Calculation):** Skips or measures depending on the judgment results of the selected window.

Reference

If measurement is skipped, measurement and judgment results for that window become 0 and are not reflected in the final results.

► Note

- If the reference window is set to itself, a circular reference error will result. If this happens, all windows in the same Program No. will have their settings invalidated (set to Always Execute).
- If a circular reference error occurs, a "!" will appear before the window number and the execution conditions to indicate an error.

3 If window number is selected, measurement can be skipped or carried out depending on the judgment results of the specified window.

- **OK:** Executes if the judgment result of the specified window is OK.
- **NG:** Executes if the judgment result of the specified window is NG.

Reference

If no tolerance is set for the selected window, the judgment result is always OK.

4 After completing the settings, select [OK].

Setting the Limits Settings

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

1 Select [Limits].

The [Enter Limits] menu appears.

2 Select an item to set limits for.

3 Select [Uppper] or [Lower] and set the tolerance.

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

- **Count**: Number of blobs
- **Area**: Pixels
- **Position**: Pixels
- **Feret**: Pixels
- **Angle**: Degrees
- **Perimeter**: Pixels
- **Roundness**: Number in the range of 0.000 to 1.000 (1.000 = complete circle)

Reference
- Tolerance can be entered by selecting [Direct Input] and specifying a tolerance or by selecting [Calc Ref] and using the results of a chosen calculation window.
- When primary target is set to [All], the maximum label measurement is used as the upper limit and the minimum label measurement is used as the lower limit.

4 To specify the tolerance of another measurement value, repeat Steps 2 and 3.

5 After completing the settings, select [OK].

Reference
- [-----] indicates that no tolerance has been set and no judgment will take place after measurement.
- Press [Clear] to clear the value.

Trend Edge Position

What is the [Trend Edge Position] Measurement Mode?

An edge position scan (segment) is performed repeatedly within the measurement window area to find multiple edge position values. The maximum, minimum, and average edge position values can be measured as well as other parameters about each specific edge scan segment.

Measurement image

When the measurement area is a rectangle or a rotated rectangle
In the case when the detection direction "→" and direction of trend is "↓"

- Segment shift distance
- Segment size
- Detected edge (max. value)
- Trend direction
- Detected edge (min. value)
- Measurement target
- Measurement area
- Scan direction
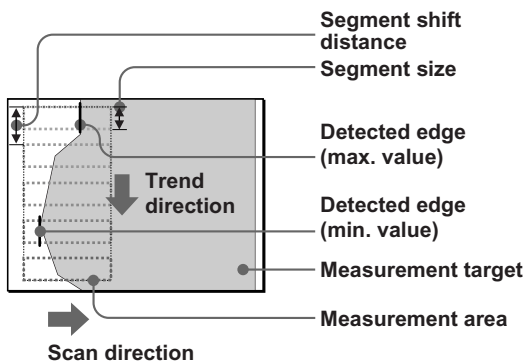
When the measurement area is a circle or an arc
When the trend direction is clockwise

- Segment shift distance
- Detected edge (max. value)
- Measurement area
- Segment size
- Measurement target
- Detected edge (min. value)
- Trend direction
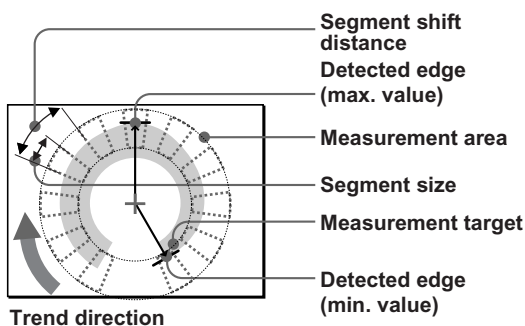
Measurement results

The measurement results that can be output in the Trend Edge Position measurement tool are shown as follows.

When the measurement area is a rectangle or rotated rectangle

- **Set. Segments:** Outputs the set number of segments.
- **Detected Segments:** Outputs the number of segments actually detected. (Available in the limits menu)
- **Number [ ]:** Outputs the number of edges in the detected segments. (Available through outputs)
- **Number (Max):** Outputs the number of edges in the detected segment with the most edges.
- **Number (Min):** Outputs the number of edges in the detected segment with the fewest edges.
- **Pos X [ ]:** Outputs the X coordinates of the detected segments. (Available in the limits menu only if the measurement area is a rectangle and the trend direction is ↓) (Available through outputs)
- **Pos X (Max):** Outputs the X coordinates of the detected segment with the highest edge position. (Available in the limits menu only if the measurement area is a rectangle and the trend direction is ↓)
- **Pos X (Min):** Outputs the X coordinates of the detected segment with the lowest edge position. (Available in the limits menu only if the measurement area is a rectangle and the trend direction is ↓)
- **Pos X (Avg):** Outputs the average X coordinate of the detected segments.
- **Pos Y [ ]:** Outputs the Y coordinates of the detected segments. (Available in thelimits menu only if the measurement area is a rectangle and the trend direction is →) (Available through outputs)
- **Pos Y (Max):** Outputs the Y coordinates of the detected segment with the highest edge position. (Available in the limits menu only if the measurement area is a rectangle and the trend direction is →)
- **Pos Y (Min):** Outputs the Y coordinates of the detected segment with the lowest edge position. (Available in the limits menu only if the measurement area is a rectangle and the trend direction is →)
- **Pos Y (Avg):** Outputs the average Y coordinate of the detected segments.

- **Angle [ ]:** Outputs the angle of rotation of a rotated measurement window. (Available through outouts)
- **Angle (Max):** Outputs the maximum angle of rotation of a rotated measurement window.
- **Angle (Min):** Outputs the minimum angle of rotation of a rotated measurement window.
- **Pos XY [ ]:** Outputs the coordinates of the detected segment. (Available through outouts)
- **Pos XY (Max):** Outputs the coordinates of the detected segment with the highest edge position.
- **Pos XY (Min):** Outputs the coordinates of the detected segment with the lowest edge position.
- **Pos XY (Avg):** Outputs the average coordinates of the detected segments.
- **Dist [ ]:** Outputs the distance from the start position to the detected segments. (Available in the limits menu only if the measurement area is a rotated rectangle) (Available through outouts)
- **Dist (Max):** Outputs the distance from the start position to the detected segment with the highest edge position. (Available in the limits menu only if the measurement area is a rotated rectangle)
- **Dist (Min):** Outputs the distance from the start position to the detected segment with the lowest edge position. (Available in the limits menu only if the measurement area is a rotated rectangle)
- **Dist (Avg):** Outputs the average distance of the detected segments from the start position.
- **Int. [ ]:** Outputs the edge intensity of the detected segments. (Available through outouts)
- **Int. (Max):** Outputs the edge intensity of the detected segment with the highest edge position.
- **Int. (Min):** Outputs the edge intensity of the detected segment with the lowest edge position.
- **Circle Radius**: Outputs the radius of detected circle. (Valid when ring search is [ON])
- **Circle Cent. X:** Outputs the X coordinates of the center of detected circle. (Valid when [Circle/Line] is [ON])
- **Circle Cent. Y:** Outputs the Y coordinates of the center of detected circle. (Valid when [Circle/Line] is [ON])
- **Circle Cent. XY:** Outputs the coordinates of the center of detected circle. (Valid when [Circle/Line] is [ON])
- **Line X1:** Outputs the X coordinate of the crossover between the detected line and the upper part (left-hand portion when the trend

direction is →) of the measurement window. (Valid when [Circle/Line] is [ON])
- **Line Y1:** Outputs the Y coordinate of the crossover between the detected line and the upper part (left-hand portion when the trend direction is →) of the measurement window. (Valid when [Circle/Line] is [ON])
- **Line XY1:** Outputs the coordinates of the crossover between the detected line and the upper part (left-hand portion when the trend direction is →) of the measurement window. (Valid when [Circle/Line] is [ON])
- **Line X2:** Outputs the X coordinate of the crossover between the detected line and the lower part (right-hand portion when the trend direction is →) of the measurement window. (Valid when [Circle/Line] is [ON])
- **Line Y2:** Outputs the Y coordinate of the crossover between the detected line and the lower part (right-hand portion when the trend direction is →) of the measurement window. (Valid when [Circle/Line] is [ON])
- **Line XY2:** Outputs the coordinates of the crossover between the detected line and the lower part (right-hand portion when the trend direction is →) of the measurement window. (Valid when [Circle/Line] is [ON])
- **Line Cent. X:** Outputs the X coordinate of the midpoint between Line XY1 and Line XY2. (Valid when [Circle/Line] is [ON])
- **Line Cent. Y:** Outputs the Y coordinate of the midpoint between Line XY1 and Line XY2. (Valid when [Circle/Line] is [ON])
- **Line Cent. XY:** Outputs the coordinates of the midpoint between Line XY1 and Line XY2. (Valid when [Circle/Line] is [ON])
- **Line Angle:** Outputs the angle between Line XY1 and Line XY2. (0 degrees to 359.999 degrees) (Valid when [Circle/Line] is [ON]])
- **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.
- **Measurement Area Position:** Outputs the measurement window position in pixels (Available as a reference only after calculation.)

When the measurement area is a ring or an arc

- **Set. Segments:** Outputs the set number of segments.
- **Detected Segments:** Outputs the number of segments actually detected. (Available in thelimits menu)
- **Number [ ]:** Outputs the number of edges in the detected segments. (Available through outouts)
- **Number (Max):** Outputs the number of edges in the detected segment with the most edges.
- **Number (Min):** Outputs the number of edges in the detected segment with the fewest edges.
- **Pos X [ ]:** Outputs the X coordinates of the detected segments. (Available through outouts)
- **Pos X (Max):** Outputs the X coordinates of the detected segment with the largest radius.
- **Pos X (Min):** Outputs the X coordinates of the detected segment with the smallest radius.
- **Pos X (Avg):** Outputs the average X coordinate of the detected segments.
- **Pos Y [ ]:** Outputs the Y coordinates of the detected segments. (Available through outouts)
- **Pos Y (Max):** Outputs the Y coordinates of the detected segment with the largest radius.
- **Pos Y (Min):** Outputs the Y coordinates of the detected segment with the smallest radius.
- **Pos Y (Avg):** Outputs the average Y coordinate of the detected segments.
- **Angle [ ]:** Outputs the angle of the detected segment. (Available through outouts)
- **Angle (Max):** Outputs the angle of the detected segment with the largest radius.
- **Angle (Min):** Outputs the angle of the detected segment with the smallest radius.
- **Pos XY [ ]:** Outputs the coordinates of the detected segments. (Available through outouts)
- **Pos XY (Max):** Outputs the coordinates of the detected segment with the largest radius.
- **Pos XY (Min):** Outputs the coordinates of the detected segment with the smallest radius.
- **Pos XY (Avg):** Outputs the average coordinates of the detected segments.
- **Dist [ ]:** Outputs the distance from the start position of the detected segments. (Available through outouts)
- **Dist (Max):** Outputs the distance from the start position to the detected segment with the largest radius.
- **Dist (Min):** Outputs the distance from the start position to the detected segment with the smallest radius.
- **Dist (Avg):** Outputs the average distance of the detected segments from the start position.
- **Radius [ ]:** Outputs the coordinates of the detected segments in pixels. (Available in the limits menu) (Available through outouts)
- **Radius (Max):** Outputs the radius of the detected segment with the largest radius. (Available in the limits menu)
- **Radius (Min):** Outputs the radius of the detected segment with the smallest radius. (Available in the limits menu)
- **Radius (Avg):** Outputs the average radius in pixels of the detected segments.
- **Int. [ ]:** Outputs the edge intensity of the detected segments. (Available through outouts)
- **Int. (Max):** Outputs the edge intensity of the detected segment with the largest radius.
- **Int. (Min):** Outputs the edge intensity of the detected segment with the smallest radius.
- **Circle Radius**: Outputs the radius of detected circles. (Valid when ring is [ON])
- **Circle Cent. X:** Outputs the X coordinates of the centers of detected circle. (Valid when [Circle/Line] is [ON])
- **Circle Cent. Y:** Outputs the Y coordinates of the centers of detected circle. (Valid when [Circle/Line] is [ON])
- **Circle Cent. XY:** Outputs the coordinates of the centers of detected circle. (Valid when [Circle/Line] is [ON])
- **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.
- **Measurement Area Position:** Outputs the measurement window position in pixels (Available as a reference only after calculation.)

Measurement sample

When the measurement area is a rectangle or rotated rectangle

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

- [Trend Dir.]: ↓
- [Scan Dir.]: →
- [Edge Dir.]: Both
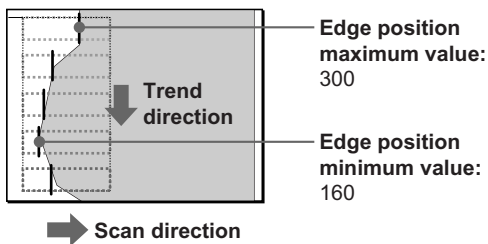
Edge position maximum value: 300

Trend direction

Edge position minimum value: 160

Scan direction

When the measurement area is a circle or an arc

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

- [Trend Dir.]: Clockwise
- [Scan Dir.]: Out → Center
- [Edge Dir.]: Both
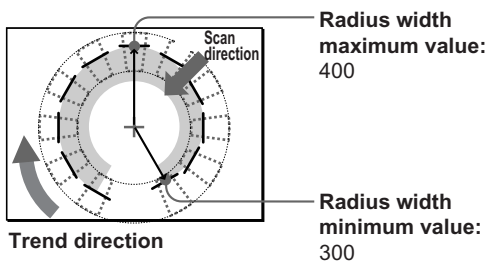
Scan direction

Radius width maximum value: 400

Trend direction

Radius width minimum value: 300

Selecting Measurement Tools

1 Select [Add/Copy/Del] from the [Edit Window] screen.

2 Select [Add].

The [Add Window] menu appears.

3 Select [Window Number], then specify the measurement window number.

Window numbers can be freely set at any value from 0 to 127 .

Specifying the Windows for Inspection and Measurement
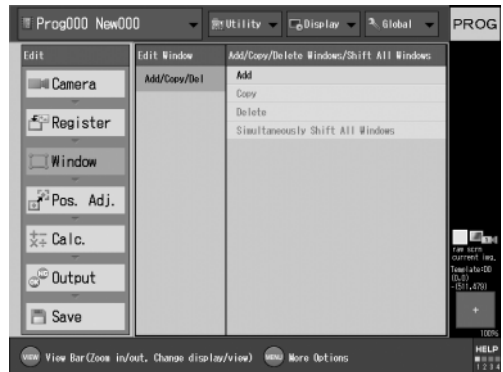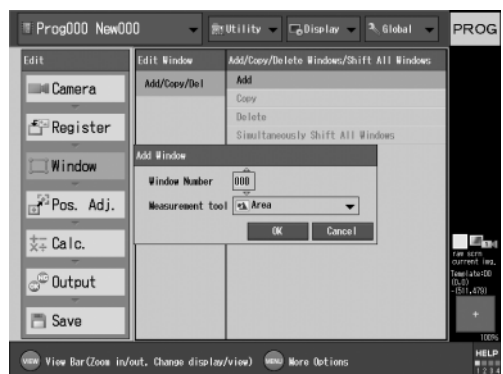
4 Select [Measurement tool] and then select [Trend edge position].
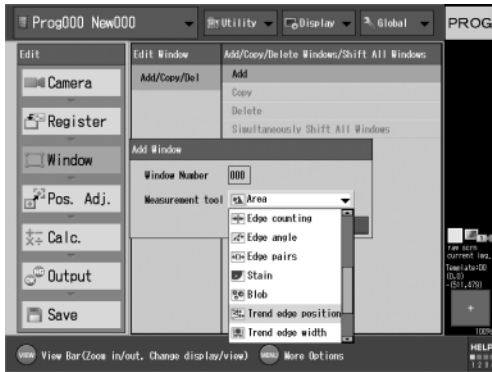
5 Select [OK].

A window with the specified number is added as a trend edge position measurement window. The current window setting list is then displayed.

The necessary settings for the trend edge position window are added next.

Selecting a Camera to Take Images

1 Select [Window] and then select the [Trend edge position] measurement window.

The window setting menu appears.

2 Select [Camera], then select a camera to use for the inspection.

Reference

Unconnected cameras can be selected. However, if the selected camera is not connected at the time of imaging, an error will occur.

Specifying a Registered Image to Use

Specify a registered image to use for processing.

Reference

The image to be used must have been previously saved in the [Register Image] screen (Page 4-19).

Select [Regist. Img.], then specify the number of the registered image to be used.

The registered image number will be displayed as "Camera number-xxx."

Specifying a Measurement Window

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

► Note

- The measurement regions available for the trend edge measurement window are rectangle, rotated rectangle, ring, and arc.
- The available functions and items change with the selected detection area.

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, see "Excluding an unwanted area (mask window)" located after "Setting the Measurement Area".

1 Select [Meas. Win.].
The [Measurement window] menu appears.

2 Select [Edit] in the [Measurement window] field.
The [Select] menu appears.

3 Select a shape, then select [OK].

4 Draw the measurement area.

See "Drawing a Measurement Window" (Page 3-13) for details.

5 After completing the drawing, select [Close] in the [Edit] field.

Clearing the measurement area

The measurement area can be cleared by following the procedure below.

1 Select [Delete] in the [Measurement window] field.

A confirmation screen appears.

2 Select [OK].

Excluding an unwanted area (mask window)

You can set up to 4 areas (mask windows) that will not be measured inside the measurement area. This is useful when the measurement target has a complicated shape or when you want to hide an unnecessary part of the target.

Select [Add] in the [Mask window] field.

The [Add mask window] menu appears.
See "Exclude Part of the Measurement Window (Mask Window)" (Page 3-25) for details on the following information.

Extracting a Color

When using a color camera, color images can be converted to black and white through an extraction process.

► **Note**

This feature is not available when using a monochrome camera.

Select [Color].

The [Color] menu appears.

See "Processing a Color Image [Color]" (Page 13-1) for details on color extraction.

Selecting an Image Enhancement

Specify an appropriate filter for the image.
When using a color camera, the filter is applied to pixels of the extracted color.

1 Select [Img. Enhance].

The [Image Enhance] menu appears.

2 Select a filter to use, then select [OK].

See "Filter List" (Page 13-9) for details on the individual filters.

Reference

- More advanced filter settings can also be made by selecting [Detail].
- Up to 13 filters can be used. When multiple filters are set, they are executed starting from the filter specified in the top portion of the screen.

Setting the Detection Conditions

Specify conditions for edge search, including search direction and edge direction

1 Select [Edge Filter].

The [Select Detection Conditions of Edges] menu appears.

The edge graph results are displayed to the side of the measurement window on the display screen.

2 Select [Display Image], and then specify an image to display on the [Select Detection Conditions of Edges] menu.

- **Regist. Img.**: Displays the image selected in [Specifying a registered image to use] (Page 4-177).
- **Current Img.**: Displays the current image from the camera selected in [Selecting a Camera to Take Images] (Page 4-176).

- Edge strength display graph is shown in the [Select Detection of Edges] menu when [Resist. Img.] is selected. To display this graph with [Current Img.] selected, the Display Graph setting in [Parameters] must be set to on.
- See "What is an Edge ?" (Page 13-15) for details on graphs.

3 **Select [Trend Dir.] and then select the segment movement direction.**

- **When the measurement area is a rectangle**: → , ↓
- **If the measurement window is a rotated rectangle**: If the direction is ↓ (top to bottom), the angle of rotation of the window matches that of the measurement area.
- **When the measurement area is a ring or an arc**: only clockwise is available.

4 **Select [Scan Dir.] and then select the direction the edges will be detected in.**

- **When the measurement area is a rectangle**: ↓↑ (Trend direction →)
  →← (Trend direction ↓)
- **If the measurement window is a rotated rectangle**:
  Forward: Scans in the direction of the arrow in the measurement window
  Reverse: Scans in the opposite direction of the arrow in the measurement window
- **When the measurement area is a ring or an arc**: Center → Out, Out → Center

5 **Select [Edge Dir.] and then select the contrast change that will signify an edge.**

- **Lght to Drk**: Detects an edge that changes from a bright area to a dark area.
- **Drk to Lght**: Detects an edge that changes from a dark area to a bright area.
- **both** (Default): Detects edges that change from a bright area to a dark area, or from a dark area to a bright area.

6 **Select [Specified Edge], then specify the number of the edge within the segment to be measured.**

The range of values you can specify is from -3600 to 3600, excluding 0 (Default: 1).
If a positive value is specified, edge numbers will be assigned in order in the direction of scan. If a negative value is specified, edge numbers will be assigned in order in the opposite direction of the scan, If the specified edge number is not found, the result of that segment is 0.

7 **If necessary, adjust the settings in the [Edge Strength] field.**

The items in the [Edge Strength] field allow you to set the conditions that indicate what will be considered an edge inside the measurement window.

- **Edge Sensitivity (%)**:Specifies the relative threshold value for recognizing edges (0 to 100) (Default: 30).
- **Edge Filter Width**: Specifies the width of the smoothing filter applied to the edge graph wave (0 to 100) (Default: 5).
- **Upper Edge Intensity (%)**:Specifies the upper limit for the absolute intensity of edges (0.000 to 255.000) (Default: 255.000).
- **Lower Edge Intensity (%)**:Specifies the lower limit for the absolute intensity of edges (0.000 to 255.000) (Default: 5.000).

Reference

- Adjusting the highest and lowest edge intensities, which are shown to the left of the graph, based on the highest intensity in the segment currently being displayed allows noisy edges to be excluded. See "What is an Edge ?" (Page 13-15) for details.

8 **If necessary, adjust the setting of the [Counting Options] field.**

- **Segment Size:** Specifies the individual segment size in the measurement window.
  - If the measurement window is a rectangle or rotated rectangle: Specify 1-9999 pixels (Default: 10) If this is set larger than the size of the measurement window in the trend direction, a measurement error will result.
  - If the measurement window is a ring or an arc: Specify 0.01-359.99 degrees (Default: 10) If this is set to a larger than the measurement window, a measurement error will result.
- **Segment Shift**: Specifies the shift between segments in the direction of the trend.
  - If the measurement window is a rectangle or rotated rectangle: Specify 0.01-9999 pixels (Default: 5)
  - If the measurement window is a ring or an arc: Specify 0.01-359.99 degrees (Default: 5)
- **Segment Offset (Start Angle):** Specifies the offset (area or degrees) from the initial segment. If an error arises when there are no search targets near the border of the search window, try moving the start point to a better location.
  - If the measurement window is a rectangle or rotated rectangle: Specify 1-9999 pixels (Default: 0)
  - If the measurement window is a ring or an arc: Specify 0.01-359.99 degrees (Default: 0)
- **Prim. Target**: Specifies the segment that will become the target of judgment. Select either maximum (default) or minimum, or with numbers ranging from 1 to 5000 (Default: 1)
- **Angled Edge Det.**: Set this to [ON] to stabilize edge detection on angled targets. This feature may affect the edge measurement accuracy.

► **Note**

The number of segments in the current measurement window, displayed as [Set. Segments], changes automatically with segment size and segment shift. The maximum number of segments is 5000, but the actual number of segments that can be set may be lower depending on the other settings.

Reference

The [Select Detection Conditions of Edges] menu displays positions, edge graphs or edge intensity values, and measurement results of segments that were set as primary targets. Specifying a segment number allows you to confirm the detection characteristics of a specific segment (If the current image is being displayed, the edge graph will not be displayed unless [Display Graph] in the [Tool Parameters] menu is ON).

9 **After completing the settings, select [OK].**

Specifying the Windows for Inspection and Measurement

Setting Other Detection Conditions

Use other trend edge position detection conditions as necessary.

1 Select [Parameters].

The [Tool Parameters] menu appears.

2 Make the necessary settings.

After completing the settings, select [OK].

Changing the reference position of the origin

Specify the reference position of the origin in [Origin] in the [Tool Parameters] menu.

Make the necessary settings in the [Origin] menu.

- **specified point** (Default): The origin point is set at the top left of the screen by default. To change the origin, select [Edit] from the [Origin] menu. 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 [Pos. X] and [Pos. Y] fields.

- **Registered Point**: Uses the detected primary target position in the registered image as an origin. The present origin point is displayed in the [Pos. X] and [Pos. Y] fields.

Reference

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

- If [specified point] has been selected, the origin point can be set outside the process area. The available range for the origin is -9600 to 9600 (X), -7200 to 7200 (Y).

Selecting the coordinate system for position adjustment

You can select the coordinate system using [Coordinate Value] in the [Tool Parameters] menu.

If a position correction (Page 4-249) is not being done, this setting will have no effect on the output.

- **[After Position Adjust]** (Default): If the position of the window used as the source of correction has shifted, the amount of this error is reflected on the measurement.

- **[Before Position Adjust]**: The distance from the position of the "Origin point" is measured.

Reference

These settings are reflected when the measurement window area position from the calculation is referenced.

Displaying edge graph (differential wave) with the measurement window

You can specify this using the [Display Graph] on the [Tool Parameters] menu. If [Display Graph] is not set to [ON], edge search conditions can be set from the current image and the edge graph displays in the [Select Detection Conditions of Edges] menu.

- **Primary Target**: Displays a graph of the primary target segment.
- **Max**: Displays a graph of the largest segment.
- **Min**: Displays a graph of the smallest segment.
- **OFF** (Default): Hides the edge graph.

► **Note**

Processing time will increase if this is set to [ON].

Selecting the search position to display

Set [Display Point] on the [Tool Parameters] menu.

- **OFF:** Hides the display point.
- **Primary Target** (Default)**:** Shows the display points of the primary target segment.
- **Primary Target Max/Min**: Shows the display points of the maximum and minimum in addition to the primary target.

Hiding the profile while operating or making settings

Set [Display Profile] on the [Tool Parameters] menu.

- **OFF:** Hides the profile. The profile is not displayed while making settings.
- **ON** (Default)**:** Displays the profile.

Hiding the segment while operating or making settings

Set [Display Segment] on the [Tool Parameters] menu.

- **OFF:** Hides the segments.
- **ON** (Default)**:** Displays the segments for display patterns other than D0.

► **Note**

If the amount of movement set in the [Select Detection Conditions of Edges] menu is less than the segment size, the segments will not be displayed regardless of the [Segment Display] settings.

Searching for circles or lines from edge information

Set [Circle/Line] on the [Tool Parameters] menu.

- **OFF** (Default)**:** Detection is turned off.
- **Circle:** Detects a circle using the least square method on the cluster of points that makes up the edge information.
- **Line:** Detects a line using the least square method on the cluster of points that makes up the edge information (Only available for rectangle or rotated rectangle measurement areas).

► **Note**

- If there are fewer than 3 segments inside the measurement area for a circle or less than two for a line, nothing will be detected.
- If circle detection results in center coordinates greater than located at ±9600 or a radius of more than 9600, the circle is not detected.

Reducing noise when detecting circles and lines

Set [Correction] on the [Tool Parameters] menu. With the [Circle/Line] feature, noise in the edge information may affect the result. Turn correction [ON] to remove non-continuous edges from the calculation and thus reduce the effects of noise.

► **Note**

If too few segments are being returned by the search for consecutive circles or lines, turning correction on may increase the incidence of error in circle or line detection.

Adjusting the sensitivity for correction

Set [Sensitivity] on the [Tool Parameters] menu when [Correction] is on.

This changes the detection sensitivity to eliminate information that appears as noise in [Circle/Line].

- **Normal** (Default)**:**Use this setting normally.
- **High:** Eliminates the small variations that are not eliminated by [Normal].

Selecting a display method for circles and lines

This can be set under [Display Figure] on the [Tool Parameters] menu.

- **ON** (Default)**:**Displays detected lines or circles.
- **OFF:** Hides lines and circles.

► **Note**

This is not available if [Circle/Line] is [OFF].

Specifying the amount of data output for each element

Set [Output Number] on the [Tool Parameters] menu. This specifies the output number (1-5000, Default: 100) when target number in output settings (Page 4-278) is set to [All].

The set limit is the maximum number of segments that will be output, regardless of the actual number of segments. If the total number of segments is less than the limit, all following data is output as 0.

Selecting an out-of-range measurement area

Select [Out of image] in the [Tool Parameters] menu. Specify whether to incorporate data that falls outside of the measurement area. This may occur when position adjustment is used.

- **Normal** (Default)**:** Excludes areas outside of the measurement area. Depending on settings, having areas outside the measurement area may increase the measurement time.
- **Fast:** Simplifies and this speeds exclusion processing, reducing the time effects of having data outside the read area. However, measurement results may change depending on the state of the current image.

Setting the Execute Conditions

The measurement window can be set to execute or not, based on the results of an OK or NG judgment of a specified window. This can be useful for instances where inspections need to be skipped. See "What are Execute Conditions?"(page 4-247) for details.

1 **Select [Execute].**

The [Window Execute Condition] menu appears.

2 **Select an appropriate condition.**

- **Always Execute** (Default) **:** Always execute on trigger input.
- **Never Execute:** Do not execute even with trigger input (skip).
- **Window Number (Measurement, Calculation):** Skips or measures depending on the judgment results of the selected window.

Reference

If measurement is skipped, measurement and judgment results for that window become 0 and are not reflected in the final results.

► Note

• If the reference window is set to itself, a circular reference error will result. If this happens, all windows in the same Program No. will have their settings invalidated (set to Always Execute).

• If a circular reference error occurs, a "!" will appear before the window number and the execution conditions to indicate an error.

3 **If window number is selected, measurement can be skipped or carried out depending on the judgment results of the specified window.**

• **OK:** Executes if the judgment result of the specified window is OK.

• **NG:** Executes if the judgment result of the specified window is NG.

Reference

If no tolerance is set for the selected window, the judgment result is always OK.

4 **After completing the settings, select [OK].**

Setting the Limits Settings

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

1 **Select [Limits].**

The [Enter Limits] menu appears.

2 **Select an item to set limits for.**

3 **Select [Uppper] or [Lower] and set the tolerance.**

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

• **Det. Segments**: Number of segments

- **Pos. X**: Pixels (Subject to tolerance test only if the measurement area is a rectangle and the trend direction is ↓)
- **Pos. Y**: Pixels (Subject to tolerance test only if the measurement area is a rectangle and the trend direction is →)
- **Distance**: Pixels (only when the measurement area is a rectangle or a rotated rectangle)
- **Radius**: Pixels (only when the measurement area is a ring or an arc)

Reference

Tolerance can be entered by selecting [Direct Input] and specifying a tolerance or by selecting [Calc Ref] and using the results of a chosen calculation window.

4 **To specify the tolerance of another measurement value, repeat Steps 2 and 3.**

5 **After completing the settings, select [OK].**

Reference

- [-----] indicates that no tolerance has been set and no judgment will take place after measurement.
- Press [Clear] to clear the value.

Trend Edge Width

What is the [Trend Edge Width] Measurement Tool?

An edge width scan (segment) is performed repeatedly within the measurement window area to find multiple edge position values, The maximum, minimum, and average edge width or radius values can be measured along with other parameters around each specific edge scan segment.

Measurement image

When the measurement area is a rectangle or a rotated rectangle

• In the case when the detection direction "→" and direction of trend is "↓"

Segment shift distance
Segment size
Width between the edges to be detected (max. value)
Trend direction
Width between the edges to be detected (min. value)
Measurement area
Measurement area
Edge scan direction

When the measurement area is a ring or an arc

• In the case when the direction of trend is (clockwise), and [Outer gap] is set for measurement

Segment shift distance
Radius width to be measured (max. value)
Measurement target
Segment size
Radius width to be measured (min. value)
Measurement area
Trend direction
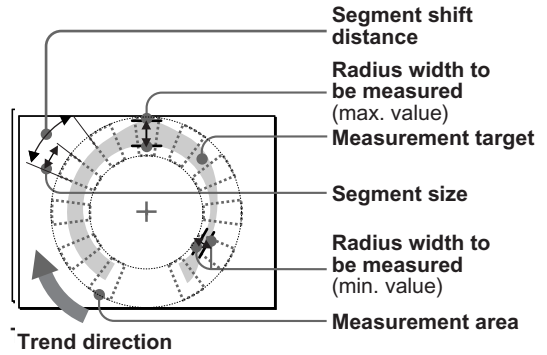
• In the case when the direction of trend is (clockwise), and [Diameter Outside] is set for measurement

Segment shift distance
Measurement area
Maximum diameter to be measured
Segment size
Minimum diameter to be measured
Measurement target
Trend direction

Measurement results

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

When the measurement area is a rectangle or rotated rectangle

- **Set. Segments:** Outputs the set number of segments.
- **Detected Segments:** Outputs the number of segments actually detected. (Available in the limits menu)
- **Number [ ]:** Outputs the pair number (0 or 1) in the detected segments. (Available through outouts)
- **Number (Max):** Outputs the pair number (0 or 1) in the detected segment with the largest edge width.
- **Number (Min):** Outputs the pair number (0 or 1) in the detected segment with the smallest edge width.
- **Edge Width [ ]:** Outputs width of the edges in the detected segments. (Available in the limits menu) (Available through outouts)
- **Edge Width (Max):** Outputs the width of the edges in the detected segment with the largest edge width. (Available in the limits menu)
- **Edge Width (Min):** Outputs the width of the edges in the detected segment with the smallest edge width. (Available in the limits menu)
- **Edge Width (Avg):** Outputs the average width of the edges in the detected segment with the largest edge width.
- **Position 1 (X/Y/XY):** Outputs all coordinates of measurement start points of the edge closer to the start point in a pair in the detected segment. (Available through outouts)
- **Position 1 (X/Y/XY) (Max):** Outputs all coordinates of measurement start points of the edge closer to the start point in a pair in the segment with the largest width.
- **Position 1 (X/Y/XY) (Min):** Outputs all coordinates of measurement start points of the edge closer to the start point in a pair in the segment with the smallest width.
- **Angle 1 [ ]:** Outputs the angle of rotation of a rotated measurement window. (Available through outouts)
- **Angle 1 (Max):** Outputs the angle of rotation of a rotated measurement window.
- **Angle 1 (Min):** Outputs the angle of rotation of a rotated measurement window.
- **Dist 1 [ ]:** Outputs the distance from the start position to position 1 of the detected segments. (Available through outouts)
- **Dist 1 (Max):** Outputs the distance from the start position to position 1 of the detected segment with the highest edge width.
- **Dist (Min):** Outputs the distance from the start position to position 1 of the detected segment with the lowest edge width.
- **Int. [ ]:** Outputs the edge intensity of position 1 of the detected segments. (Available through outouts)
- **Int. 1 (Max):** Outputs the edge intensity at position 1 of the detected segment with the highest edge width.
- **Int. 1 (Min):** Outputs the edge intensity at position 1 of the detected segment with the lowest edge width.
- **Position 2 (X/Y/XY):** Outputs all coordinates of measurement start points of the edge farther from the start point in a pair in the detected segment. (Available through outouts)
- **Position 2 (X/Y/XY) (Max):** Outputs all coordinates of measurement start points of the edge farther from the start point in a pair in the segment with the largest width.
- **Position 2 (X/Y/XY) (Min):** Outputs all coordinates of measurement start points of the edge farther from the start point in a pair in the segment with the smallest width.
- **Angle 2 [ ]:** Outputs the angle of rotation of a rotated measurement window. (Available through outouts)
- **Angle 2 (Max):** Outputs the angle of rotation of a rotated measurement window.
- **Angle 2 (Min):** Outputs the angle of rotation of a rotated measurement window.
- **Dist 2 [ ]:** Outputs the distance from the start position to position 2 of the detected segments. (Available through outouts)
- **Dist 2 (Max):** Outputs the distance from the start position to position 2 of the detected segment with the highest edge width.
- **Dist 2 (Min):** Outputs the distance from the start position to position 2 of the detected segment with the lowest edge width.
- **Int. 2 [ ]:** Outputs the edge intensity of position 2 of the detected segments. (Available through outouts)
- **Int. 2 (Max):** Outputs the edge intensity at position 2 of the detected segment with the highest edge width.
- **Int. 2 (Min):** Outputs the edge intensity at position 2 of the detected segment with the lowest edge width.
- **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.
- **Measurement Area Position:** Outputs the measurement window position in pixels (Available as a reference only after calculation.)

When the measurement area is a ring or an arc
- **Set. Segments:** Outputs the set number of segments.
- **Detected Segments:** Outputs the number of segments actually detected. (Available in the limits menu)
- **Number [ ]:** Outputs the pair number (0 or 1) in the detected segments. (Available through outouts)
- **Number (Max):** Outputs the pair number (0 or 1) in the detected segment with the largest edge width.
- **Number (Min):** Outputs the pair number (0 or 1) in the detected segment with the smallest edge width.
- **Edge Width [ ]:** Outputs all of the edge widths in the detected segments. (Available in the limits menu) (Available through outouts)
- **Edge Width (Max):** Outputs the width of the edges in the detected segment with the largest edge width. (Available in the limits menu)
- **Edge Width (Min):** Outputs the width of the edges in the detected segment with the smallest edge width. (Available in the limits menu)
- **Edge Width (Avg):** Outputs the average width of the edges in the detected segment with the largest edge width.
- **Position 1 (X/Y/XY):** Outputs all coordinates of measurement start points of the edge closer to the start point in a pair in the detected segment. (Available through outouts)
- **Position 1 (X/Y/XY) (Max):** Outputs all coordinates of measurement start points of the edge closer to the start point in a pair in the segment with the largest width.
- **Position 1 (X/Y/XY) (Min):** Outputs all coordinates of measurement start points of the edge closer to the start point in a pair in the segment with the smallest width.
- **Angle [ ]:** Outputs the angles of all detected segments. (Available through outouts)
- **Angle 1 (Max):** Outputs the angle of the detected segment with the largest edge width.
- **Angle 1 (Min):** Outputs the angle of the detected segment with the smallest edge width.
- **Dist 1 [ ]:** Outputs the distance from the start position to position 1 of the detected segments. (Available through outouts)
- **Dist 1 (Max):** Outputs the distance from the start position to position 1 of the detected segment with the highest edge width.
- **Dist 1 (Min):** Outputs the distance from the start position to position 1 of the detected segment with the lowest edge width.

- **Int. 1[ ]:** Outputs the edge intensity at position 1 of the detected segments. (Available through outouts)
- **Int. 1 (Max):** Outputs the edge intensity at position 1 of the detected segment with the highest edge width.
- **Int. 1 (Min):** Outputs the edge intensity at position 1 of the detected segment with the lowest edge width.
- **Position 2 (X/Y/XY):** Outputs all coordinates of measurement start points of the edge farther from the start point in a pair in the detected segment. (Available through outouts)
- **Position 2 (X/Y/XY) (Max):** Outputs all coordinates of measurement start points of the edge farther from the start point in a pair in the segment with the largest width.
- **Position 2 (X/Y/XY) (Min):** Outputs all coordinates of measurement start points of the edge farther from the start point in a pair in the segment with the smallest width.
- **Angle 2 [ ]:** Outputs the angles of all detected segments. (For internal and external gaps, this is the same value as Angle 1. For diameter outside and diameter inside, this is the same value as Angle 1 plus 180 degrees.) (Available through outouts)
- **Angle 2 (Max):** Outputs the angle of the detected segments with the largest edge width. (For internal and external gaps, this is the same value as Angle 1. For diameter outside and diameter inside, this is the same value as Angle 1 plus 180 degrees.)
- **Angle 2 (Min):** Outputs the angle of the detected segments with the smallest edge width. (For internal and external gaps, this is the same value as Angle 1. For diameter outside and diameter inside, this is the same value as Angle 1 plus 180 degrees.)
- **Dist 2 [ ]:** Outputs the distance from the start position to position 2 of the detected segments. (Available through outouts)
- **Dist 2 (Max):** Outputs the distance from the start position to position 2 of the detected segment with the highest edge width.
- **Dist 2 (Min):** Outputs the distance from the start position to position 2 of the detected segment with the lowest edge width.
- **Int. 2[ ]:** Outputs the edge intensity at position 2 of the detected segments. (Available through outouts)
- **Int. 2 (Max):** Outputs the edge intensity at position 2 of the detected segment with the highest edge width.
- **Int. 2 (Min):** Outputs the edge intensity at position 2 of the detected segment with the lowest edge width.

Specifying the Windows for Inspection and Measurement

- **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.
- **Measurement Area Position:** Outputs the measurement window position in pixels (Available as a reference only after calculation.)

Measurement sample

When the measurement area is a rectangle or rotated rectangle

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

- [Measure]: Outer Gap
- [Trend Dir.]: ↓
- [Scan Dir.]: →
- [Edge Dir.]: Both

Edge width maximum value: 500

Edge width minimum value: 200

Trend direction

Scan direction

When the measurement area is a ring or an arc (1)

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

- [Measure]: Outer Gap
- [Trend Dir.]: Clockwise
- [Scan Dir.]: Center → Out
- [Edge Dir.]: Both

Outer gap maximum value: 100

Outer gap minimum value: 30

Trend direction

Thickest part of the measurement target

Thinnest part of the measurement target
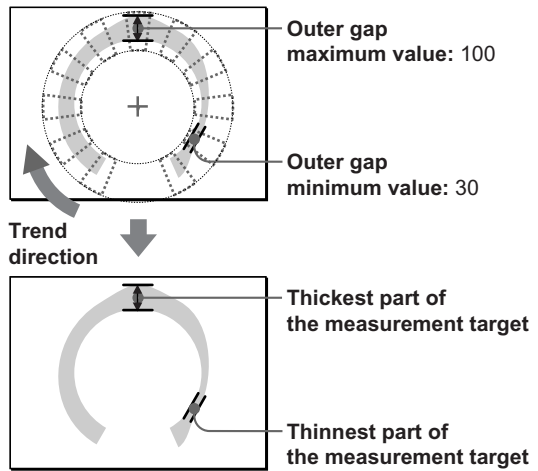
When the measurement area is a ring or an arc (2)

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

- [Measure]: Diameter Outside
- [Trend Dir.]: Clockwise
- [Scan Dir.]: Center → Out
- [Edge Dir.]: Both
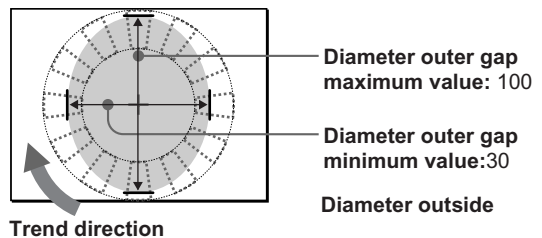
Diameter outer gap maximum value: 100

Diameter outer gap minimum value: 30

Diameter outside

Trend direction

Selecting Measurement Tools

1 **Select [Add/Copy/Del] from the [Edit Window] screen.**
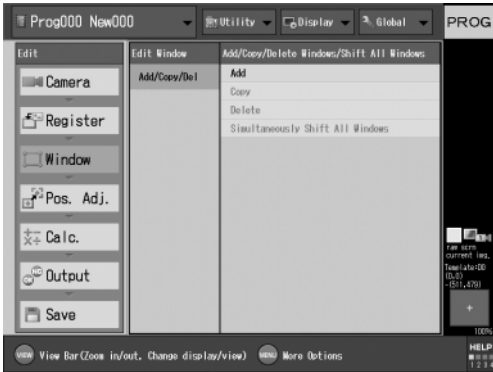
2 **Select [Add].**

The [Add Window] menu appears.

3 **Select [Window Number], then specify the measurement window number.**
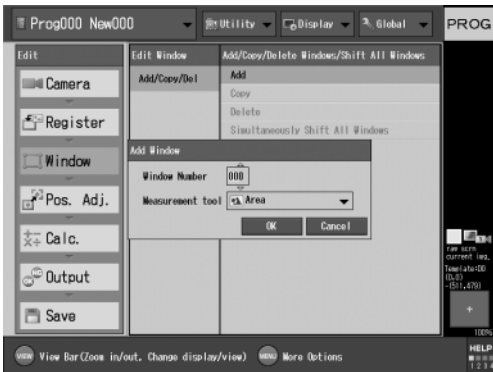
Window numbers can be freely set at any value from 0 to 127 .

4 **Select [Measurement tool] and then select [Trend edge width].**
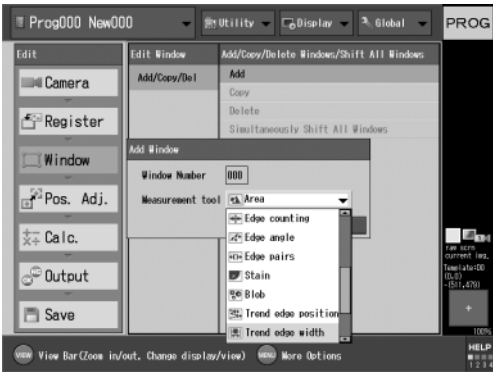
5 **Select [OK].**

A window with the specified number is added as a trend edge width measurement window. The current window setting list is then displayed.

The necessary settings for the trend edge width measurement window are added next.

Selecting a Camera to Take Images

1 **Select [Window] and then select the [Trend edge width] measurement window.**

The window setting menu appears.
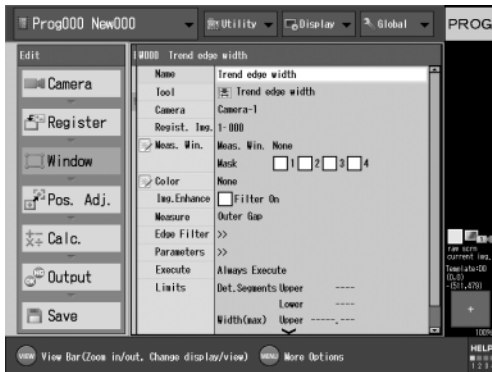
2 **Select [Camera], then selecting a camera for the inspection**
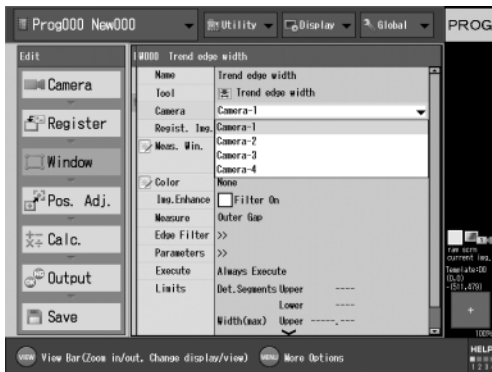
Reference

Unconnected cameras can be selected. However, if the selected camera is not connected at the time of imaging, an error will occur.

Specifying a Registered Image to Use

Specify a registered image to use for processing.

Reference

The image to be used must have been previously saved to the [Register Image] screen (Page 4-19).

Select [Regist. Img.], then specify the number of the registered image to be used.

The registered image number will be displayed as "Camera number-xxx."

Specifying a Measurement Window

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

▶ **Note**

- The measurement regions available for the trend edge measurement window are rectangle, rotated rectangle, ring, and arc.
- The available functions and items change with the selected detection area.

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, see "Excluding an unwanted area (mask window)" located after "Setting the Measurement Area".

1 Select [Meas. Win.].

The [Measurement window] menu appears.

2 Select [Edit] in the [Measurement window] field.

The [Select] menu appears.

3 Select a shape, then select [OK].

4 Draw the measurement area.

See "Drawing a Measurement Window" (Page 3-13) for details.

5 After completing the drawing, select [Close] in the [Edit] field.

Clearing the measurement area

The measurement area can be cleared by following the procedure below.

1 Select [Delete] in the [Measurement window] field.

A confirmation screen appears.

2 Select [OK].

Excluding an unwanted area (mask window)

You can set up to 4 areas (mask windows) that will not be measured inside the measurement area. This is useful when the measurement target has a complicated shape or when you want to hide an unnecessary part of the target.

Select [Add] in the [Mask window] field.

The [Add mask window] menu appears.
See "Exclude Part of the Measurement Window (Mask Window)" (Page 3-25) for details on the following information.

Specifying the Windows for Inspection and Measurement

Extracting a Color

When using a color camera, color images can be converted to black and white through an extraction process.

► **Note**

This feature is not available when using a monochrome camera.

Select [Color].

The [Color] menu appears.

See "Processing a Color Image [Color]" (Page 13-1) for details on color extraction.

Selecting an Image Enhancement

Specify an appropriate filter for the image.
When using a color camera, the filter is applied to pixels of the extracted color.

1 Select [Img. Enhance].

The [Image Enhance] menu appears.

2 Select a filter to use, then select [OK].

See "Filter List" (Page 13-9) for details on the individual filters.

Reference

- More advanced filter settings can also be made by selecting [Detail].
- Up to 13 filters can be used. When multiple filters are set, they are executed starting from the filter specified in the top portion of the screen.

Selecting the Type of Edge Width to Measure

You can specify the type of edge width to measure.

Select [Measure tool] and then select the type of edge width to measure.

• **Outer Gap** (Default)**:** Measures the distance between the outermost edges within the window.

When the measurement area is a rectangle or rotated rectangle:
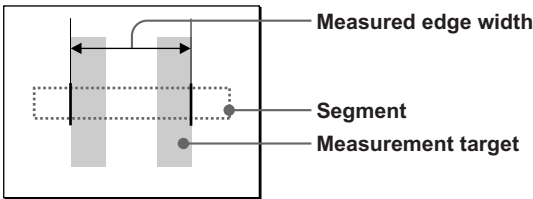
When the measurement area is a ring or an arc:
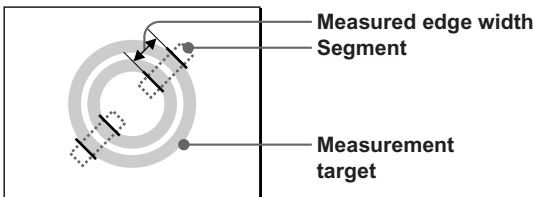
• **Inner Gap:** Measures the distance between the innermost edges within the window.

When the measurement area is a rectangle or rotated rectangle:
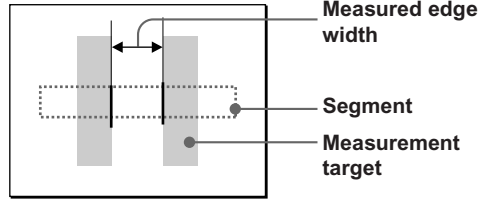
When the measurement area is a ring or an arc:
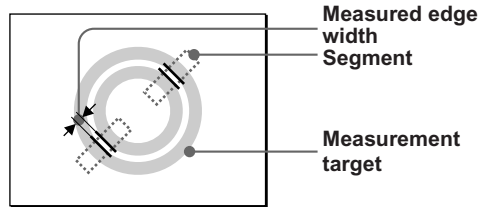
• **Diameter Outside** (Ring)**:** Measures the outer diameter of the edges detected by the diagonal elements on a ring measurement window.
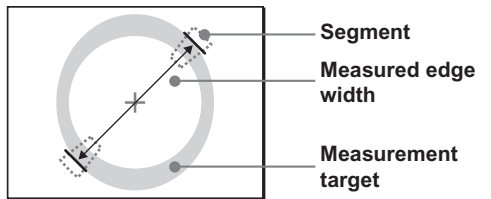
• **Diameter Inside** (Ring)**:** Measures the inner diameter of the edges detected by the diagonal elements on a ring measurement window.
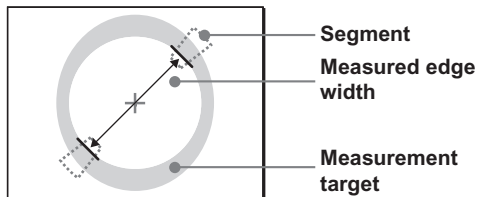
Setting the Detection Conditions

Specify conditions for edge search, including search direction and edge direction
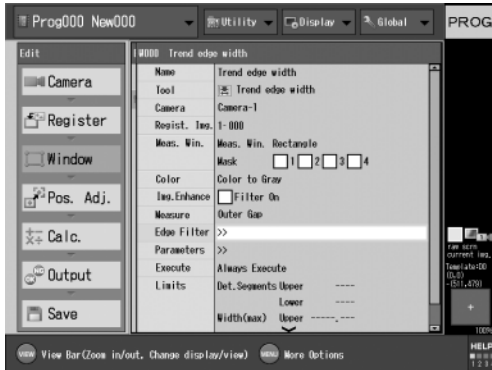
1 Select [Edge Filter].

The [Select Detection Conditions of Edges] menu appears.
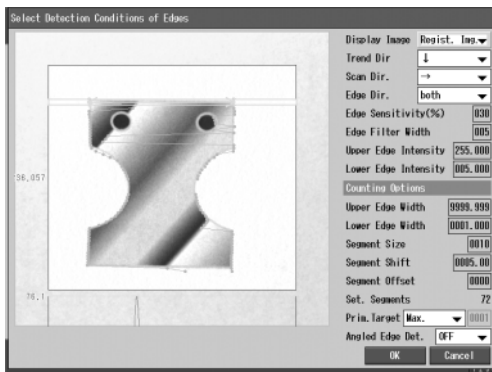
The edge graph are displayed to the side of the measurement window on the display screen.

2 Select [Display Image], and then specify an image to display on the [Select Detection Conditions of Edges] menu.

- **Regist. Img.**: Displays the image selected in "Specifying a registered image to use" (Page 4-192).
- **Current Img.**: Displays the current image from the camera selected in "Selecting a Camera to Take Images"(Page 4-192).

Reference

- Edge strength display graph is shown in the [Select Detection of Edges] menu when [Resist. Img.] is selected. To display this graph with [Current Img.] selected, the Display Graph setting in [Parameters] must be set to on.
- See "What is an Edge ?" (Page 13-15) for details on graphs.

3 Select [Trend Dir] and then select the segment movement direction.

- **When the measurement area is a rectangle**: → , ↓
- **If the measurement window is a rotated rectangle**: If the direction is ↓ (top to bottom), the angle of rotation of the window matches that of the measurement area.
- **When the measurement area is a ring an arc**: only clockwise is available.

4 Select [Scan Dir.] and then select the direction the edges will be detected in.

- **When the measurement area is a rectangle**: ↓↑ (Trend direction →)
  → ← (Trend direction ↓)
- **If the measurement window is a rotated rectangle**:
  Forward: Scans in the direction of the arrow in the measurement window
  Reverse: Scans in the opposite direction of the arrow in the measurement window
- **When the measurement area is a ring or an arc**: Center → Out, Out → Center

5 Select [Edge Dir.] and then select the contrast change that will signify an edge.

- **Lght to Drk**: Detects an edge that changes from a bright area to a dark area.
- **Drk to Lght**: Detects an edge that changes from a dark area to a bright area.
- **both** (Default): Detects edges that change from a bright area to a dark area, or from a dark area to a bright area.

6 **If necessary, adjust the settings in the [Edge Strength] field.**

The items in the [Edge Strength] field allow you to set the conditions that indicate what will be considered an edge inside the measurement window.

- **Edge Sensitivity (%)**:Specifies the relative threshold value for recognizing edges (0 to 100) (Default: 30).
- **Edge Filter Width**: Specifies the width of the smoothing filter applied to the derivative wave to detect edges (0 to 100) (Default: 5).
- **Upper Edge Intensity (%)**:Specifies the upper limit for the absolute intensity of edges (0.000 to 255.000) (Default: 255.000).

Lower Edge Intensity (%):Specifies the lower limit for the absolute intensity of edges (0.000 to 255.000) (Default: 5.000).

Reference

Adjusting the highest and lowest edge intensities, which are shown to the left of the graph, based on the highest intensity in the segment currently being displayed allows noisy edges to be excluded. See "What is an Edge ?" (Page 13-15) for details.

7 **If necessary, adjust the setting of the [Counting Options] field.**

- **Upper Edge Width**: Specifies the upper width limit for edges that are part of a pair (0-9999.999) (Default: 9999.999).
- **Lower Edge Width**: Specifies the lower width limit for edges that are part of a pair (0-9999.999) (Default: 1.000).
- **Segment Size**: Specifies the segment size in the measurement window.
  - If the measurement window is a rectangle or rotated rectangle: Specify 1-9999 pixels (Default: 10) If this is set larger than the size of the measurement window in the trend direction, a measurement error will result.
  - If the measurement window is a ring or an arc: Specify 0.01-359.99 degrees (Default: 10) If this is set to a larger than the measurement window, a measurement error will result.

- **Segment Shift**: Specifies the shift between segments in the direction of the trend.
  - If the measurement window is a rectangle or rotated rectangle: Specify 0.01-9999 pixels (Default: 5)
  - If the measurement window is a ring or an arc: Specify 0.01-359.99 degrees (Default: 5)
- **Segment Offset (Start Angle):** Specifies the offset (area or degrees) from the initial segment. If an error arises when there are no search targets near the border of the search window, try moving the start point to a better location.
  - If the measurement window is a rectangle or rotated rectangle: Specify 1-9999 pixels (Default: 0)
  - If the measurement window is a circle or an arc: Specify 0.01-359.99 degrees (Default: 0)
- **Prim. Target**: Specifies the segments that will become the target of judgment. Select either maximum (default) or minimum, or with numbers ranging from 1 to 5000 (Default: 1)
- **Angled Edge Det.**: Set this to [ON] to stabilize edge detection on angled targets. This feature may affect the edge measurement accuracy.

► Note

The number of segments in the current measurement window, displayed as [Set. Segments], changes automatically with segment size and segment shift. The maximum number of segments is 5000, but the actual number of segments that can be set may be lower depending on the other settings.

Reference

The [Select Detection Conditions of Edges] menu displays positions, edge graphs or edge intensity values, and measurement results of segments that were set as primary targets. Specifying a segment number allows you to confirm the detection characteristics of a specific segment (If the current image is being displayed, the edge graph will not be displayed unless [Display Graph] in the [Tool Parameters] menu is ON).

8 **After completing the settings, select [OK].**

Setting Other Detection Conditions

Use other edge width measurement conditions as necessary.

1 Select [Parameters].

The [Tool Parameters] menu appears.

2 Make the necessary settings.

After completing the settings, select [OK].

Changing the reference position of the origin

Specify the reference position of the origin in [Origin] in the [Tool Parameters] menu.

Make the necessary settings in the [Origin] menu.

- **specified point** (Default): The origin point is set at the top left of the screen by default. To change the origin, select [Edit] from the [Origin] menu. 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 [Pos. X] and [Pos. Y] fields.

Reference

If [specified point] has been selected, the origin point can be set outside the process area. The range of points you can set is from -9600 to 9600 (X) and -7200 to 7200 (Y).

Selecting the coordinate system for position adjustment

You can select the coordinate system using [Coordinate Value] in the [Tool Parameters] menu. If a position correction (Page 4-249) is not being done, this setting will have no effect on the output.

- **[After Position Adjust]** (Default):
  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.
- **[Before Position Adjust]**: The distance from the position of the "Origin point" is measured.

Reference

These settings are reflected when the measurement window area position from the calculation is referenced.

Displaying edge graph (differential wave) with the measurement window

You can specify this using the [Display Graph] on the [Tool Parameters] menu. If [Display Graph] is not set to [ON], edge search conditions can be set from the current image and the edge graph displays in the [Select Detection Conditions of Edges] menu.

• **Primary Target**: Displays a graph of the primary target segment.
• **Max**: Displays a graph of the largest segment.
• **Min**: Displays a graph of the smallest segment.
• **OFF** (Default): Hides the edge graph.

► Note
Processing time will increase if this is set to [ON].

Selecting the search position to display

Set [Display Point] on the [Tool Parameters] menu.

• **OFF:** Hides the display point.
• **Primary Target** (Default)**:** Shows the display points of the primary target segment.
• **Primary Target Max/Min**: Shows the display points of the maximum and minimum in addition to the primary target.

Hiding the profile while operating or making settings

Set [Display Profile] on the [Tool Parameters] menu.

• **OFF:** Hides the profile. The profile is not displayed while making settings.
• **ON** (Default)**:** Displays the profile.

Hiding the segment while operating or making settings

Set [Display Segments] on the [Tool Parameters] menu.

• **OFF:** Hides the segments.
• **ON** (Default)**:** Displays the segments for display patterns other than D0.

► Note
If the amount of segment shift set in the [Select Detection Conditions of Edges] menu is less than the segment size, the segments will not be displayed regardless of the [Segment Display] settings.

Specifying the amount of data output for each element

Set [Output Number] on the [Tool Parameters] menu. This specifies the output number (1-5000, Default: 100) when target number in output settings (Page 4-278) is set to [All]. The set limit is the maximum number of segments that will be output, regardless of the actual number of segments. If the total number of segments is less than the limit, all following data is output as 0.

Selecting an out-of-range measurement area

Select [Out of image] in the [Tool Parameters] menu. Specify whether to incorporate data that falls outside of the measurement area. This way occur when position adjustment is used.

• **Normal** (Default)**:** Excludes areas outside of the measurement area. Depending on settings, having areas outside the measurement area may increase the measurement time.
• **Fast:** Simplifies and this speeds exclusion processing, reducing the time effects of having data outside the read area. However, measurement results may change depending on the state of the current image.

Setting the Execute Conditions

The measurement window can be set to execute or not, based on the results of an OK or NG judgment of a specified window. This can be useful for instances where inspections need to be skipped. See "What are Execute Conditions?" (page 4-247) for details.

1 Select [Execute].

The [Window Execute Condition] menu appears.

2 Select an appropriate condition.

- **Always Execute** (Default) **:** Always execute on trigger input.
- **Never Execute:** Do not execute even with trigger input (skip).
- **Window Number (Measurement, Calculation):** Skips or measures depending on the judgment results of the selected window.

Reference

If measurement is skipped, measurement and judgment results for that window become 0 and are not reflected in the final results.

► Note

- If the reference window is set to itself, a circular reference error will result. If this happens, all windows in the same Program No. will have their settings invalidated (set to Always Execute).
- If a circular reference error occurs, a "!" will appear before the window number and the execution conditions to indicate an error.

3 If window number is selected, measurement can be skipped or carried out depending on the judgment results of the specified window.

- **OK:** Executes if the judgment result of the specified window is OK.
- **NG:** Executes if the judgment result of the specified window is NG.

Reference

If no tolerance is set for the selected window, the judgment result is always OK.

4 After completing the settings, select [OK].

Setting the Limits Settings

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

1 **Select [Limits].**
The [Enter Limits] menu appears.

2 **Select an item to set limits for.**

3 **Select [Uppper] or [Lower] and set the tolerance.**
- **Det. Segments**: Number of segments
- **Width**: Pixels

Reference
Tolerance can be entered by selecting [Direct Input] and specifying a tolerance or by selecting [Calc Ref] and using the results of a chosen calculation window.

4 **To specify the tolerance of another measurement value, repeat Steps 2 and 3.**

5 **After completing the settings, select [OK].**

Reference
- [-----] indicates that no tolerance has been set and no judgment will take place after measurement.
- Press [Clear] to clear the value.

Specifying the Windows for Inspection and Measurement

Intensity Inspection

What is the [Intensity] Measurement Mode?

The Intensity tool can measure the maximum, minimum, average, and deviation in average grayscale intensity within the measurement area. (Intensity is a level of 0 to 255). This tool can be effective in sensing presence/absence of parts based off the difference of intensity of the target and the background.

Measurement image

When the intensity differential is large
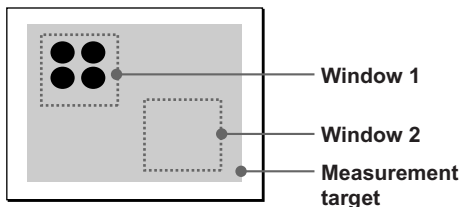
- Average intensity of window 1: 50
- Average intensity of window 2: 200
- Intensity difference: 150

When the intensity differential is small
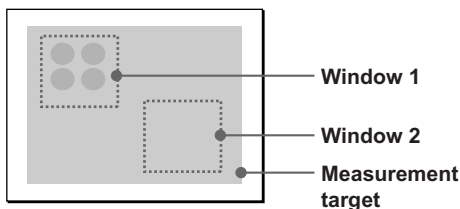
- Average intensity of window 1: 150
- Average intensity of window 2: 200
- Intensity difference: 50

► Note

To obtain the intensity differential, the calculation feature (Page 4-253) is used.

Measurement results

The measurement results that can be output in the [Intensity] inspection measurement tool are shown below.

- **Ave**: The average intensity in the measurement area is output on a scale of 0 to 255. (Available in the limits menu)
- **Max.**: Outputs the maximum intensity (the brightest part) in the measurement area. (Available in the limits menu)
- **Min.**: Outputs the minimum intensity (the darkest part) in the measurement area. (Available in the limits menu)
- **Dev**: Outputs the intensity deviation in the measurement area. This deviation represents the variation level in the intensity of each pixel (standard deviation). (Available in the limits menu)
- **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.
- **Measurement Area Position**: Outputs the measurement window position in pixels (available as a reference after calculation) Note that polygon measurement area information is not output.

Reference

When [Color to Binary] or [Color to Gray] extraction have been used, the post extraction black and white image is used for intensity inspection.

Selecting Measurement Tools

1 **Select [Add/Copy/Del] from the [Edit Window] screen.**

2 **Select [Add].**

The [Add Window] menu appears.

3 **Select [Window Number], then specify the measurement window number.**
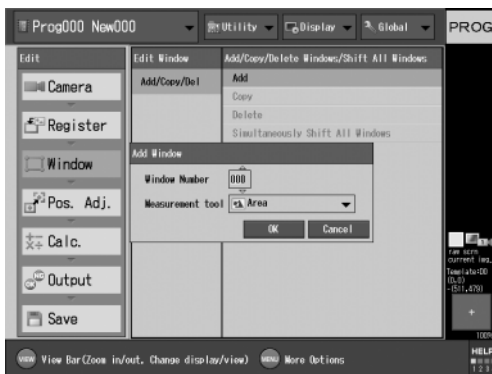
Window numbers can be freely set at any value from 0 to 127 .

4 **Select [Measurement tool] and then select [Intensity].**
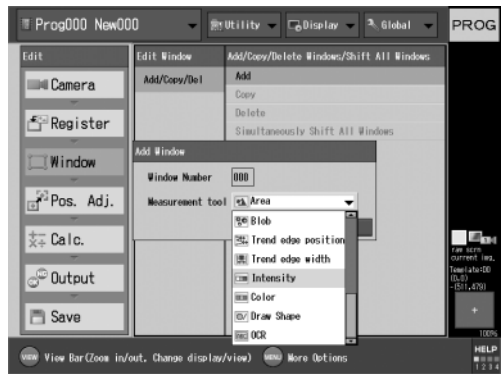
5 **Select [OK].**

A window with the specified number is added as a intensity measurement window. The current window setting list is then displayed.

The necessary settings for the intensity inspection window are added next.

Specifying the Windows for Inspection and Measurement

Selecting a Camera to Take Images

1 **Select [Window] and then select the [Intensity] measurement window.**

The window setting menu appears.

2 **Select [Camera], then select a camera to use for the inspection.**

Unconnected cameras can be selected. However, if the selected camera is not connected at the time of imaging, an error will occur.

Specifying a Registered Image to Use

Specify a registered image to use for processing.

The image to be used must have been previously saved in the "Register Image" screen (Page 4-19).

Select [Regist. Img.], then specify the number of the registered image to be used.

The registered image number will be displayed as "Camera number-xxx."

Specifying a Measurement Window

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

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, see "Excluding an unwanted area (mask window)" located after "Setting the Measurement Area".

1 Select [Meas. Win.].

The [Measurement window] menu appears.

2 Select [Edit] in the [Measurement window] field.

The [Select] menu appears.

3 Select a shape, then select [OK].

4 Draw the measurement area.

See "Drawing a Measurement Window" (Page 3-13) for details.

5 After completing the drawing, select [Close] in the [Edit] field.

Clearing the measurement area

The measurement area can be cleared by following the procedure below.

1 Select [Delete] in the [Measurement window] field.

A confirmation screen appears.

2 Select [OK].

Excluding an unwanted area (mask window)

You can set up to 4 areas (mask windows) that will not be measured inside the measurement area. This is useful when the measurement target has a complicated shape or when you want to hide an unnecessary part of the target.

Select [Add] in the [Mask window] field.

The [Add mask window] menu appears.
See "Exclude Part of the Measurement Window (Mask Window)" (Page 3-25) for details on the following information.

Specifying the Windows for Inspection and Measurement

Extracting a Color

When using a color camera, color images can be converted to black and white through an extraction process.

► Note

This feature is not available when using a monochrome camera.

Reference

- Intensity inspection can be applied to the black and white images created here.
- Use the [Gray] extraction method, if possible, when you plan to use intensity inspection.

Select [Color].

The [Color] menu appears.

See "Processing a Color Image [Color]" (Page 13-1) for details on color extraction.

Selecting an Image Enhancement

Specify an appropriate filter for the image.
When using a color camera, the filter is applied to pixels of the extracted color.

1 Select [Img. Enhance].

The [Image Enhance] menu appears.
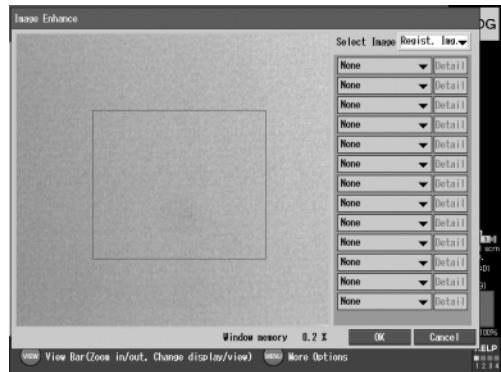
2 Select a filter to use, then select [OK].

See "Filter List" (Page 13-9) for details on the individual filters.

Reference

- More advanced filter settings can also be made by selecting [Detail].
- Up to 13 filters can be used. When multiple filters are set, they are executed starting from the filter specified in the top portion of the screen.

Setting Other Detection Conditions

Set other intensity inspection measurement conditions as necessary.

1 Select [Parameters].

The [Tool Parameters] menu appears.

2 Make the necessary settings.

After completing the settings, select [OK].

Changing the reference position of the origin

Specify the reference position of the origin in [Origin] in the [Tool Parameters] menu.
Make the necessary settings in the [Origin] menu.

- **specified point** (Default): The origin point is set at the top left of the screen by default. To change the origin, select [Edit] from the [Origin] menu. 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 [Pos. X] and [Pos. Y] fields.

Reference

If [specified point] has been selected, the origin point can be set outside the process area. The range of points you can set is from -9600 to 9600 (X) and -7200 to 7200 (Y).

Selecting the coordinate system for position adjustment

You can select the coordinate system using [Coordinate Value] in the [Tool Parameters] menu. If a position correction (Page 4-249) is not being done, this setting will have no effect on the output.

- **[After Position Adjust]** (Default): If the position of the window used as the source of correction has shifted, the amount of this error is reflected on the measurement.
- **[Before Position Adjust]**: The distance from the position of the "Origin point" is measured.

Reference

These settings are reflected when the measurement window area position from the calculation is referenced.

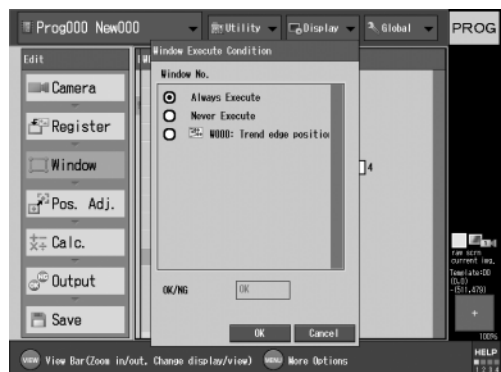Specifying the Windows for Inspection and Measurement

Setting the Execute Conditions

The measurement window can be set to execute or not, based on the results of an OK or NG judgment of a specified window. This can be useful for instances where inspections need to be skipped. See "What are Execute Conditions?" (page 4-247) for details.

1 **Select [Execute].**

The [Window Execute Condition] menu appears.

2 **Select an appropriate condition.**

- **Always Execute** (Default) **:** Always execute on trigger input.
- **Never Execute:** Do not execute even with trigger input (skip).
- **Window Number (Measurement, Calculation):** Skips or measures depending on the judgment results of the selected window.

Reference

If measurement is skipped, measurement and judgment results for that window become 0 and are not reflected in the final results.

► Note

- If the reference window is set to itself, a circular reference error will result. If this happens, all windows in the same Program No. will have their settings invalidated (set to Always Execute).
- If a circular reference error occurs, a "!" will appear before the window number and the execution conditions to indicate an error.

3 **If window number is selected, measurement can be skipped or carried out depending on the judgment results of the specified window.**

- **OK:** Executes if the judgment result of the specified window is OK.
- **NG:** Executes if the judgment result of the specified window is NG.

Reference

If no tolerance is set for the selected window, the judgment result is always OK.

4 **After completing the settings, select [OK].**
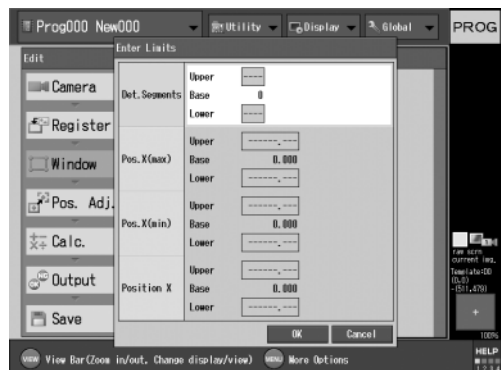
Setting the Limits Settings

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

1 **Select [Limits].**

The [Enter Limits] menu appears.

2 **Select an item to set limits for.**

3 **Select [Upper] or [Lower] and set the tolerance.**

The contents of limits change depending on the item being measured.

- **Average**: Brightness level
- **Deviation**: Variation in the brightness

- **Intensity**: Maximum and minimum brightness level

Reference

Tolerance can be entered by selecting [Direct Input] and specifying a tolerance or by selecting [Calc Ref] and using the results of a chosen calculation window.

4 **To specify the tolerance of another measurement value, repeat Steps 2 and 3.**

5 **After completing the settings, select [OK].**

Reference

- [-----] indicates that no tolerance has been set and no judgment will take place after measurement.
- Press [Clear] to clear the value.

Color

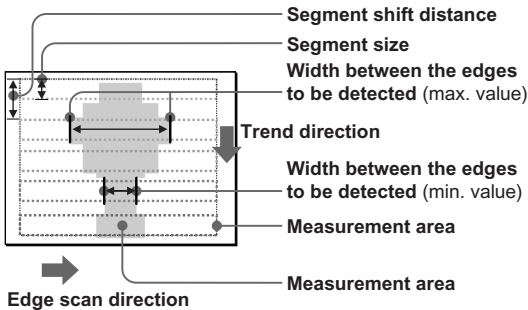## What is the [Color] Measurement Mode?

The [Color] tool can measure the average, maximum, and deviation of the color elements within the measurement area. The Red/Green/Blue or the Hue/Saturation/Brightness values can be measured. Measuring the color information allows for colors to be differentiated through detailed, fine inspection of specific color elements

► **Note**

The results of the color measurement vary not only with the surrounding environment, but also with the CCD of the camera, the individual IC controller, and the white balance conditions. When changing cameras or comparing results from different cameras, be sure to confirm the actual results.

Measurement image

Example of measuring a red object:

Window
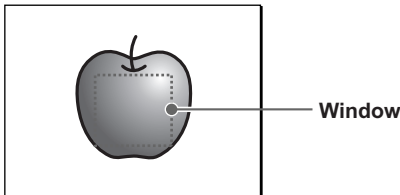
- R-Ave: 200
- G-Ave: 50
- B-Ave: 50

Example of measuring a yellow object:

Window
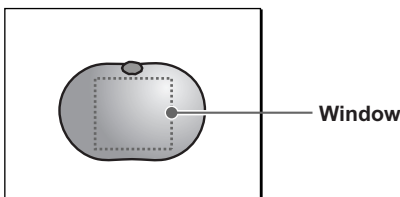
- R-Ave: 250
- G-Ave: 200
- B-Ave: 4

Measurement results

The measurement results that can be output in color measurement tool are shown below.

- **Ave**: The average RGB or HSB intensity in the measurement area is output on a scale of 0 to 255. (Available in the limits menu)
- **Dev.**: The RGB or HSB intensity deviation in the measurement area is output. (Available in the limits menu)
- **Max.**: The maximum RGB or HSB intensity in the measurement area is output. (Available in the limits menu)
- **Min.**: The minimum RGB or HSB intensity in the measurement area is output. (Available in the limits menu)
- **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.
- **Measurement Area Position**: Outputs the measurement window position in pixels (available as a reference after calculation) Note that polygon measurement area information is not output.

► **Note**

The minimum and maximum values of H in HSB format are fixed at 0.

Reference

See "HSB Color System Used in the System" (Page 13-8) for details on HSB format color information patterns.

Selecting Measurement Tools

1 **Select [Add/Copy/Del] from the [Edit Window] screen.**

2 **Select [Add].**

The [Add Window] menu appears.

3 **Select [Window Number], then specify the measurement window number.**

Window numbers can be freely set at any value from 0 to 127 .

4 **Select [Measurement tool] and then select [Color].**
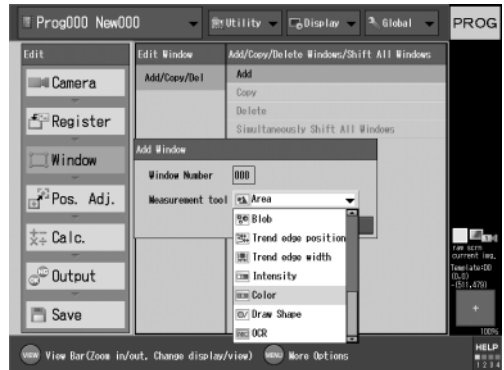
5 **Select [OK].**

A window with the specified number is added as a color measurement window. The current window setting list is then displayed.

The necessary settings for the color measurement window are added next.

Selecting a Camera to Take Images

1 **Select [Window] and then select the [Color] measurement window.**

The window setting menu appears.
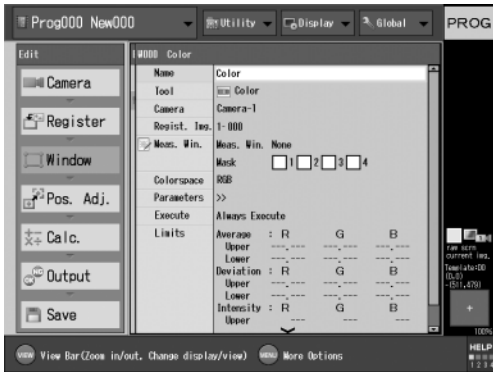
2 **Select [Camera], then select a camera to use for inspection.**

Unconnected cameras can be selected. However, if the selected camera is not connected at the time of imaging, an error will occur.

Specifying a Registered Image to Use

Specify a registered image to use for processing.

Reference

The image to be used must have been previously saved to an image number in the "Register Image" screen (Page 4-19).

Select [Regist. Img.], then specify the number of the registered image to be used.

The registered image number will be displayed as "Camera number-xxx."

Specifying a Measurement Window

Within the captured image, the measurement window is set as follows:
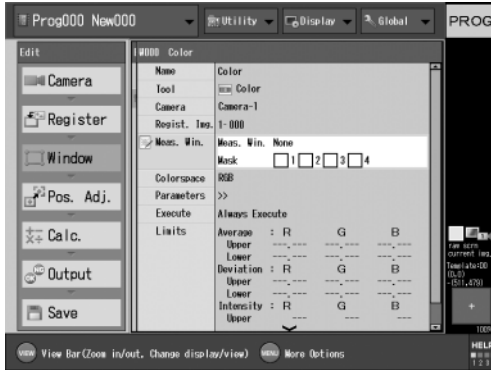
Auto-adjust rectangle and Auto-adjust circle cannot be selected.

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, see "Excluding an unwanted area (mask window)" located after "Setting the Measurement Area".

1 Select [Meas. Win.].

The [Measurement window] menu appears.

2 Select [Edit] in the [Measurement window] field.

The [Select] menu appears.

3 Select a shape, then select [OK].

4 Draw the measurement area.

See "Drawing a Measurement Window" (Page 3-13) for details.

5 After completing the drawing, select [Close] in the [Edit] field.

Clearing the measurement area

The measurement area can be cleared by following the procedure below.

1 Select [Delete] in the [Measurement window] field.

A confirmation screen appears.

2 Select [OK].

Excluding an unwanted area (mask window)

You can set up to 4 areas (mask windows) that will not be measured inside the measurement area. This is useful when the measurement target has a complicated shape or when you want to hide an unnecessary part of the target.

Select [Add] in the [Mask window] field.

The [Add mask window] menu appears.
See "Exclude Part of the Measurement Window (Mask Window)" (Page 3-25) for details on the following information.

Selecting the Color Measurement Parameters

Specify the color measurement parameters.

Select [Colorspace] and then select measurement parameters.
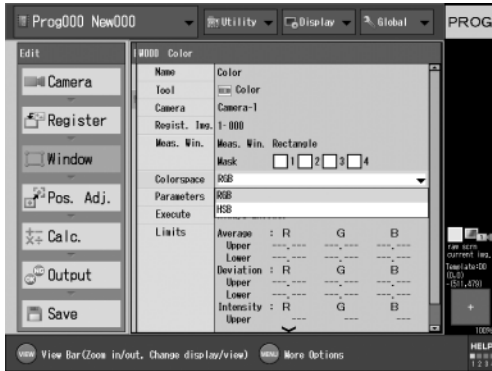
• **RGB** (Default)**:** Measures color through RGB parameters.
• **HSB:** Measures color through HSB parameters.

► **Note**

• RGB and HSB parameters cannot be measure in the same window.
• When using the HSB color format, the minimum and maximum values of H (Hue) are not measured (fixed at 0).

Setting Other Detection Conditions

Set other color measurement conditions as necessary.

1 **Select [Parameters].**
The [Tool Parameters] menu appears.

2 **Make the necessary settings.**
After completing the settings, select [OK].

Changing the reference position of the origin
Specify the reference position of the origin in
[Origin] in the [Tool Parameters] menu.
Make the necessary settings in the [Origin] menu.
• **specified point** (Default): The origin point is set
  at the top left of the screen by default. To change
  the origin, select [Edit] from the [Origin] menu.
  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 [Pos. X] and [Pos.
  Y] fields.

Reference

If [specified point] has been selected, the origin point can be
set outside the process area. The range of points you can set
is from -9600 to 9600 (X) and -7200 to 7200 (Y).

**Selecting the coordinate system for position
adjustment**
You can select the coordinate system using
[Coordinate Value] on the [Tool Parameters] menu.
If a position correction (Page 4-249) is not being
done, this setting will have no effect on the output.
• **[After Position Adjust]** (Default): If the position
  of the window used as the source of correction
  has shifted, the amount of this error is reflected
  on the measurement.
• **[Before Position Adjust]**: The distance from the
  position of the "Origin point" is measured.

Reference

These settings are reflected when the window measurement
area position from the calculation is referenced.

Setting the Execute Conditions

The measurement window can be set to execute or
not, based on the results of an OK or NG judgment
of a specified window. This can be useful for
instances where inspections need to be skipped.
See "What are Execute Conditions?" (page 4-247)
for details.

1 Select [Execute].
The [Window Execute Condition] menu appears.

2 Select an appropriate condition.
• **Always Execute** (Default)**:** Always execute on
  trigger input.
• **Never Execute:** Do not execute even with
  trigger input (skip).
• **Window Number (Measurement,
  Calculation):** Skips or measures depending on
  the judgment results of the selected window.

Reference

If measurement is skipped, measurement and judgment results for that window become 0 and are not reflected in the final results.

► Note

• If the reference window is set to itself, a circular reference error will result. If this happens, all windows in the same Program No. will have their settings invalidated (set to Always Execute).

• If a circular reference error occurs, a "!" will appear before the window number and the execution conditions to indicate an error.

3 **If window number is selected, measurement can be skipped or carried out depending on the judgment results of the specified window.**

• **OK:** Executes if the judgment result of the specified window is OK.

• **NG:** Executes if the judgment result of the specified window is NG.

Reference

If no tolerance is set for the selected window, the judgment result is always OK.

4 **After completing the settings, select [OK].**

Setting the Limits Settings

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

1 **Select [Limits].**

The [Enter Limits] menu appears.

2 **Select an item to set limits for.**

3 **Select [Uppper] or [Lower] and set the tolerance.**

Reference

- The upper intensity limit is set to the maximum intensity value, the lower intensity limit is set to the minimum intensity value.
- Tolerance can be entered by selecting [Direct Input] and specifying a tolerance or by selecting [Calc Ref] and using the results of a chosen calculation window.
- If the [HSB] parameter type is selected, H (hue) is output as 0~255 in an iterative loop. This means that the lower limit can have a higher value than the upper limit.

Example: A red area (hue: 0) that is OK

Lower limit: 235

0

Upper limit: 020
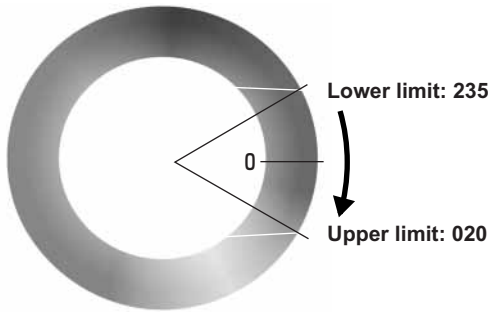
See "HSB Color System Used in the System" (Page 13-8) for details on hue.

4 **To specify the tolerance of another measurement value, repeat Steps 2 and 3.**

5 **After completing the settings, select [OK].**

Reference

- [-----] indicates that no tolerance has been set and no judgment will take place after measurement.
- Press [Clear] to clear the value.

Specifying the Windows for Inspection and Measurement

Draw Shape

What is the "Draw Shape" Tool?

The [Draw Shape] tool is used to set up a point, line, or circle to use for reference purposes. This tool does not measure the target, but the reference values set in the window can be used in calculations for advance measurements. For example, the distance between a detected edge and a reference point can be calculated. The reference parameters can be changed based off of a calculation value.

► **Note**

See "Applying Calculations to the Measurement Results [Calc]" (Page 4-253) for details on calculation processing.

Reference

The draw shape window judgment results are fixed to [OK].

Selecting Measurement Tools

**1** **Select [Add/Copy/Del] from the [Edit Window] screen.**

2 **Select [Add].**

The [Add Window] menu appears.

3 **Select [Window Number], then specify the measurement window number.**
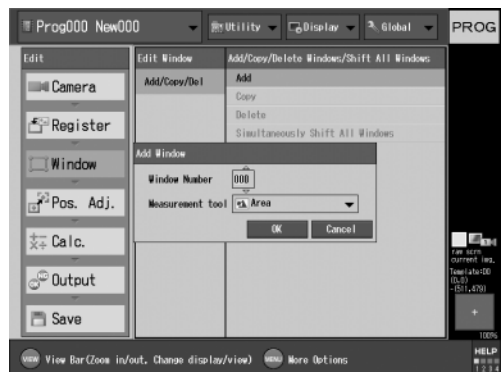
Window numbers can be freely set at any value from 0 to 127 .

4 Select [Measurement tool] and then select [Draw Shape].
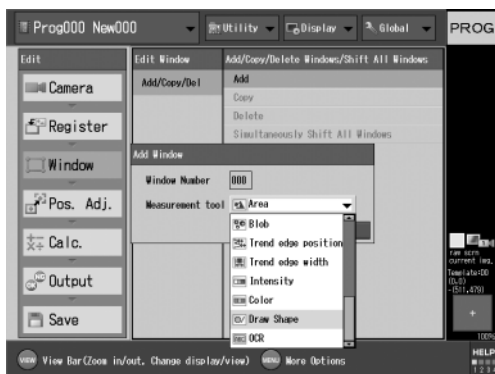
5 Select [OK].

The window with the specified number is added as a draw shape window. The current window setting list is then displayed.
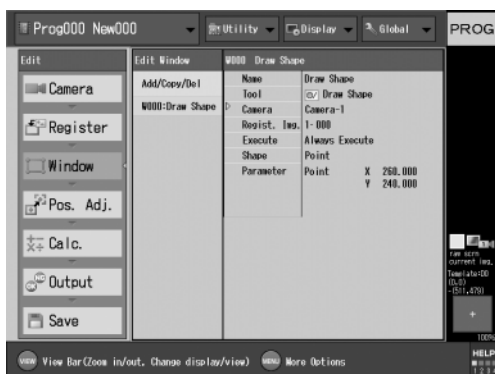
The necessary settings for the draw shape window are added next.

Selecting a Camera to Take Images

1 Select [Window] and then select the [Draw Shape] window.

The window setting menu appears.

2 Select [Camera], then selecting a camera to take images
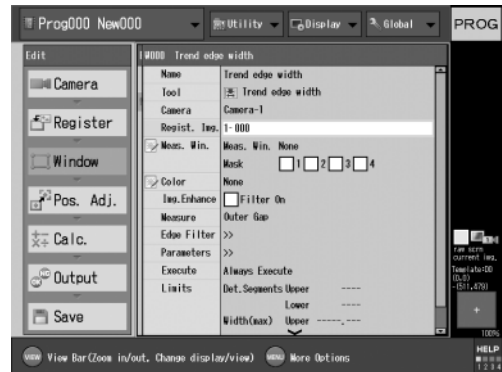

Reference

Unconnected cameras can be selected. However, if the selected camera is not connected at the time of imaging, an error will occur.

Specifying the Windows for Inspection and Measurement
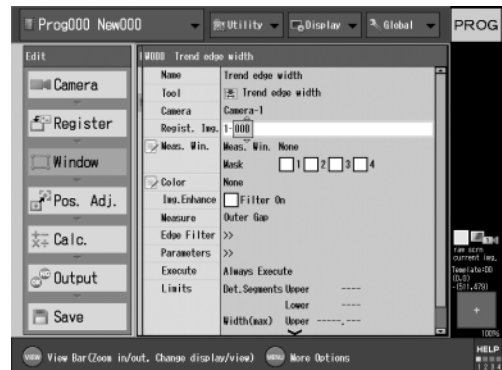
Specifying a Registered Image to Use

Specify a registered image to use for processing.

The image to be used must have been previously saved to an image number in the [Register Image] screen (Page 4-19).
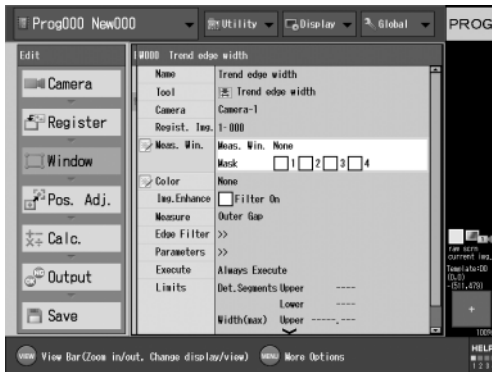
Select [Regist. Img.], then specify the number of the registered image to be used.

The registered image number will be displayed as "Camera number-xxx."

Setting the Execute Conditions

The measurement window can be set to execute or not, based on the results of an OK or NG judgment of a specified window. This can be useful for instances where inspections need to be skipped. See "What are Execute Conditions?" (page 4-247) for details.

1 Select [Execute].

The [Window Execute Condition] menu appears.

2 Select an appropriate condition.

- **Always Execute** (Default) **:** Always execute on trigger input.
- **Never Execute:** Do not execute even with trigger input (skip).
- **Window Number (Measurement, Calculation):** Skips or measures depending on the judgment results of the selected window.

Reference

If measurement is skipped, measurement and judgment results for that window become 0 and are not reflected in the final results.

► Note

- If the reference window is set to itself, a circular reference error will result. If this happens, all windows in the same Program No. will have their settings invalidated (set to Always Execute).
- If a circular reference error occurs, a "!" will appear before the window number and the execution conditions to indicate an error.

3 **If window number is selected, measurement can be skipped or carried out depending on the judgment results of the specified window.**

- **OK:** Executes if the judgment result of the specified window is OK.
- **NG:** Executes if the judgment result of the specified window is NG.

Reference

If no tolerance is set for the selected window, the judgment result is always OK.

4 **After completing the settings, select [OK].**

Selecting a Shape to be Drawn

Select the shape to be drawn in the draw shape window.

Select [Shape] and then specify the shape to be drawn.
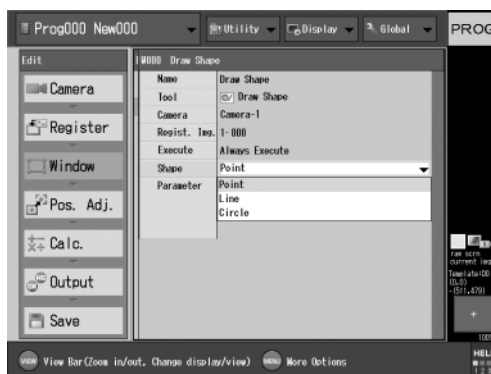
- **Point:** Draws a point.
- **Line:** Draws a line.
- **Circle:** Draws a circle.

Drawing a Shape

Select [Shape] and then draw the specified shape.
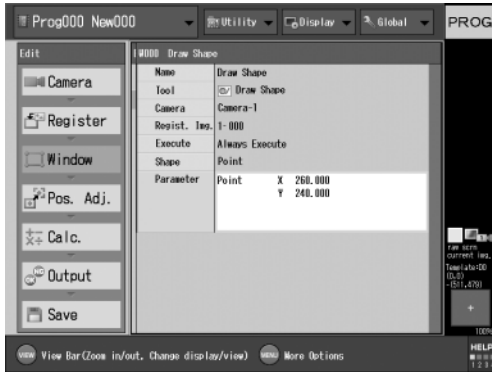
1 Select [Parameter].

The [Tool Parameter] menu appears.
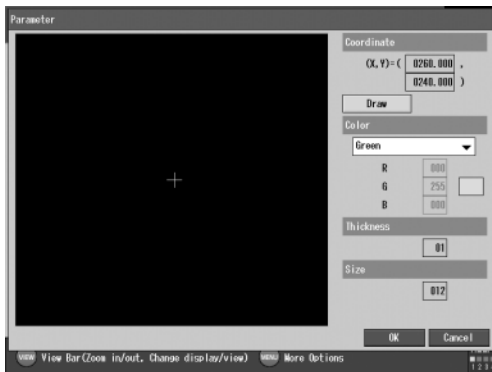
2 Draw the measurement area.

Each of the shapes selectable in the [Shape] window is drawn in a different manner.

- See "Drawing a point" (Page 4-222) for details on points.
- See "Drawing a line" (Page 4-223) for details on lines.
- See "Drawing a circle" (Page 4-223) for details on circles.

3 After drawing is complete, select [OK].

Drawing a point

1 Select the location of the point.

Selected [Draw] from the [Parameter] menu and use the cursor to select the position of the point.

2 Press the [ESCAPE] button after the image has been drawn.

3 Select a display method.

- **Color:** Select the color of the point.
- **Thickness:** Specifies the thickness of the point.
- **Size:** Specifies the size of the cross that marks the point.

Reference

- Point location can also be specified numerically. See "Draw the Window by Entering Values" (Page 3-24) for details.
- By specifying a calculation reference, the coordinates of a point can be changed automatically as the results of the calculation change,

► Note

No point will be displayed if the calculation reference value falls outside the following parameters.

- $-9600 \leqq x \leqq 9600$
- $-9600 \leqq y \leqq 9600$

Drawing a line

1 Select the location of the start of the line.

Select [Draw] from the [Parameter] menu and use the cursor to select the start point of the line. Press the [ENTER] button.

2 Select the location of the endpoint of the line.

Use the cursor to select the end point of the line and press the [ENTER] button.

3 Move the line.

Move the [ENTER] button to specify the new location of the line, and then press the [ENTER] button. Each time you press the [ENTER] button, it cycles through steps 1 through 3.

4 Press the [ESCAPE] button after the image has been drawn.

5 Select the type of line.

- **Straight** (Default)**:** Displays a straight line between the two points.
- **Segment:** Draws segmented line between the two points.

6 Select a display method.

- **Color:** Select the color of the line.
- **Thickness:** Specifies the thickness of the line.

Reference

- Start and end point locations can also be specified numerically. See "Draw the Window by Entering Values" (Page 3-24) for details.
- By specifying a calculation reference, the coordinates of a line can be changed automatically as the results of the calculation change,

► Note

No line will be displayed will be displayed if any of calculation reference values for the start and end points fall outside the following parameters.

- $-9600 \leqq x \leqq 9600$
- $-9600 \leqq y \leqq 9600$

Drawing a circle

1 Move the circle.

Select [Draw] from the [Parameter] menu and move the [ENTER] button to specify the location of the circle, then press the [ENTER] button.

2 Specify the size of the circle.

Move the [ENTER] button to specify the position of Point A, which changes the size of the circle. Each time you press [ENTER], it will alternate between adjustment steps 1 and 2.

3 Press the [ESCAPE] button after the image has been drawn.

4 Select a display method.

- **Color:** Select the color of the circle.
- **Thickness:** Specifies the thickness of the circle.
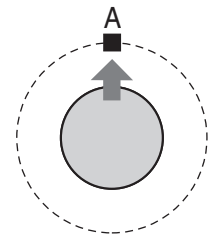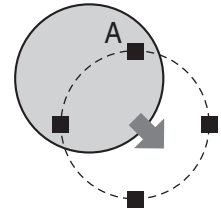
Reference

- The location of the center of the circle and the radius of the circle can also be specified numerically. See "Draw the Window by Entering Values" (Page 3-24) for details.
- By specifying a calculation reference, the coordinates of the circle can be changed automatically as the results of the calculation change.

► Note

No circle will be displayed will be displayed if any of calculation reference values for the center and radius fall outside the following parameters.

- $-9600 \leqq x \leqq 9600$
- $-9600 \leqq y \leqq 9600$
- $0 \leqq r$ (radius) $\leqq 9600$

Specifying the Windows for Inspection and Measurement

OCR

What is the [OCR] Measurement Tool?

A character string that is captured within the measurement window can be recognized by verifying the character information with the library data stored in the program. This tool can be used to perform a quality check on a preset character string or a varying character string like a date code or serial number. The actual detected character string can also be output from the controller.

Measurement image

Measurement area

Characters to be measured
Extracts the character information in the measurement window, and recognizes it as a character string.
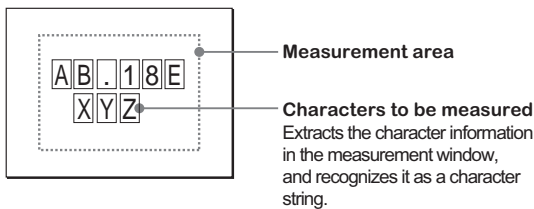
Measurement results

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

- **L1 String**: The first line of the recognized character string is output. (Tolerance inspection target)
- **L2 String**: The second line of the recognized character string is output. (Tolerance inspection target)
- **L1 Regist String**: The first line of the character string that will be used as a inspection reference is output.
- **L2 Regist String**: The second line of the character string that will be used as a inspection reference is output.
- **Regist Char [ ]**: All the recognized characters are output. (Label specification target)
- **1st Cand Char [ ]**: All the characters that are the first candidate in the recognition result are output. (Label specification target)
- **2nd Cand Char [ ]**: All the characters that are the second candidate in the recognition result are output. (Label specification target)
- **1st Cand Corr [ ]**: How similar the first candidate character in the recognition result is to the library data is all output in the values between 0 and 99. (Label specification target)
- **2nd Cand Corr [ ]**: How similar the second candidate character in the recognition result is to

the library data is all output in the values between 0 and 99. (Label specification target)
- **Stability [ ]**: The difference of the correlation between the first candidate and the second candidate for the recognized character is all output in the values between 0 and 99. (Label specification target)
- **Line Num**: The number of the extracted lines is output.
- **L1 Char Num**: The number of characters in the first extracted line is output.
- **L2 Char Num**: The number of characters in the second extracted line is output.
- **L1 Corr(max)**: The maximum correlation of the first line of the recognized character string is output.
- **L1 Corr(min)**: The minimum correlation of the first line of the recognized character string is output. (Tolerance inspection target)
- **L1 Stbl(max)**: The maximum stability value of the first line of the recognized character string is output.
- **L1 Stbl(min)**: The minimum stability value of the first line of the recognized character string is output. (Tolerance inspection target)
- **L2 Corr(max)**: The maximum correlation of the second line of the recognized character string is output.
- **L2 Corr(min)**: The minimum correlation of the second line of the recognized character string is output. (Tolerance inspection target)
- **L2 Stbl(max)**: The maximum stability value of the second line of the recognized character string is output.
- **L2 Stbl(min)**: The minimum stability value of the second line of the recognized character string is output. (Tolerance inspection target)
- **Measurement window position**: The position of the measurement window is output in pixels. (Available only for reference from calculation)

Measurement sample

Example showing the results of a measurement performed under the following conditions:
- Line Num: 2
- L1 String: 6
- L2 String: 3

The first line of the recognized character string
AB.18E
The second line of the recognized character string
XYZ
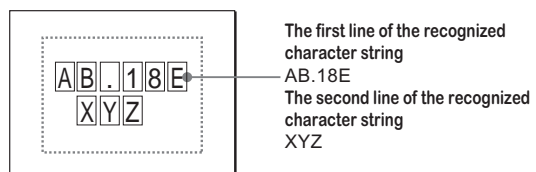
Selecting the Measurement Method

Select the [OCR] measurement tool.

1 **Select [Window] and then select [Add/Copy/Del].**
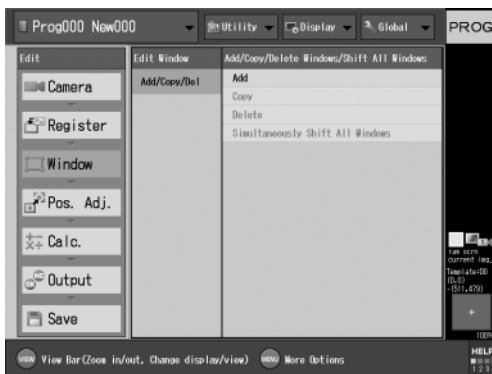
2 **Select [Add].**

The [Add Window] menu appears.

3 **Select [Window Number], then specify the measurement window number.**
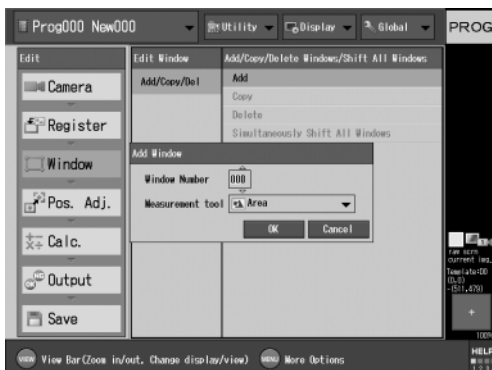
You can freely assign the window numbers between 0 and 127.

4 **Select [Measurement tool] and then select [OCR].**

5 **Select [OK].**

The window with the specified number is added as the OCR measurement window, and the list of the current settings of the window appears.

Continue adding the settings necessary for the OCR measurement.

Selecting a Camera to Take Images

1   Select [Window], and then select the window setting in which the OCR measurement is set.

The window setting menu appears.
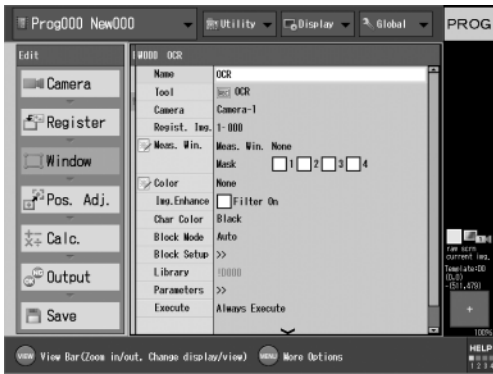
2   Select [Camera], and then select the camera number to use for the inspection.
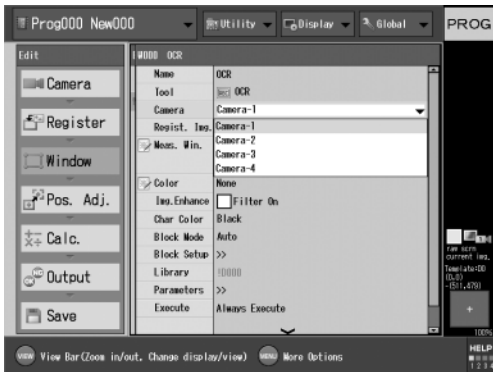
► Note

You can select an unconnected camera, but an error occurs if the selected camera is not connected to the controller when the processing is executed.

Specifying the Registered Image to Use

Specify a registered image to use for processing.
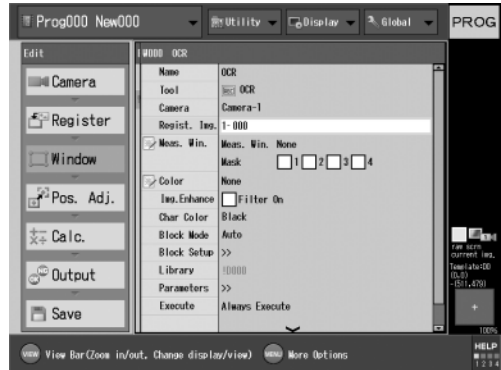
Reference

The registered image number that is specified must have been previously stored in the desired registration number with the [Register Image] menu (page 4-18).

Select [Regist. Img.], and then specify the number of the registered image you want to use.

The registered image number is displayed as "Camera No.-xxx".

Setting a Measurement Window

Specify the area on the captured image to inspect for the character string.
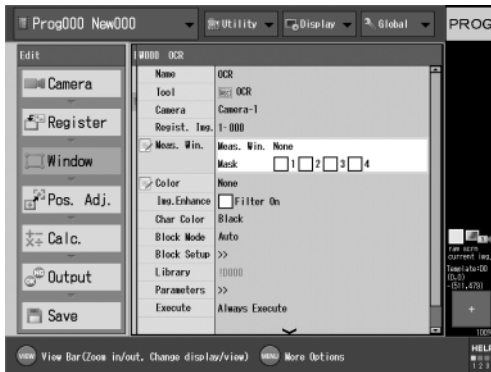
Reference

- If there are sections of the measurement window that you do not wish to detect, you can set a mask to hide the unwanted parts. For details, refer to "Exclude an unwanted area (mask window)" located after "Setting the Measurement Window".
- Only the rectangular area can be set for the OCR measurement.

1 Select [Meas win.].

The [Measurement window] menu appears.
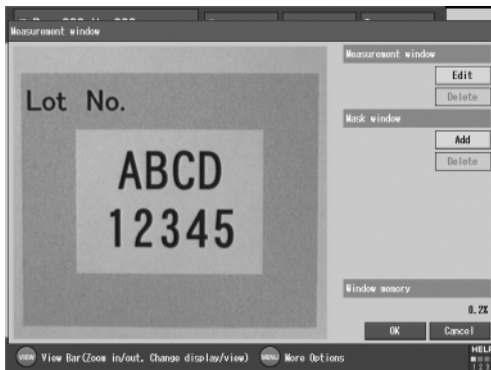
2 Select [Edit] in the [Measurement window] field.

3 Draw the measurement window.

Refer to "Drawing a Measurement Window" (page 3-13) for details.
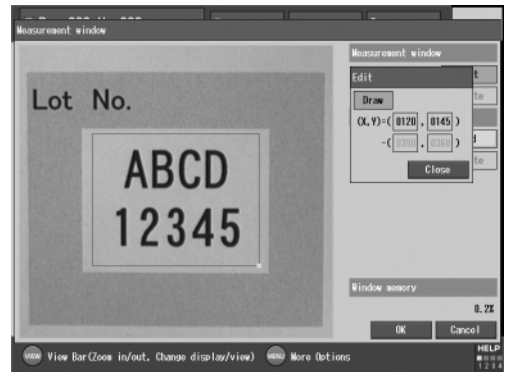
▶ **Note**

Be sure to draw the measurement window to only include the desired character string to be inspected and not any unwanted background areas.

4 When drawing is complete, select [Close] in the [Edit] menu.

Clearing the measurement window

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

1 Select [Delete] in the [Measurement window] menu.

A confirmation screen appears.

2 Select [OK].

Exclude an unwanted area (mask window)

You can set up to four areas (mask windows) that will not be inspected in the measurement window. This is useful when the measurement target has a complicated shape or when you want to hide an area that is not necessary for inspection.

Select [Add] in the [Mask window] menu.

The [Add mask window] menu appears.
Refer to "Exclude Part of the Measurement Window(Mask Window)" (page 3-25) for the subsequent operations.

Specifying the Windows for Inspection and Measurement

Extracting a Color

When using a color camera, the images are converted to black and white through the desired extraction process.

► Note

This feature is not available when using a monochrome camera.
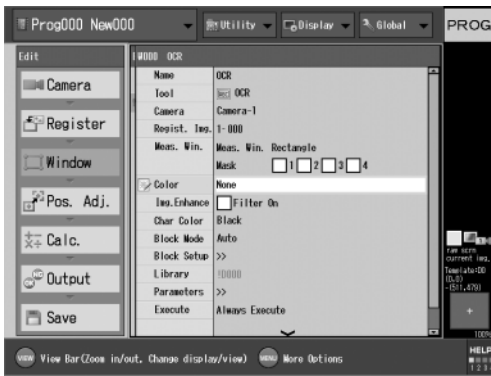
Select [Color].

The [Color] menu appears.
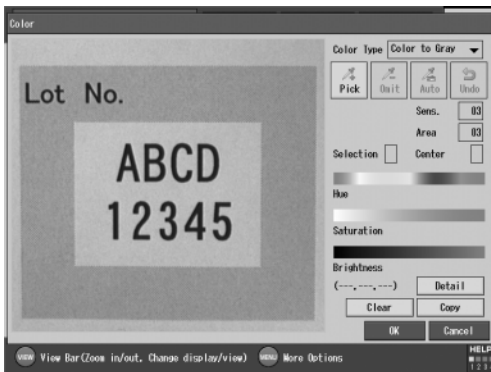
Refer to "Processing a Color Image [Color]" (page 13-1) for the concept of color extraction and its operation.

Reference

When the characters are black and the background is white, selecting [Gray] for [Color Type] can stably extract the character string.

Selecting an Image Enhancement

Specify the filter processing to apply to the image. When a color camera is used, the filter is applied to the images converted using color extraction.
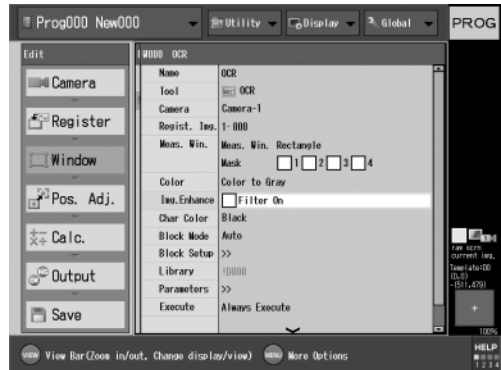
1 Select [Img.Enhance].

The [Image Enhance] menu appears.
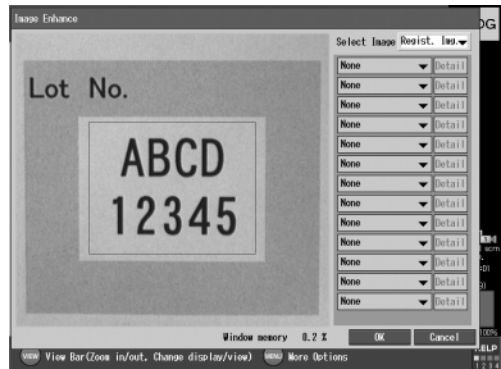
2 Select a filter you want to apply, and then select [OK].

Refer to "Filter List" (page 13-9) for details about the processing content of each filter.

► Note

The subtract filter cannot be selected in the OCR measurement mode.

Reference

• You can select [Detail] to configure the filter settings in more detail.
• Up to 13 types of filters can be set according to the application needs. When multiple filters are set, they are processed starting from the one set at the upper part of the screen.

Specifying the Character Color

By comparing the target characters to the background, set the appropriate character color for the inspection.
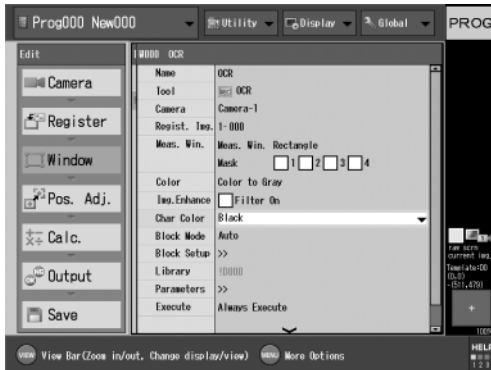
Select [Char Color], and then select a color to be recognized as a character.

- **Black (default)**: Recognizes black (or darker) targets as characters.
- **White**: Recognized white (or lighter) targets as characters.

Specifying the Extraction Mode for Recognizing the Character String in the Measurement Window

Select the mode for separating (extracting) each character to recognize a character string in the measurement window as a group of characters.
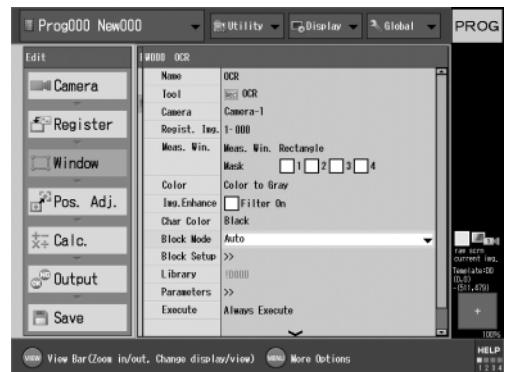
What is "Extraction"?

This manual uses the word "extraction" for the process that separates the character information in the measurement window into each character. An appropriate extraction process is required for recognizing the characters in the OCR measurement mode.

The default extraction process (Block Mode) is [Auto]. This can automatically extract up to two lines of characters in one measurement window. Each line can contain up to 20 characters. If the target characters cannot be properly extracted using the [Auto] mode, select [Fixed] for the Block Mode. [Fixed] mode will allow you to manually extract one line of up to 20 characters within the measurement window. Refer to "If Character Strings Cannot Be Extracted with Auto Extraction (Fixed Extraction)" (page 4-245) for details.

Specifying the Windows for Inspection and Measurement

Specifying the extraction method

Select [Block Mode], and then select the extraction method for the characters within the measurement window.

- **Auto (default)**: Automatically extracts lines or characters from image data.
- **Fixed**: Extracts lines or characters from the manually specified area.

► Note

When [Fixed] is selected, all character strings are treated as the first line.

Changing the Auto Extraction Settings

Set each parameter according to the selected extraction method. This section describes the operation assuming that you have selected [Auto] for [Block Mode].
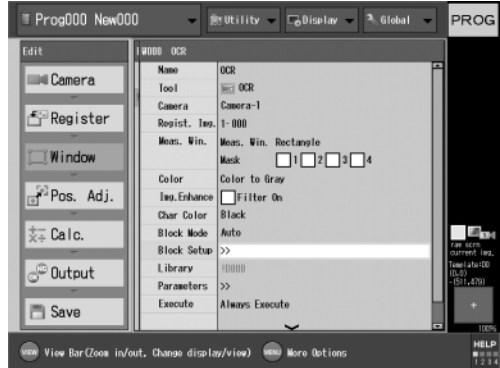
► Note

If you have selected [Fixed] for [Block Mode], refer to "If Character Strings Cannot Be Extracted with Auto Extraction (Fixed Extraction)"(page 4-245).

1 Select [Block Setup].

The [Block Set] menu appears, and the extraction status of lines and characters under the current settings is displayed in the measurement window. Also, the projected waveforms that can be used as a reference for auto extraction are displayed for the lines and the characters.
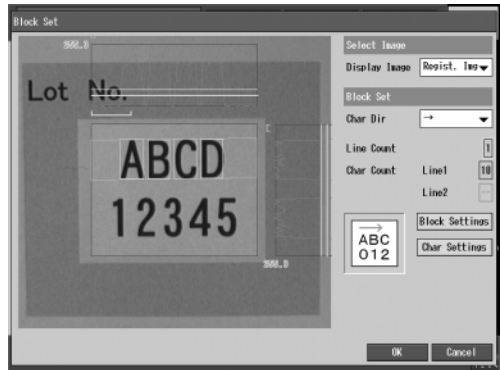
Reference

- The extraction may not be executed properly if the background of the characters is included in the measurement window. Be sure to set the measurement window to enclose the characters only.
- The projected waveforms display the intensity information in the area projected vertically with reference to the reading direction.

2 **Select [Display Image], and then select the image to be displayed on the [Block Set] menu.**

- **Regist. Img**: Displays the registered image selected in "Specifying the Registered Image to Use" (page 4-226).
- **Input img**: Displays the image imported from the camera selected in "Selecting a Camera to Take Images" (page 4-219).

3 **Select the [Char Dir], and then select the reading direction of the character string with reference to the screen.**

If the character string is rotated with 90° increments with reference to the screen's level position, change the reading direction. One of the following icons that show the current reading direction is displayed on the screen.

- → **(default)**: Reads characters from the left side of the screen to the right (normal).
- ←: Reads characters from the right side of the screen to the left (rotated by 180°).
- ↑: Reads characters from the bottom of the screen to the top (rotated by 90° counterclockwise).
- ↓: Reads characters from the top of the screen to the bottom (rotated by 90° clockwise).

> **Reference**
> If the tilt angle of the target string varies or is not an increment of 90°, use the position adjustment function to correct the measurement window.

4 **Select [Line Count], and then specify the maximum number of lines to be extracted from the measurement window.**

Specify 1 or 2 (default: 1).

5 **Select [Char Count], and then specify the maximum number of characters to be extracted from each line.**

Specify the number of characters between 1 and 20 (default: 10).

6 **When the setting is complete, select [OK].**

> **Reference**
> If the target characters are not properly extracted at this point, change the Block Mode to [Fixed] to manually extract or configure the detailed [Auto] settings under [Block Settings] and [Char Settings].
> Refer to "If Character Recognition Is Not Stable with Auto Extraction (Detailed Setting)" (page 4-241) and "If Character Strings Cannot Be Extracted with Auto Extraction (Fixed Extraction)" (page 4-245) for details.

Registering the Character Pattern to Be Used for Character Recognition

In addition to alphanumeric characters (0-9, A-Z) and symbols (dash, period, colon and forward slash), up to 20 user-defined characters can be registered in a single library setting.
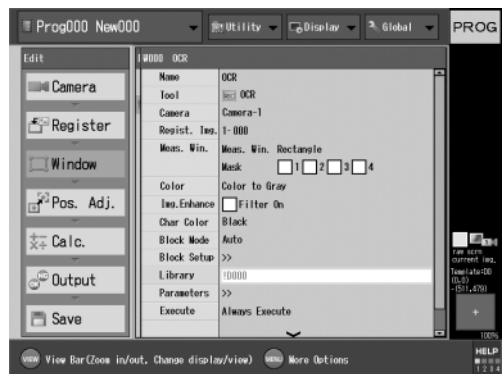
> **Reference**
> - To use the OCR tool, character data must be registered in a library. If there is no character data registered in the selected library, the selected library number is displayed in red (i.e. "!D000") and the window is not valid.
> - You can register desired patterns such as Kanji, pictograms, and custom characters as user characters.
> - The user characters are displayed as (1) to (20) on the screen and managed.

1 **Select [Library].**

The [Library] menu appears.

Specifying the Windows for Inspection and Measurement
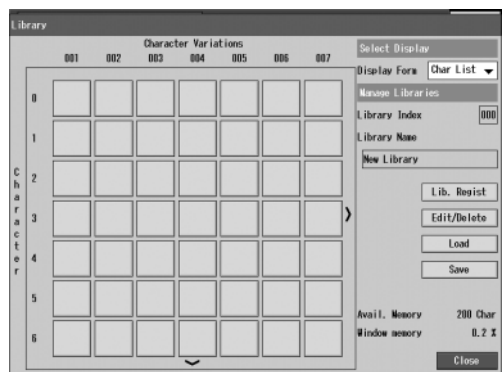
Changing the list format

You can change the display format using [Display Form].

- **Char List (default)**: Displays the list of the registered characters in a matrix format.
- **Var List**: Displays the registration status of each character type in a list.

Switching the library number to register

Specify the library number you want to register using [Library Index] (Between 000 and 999. Note that the number of libraries that can be created may be limited depending on the free space of the internal memory).

Changing the library name

Select [Library Name], and then enter a desired name (up to 30 double-byte characters or 60 single-byte characters).

2 Select [Lib. Regist].

The [Lib. Regist] menu appears.
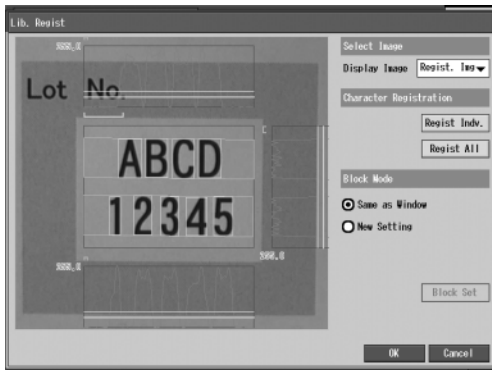
3 Select [Display Image], and then select the image to be displayed on the extraction setting screen.

- **Regist. Img**: Displays the registered image selected in "Specifying the Registered Image to Use" (page 4-226).
- **Input img**: Displays the image imported from the camera selected in "Selecting a Camera to Take Images" (page 4-226).

4 Select the character registration method and the extraction method, and then perform library registration.

The following two methods are available for character registration. You can also select the extraction method to use for each registration method.

Character Registration:

- **Regist Indv.**: Registers the extracted character one by one while specifying the character type.
- **Regist All**: Registers the extracted characters in a character string all together.

Reference

Up to 200 characters can be registered in one library, but may be less depending on the setting status.

Selecting the extraction method ([Block Mode])

- **Same as Window(default)**: The same extraction setting (Block Mode) that was set in the inspection window menu is used for the character registration.
- **New Setting**: A different extraction setting (Block Mode) than the one set in the inspection window menu is used for character registration. This is useful when registering characters from images, such as character templates, that are different from the actual inspected images.

Reference

Refer to "Changing the Auto Extraction Settings" (page 4-230) for details on the extraction setting.

When [Regist Indv.] is selected

Use the cursor to select the desired extracted character on the screen and press [Enter]. The [Register Characters] menu will appear. Choose the desired character type in which to register the selected character into and press [Enter]. Repeat this step until all the required character types are registered.
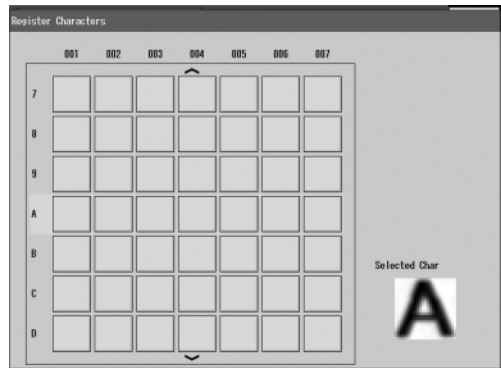
Reference

If multiple character registrations are made for one character type, the additional characters are automatically registered as character variations in the character type. Registering several variations of a character type can stabilize detection since the best-fit character from the registered variations is used for matching, even when the character shape fluctuates.

When [Regist All] is selected

The [Regist All] menu appears.

Select the appropriate line number and manually enter the character string that is currently extracted. Select [Register] to register the character types into the current library.
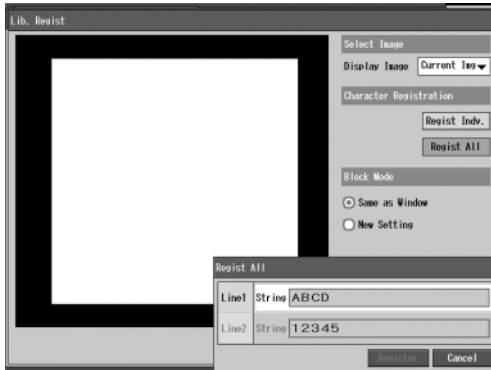
- If there is any characters in the extracted string that you do not wish to register into the library, enter an asterisk "*" in place of the character that you want to ignore when entering the string in the [Regist All] menu.
- If more than one of the same character type coexists in the extracted string to be registered, the repeated characters will be registered as character variations in that character type. If you do not want the repeated characters to be registered as variations of the same type, enter an asterisk "*" in place of the repeated characters when entering the string.

5 **When the setting is complete, select [OK].**

The system returns to the [Library] menu.

► **Note**

If the same character pattern is registered to several different character types in the library, the smallest character type in the ASCII code is output for that character pattern as a result of recognition regardless of the actual character content. As this may cause a wrong judgment, do not register the same pattern to different character types.

Reference

The recognition result of the character pattern registered as user character is displayed as (1) to (20), but it is converted into "a" to "t" (lower-case alphabet) in the calculation or output.

6 **Select [Close].**

Editing and deleting the registered library data

You can edit or delete the registered library data by following the procedure below.

► **Note**

The deleted character patterns cannot be restored.

1 **Select [Edit/Delete] on the [Library] menu.**

The [Edit/Delete] menu appears.

2 **Perform necessary operations.**

Enable/Disable

Temporarily enables or disables the selected character pattern. A red X is displayed on top of the disabled character indicating it has been disabled. The character data is not deleted and can be re-enabled when desired.

Delete Character

Deletes the selected character pattern.

Delete Variation

Deletes all the character patterns registered in the selected character type.

Delete All

Deletes all the character patterns registered in the selected library number.

3 **When setting is complete, select [Close].**

Loading library data that is stored on the memory card

Load the library data saved on the memory card to the current library number by following the procedure below.

► Note

The loaded data is added to the library number currently selected. If you want to use the loaded data alone, delete the selected library data beforehand, or select an empty library number.

Reference

The library data created with a different camera type can also be loaded, but make sure to check if the data can be correctly recognized.

1 **Select [Load] on the [Library] menu.**
The [Load] menu appears.

2 **Specify the folder that contains the library data.**

3 **Select [Execute].**
The library data is loaded from the memory card, and added to the current library number.

► Note

You cannot select [Execute] unless you specify the folder that contains the library data (cvdic.dat) in step 2.

Saving the current library data in the memory card

The registered library data can be saved to the memory card so that other program numbers or controllers can use it by following the procedure below.

1 **Select [Save] on the [Library] menu.**
The [Save] menu appears.

2 **Specify the save destination.**

► Note

The C drive (flash memory in the controller) cannot be specified as the save destination.

3 **Select [Execute].**
The library data is saved in the specified folder in the memory card.

Reference

The library data is saved in the specified folder as the binary file named "cvdic.dat".

► Note

Do not change the file name "cvdic.dat". If you change this name, the controller will not be able to read this file.

Setting Other Measurement Conditions

Set other OCR measurement conditions as necessary.
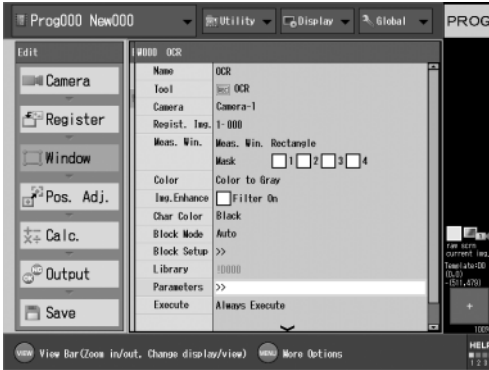
1 Select [Parameters].

The [Tool Parameters] menu appears.
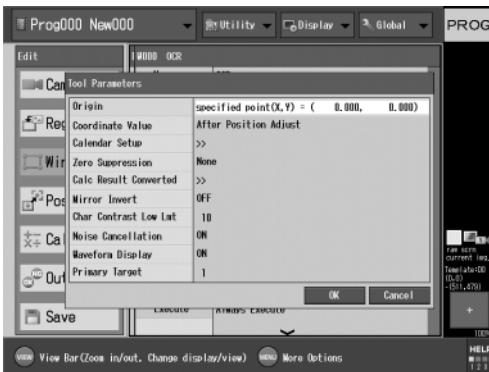
2 Make the necessary settings.

When the setting is complete, select [OK].

Changing the reference position of the origin

Specify the reference position of the origin in [Origin] on the [Tool Parameters] menu.
Make the necessary settings on the [Origin Selection] menu.

- **Specified point (default)**: As a default, the origin is set at the upper left coordinate of the screen (0,0). You can freely change the origin point by selecting [Edit] and moving the cursor on the screen to the desired location. Press [Escape] to set the new position and the coordinates will be display in the "(X, Y)=" field.
- **Registered point**: Cannot be used for the OCR measurement.

Reference

If [Specified point] has been selected, the origin point can be set outside the process area. The range of values you can specify is between -9600 and 9600 (X), or -7200 and 7200 (Y).

Selecting the coordinate system for position adjustment

You can select the coordinate system using [Coordinate Value] on the [Tool Parameters] menu. If a position correction (page 4-249) is not being done, this setting will have no effect on the output.

- **After Position Adjust (default)**: 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.
- **Before Position Adjust**: The distance from the position of the "Origin point" is measured.

Reference

This setting is reflected in the value when the measurement window position is reference in a calculation.

Setting the offset or allowable error for the calendar tolerance

Select [Calendar Setup] from the [Tool Parameters] menu to modify these settings.

- **Offset**: An offset can be added to the current date/time that is referenced when using the date/time in the character string limit setup (page 4-239). The offset result is displayed in the [Offset Date] field in the [Calendar Setup] menu. The range of offset values that can be specified are: Year: +/-10, Month: +/-12, Day: +/-366, Hour: +/-24. (By default, all of the offset values are set to 0).
- **Allowable Error**: Sets the allowable error in the time difference between the internal calendar and the external device (string being inspected) when the date/time changes to the next day or next hour. A range of up to +/-3599 seconds can be set and will be reflected in the tolerance when using date/time in the character string limit setup (page 4-239).

Example: Inspection status with the allowable error set to ±60 seconds at the turn of the day

Current time of the internal calendar	2006.12.31		2007.1.1	
	Up to 23:58:59	23:59:00 to 23:59:59	0:00:00 to 0:01:00	0:01:01 and later
Print 2006/12/31	OK		OK	NG
Print 2007/1/1	NG	OK	OK	

Tolerance -60 sec   Tolerance +60 sec

Performing judgment by removing preceding zeros in the calendar tolerance or calculation tolerance (Zero Suppression)

Select [Zero Suppression] from the [Tool Parameters] menu to modify this setting.

- **None (default)**: Does not perform zero suppression.
- **Before Character**: Performs judgment by placing spaces instead of zeros in front of the number.
- **After Character**: Performs judgment by placing spaces instead of zeros after the number.
- **Remove Zeros**: Performs judgment by removing zeros.

► Note

- Zeros in the first digit (and second digit for the year) are exempt from zero suppression regardless of the setting.
- Use [Before Character] or [After Character] only when [Fixed] or [Auto (Ratio Spec.)] is selected. The allocated space is judged as SPACE for tolerance, so if [Auto (Waveform)] is used, the space cannot be extracted, and there will be disagreement with the tolerance.

Example: Conversion result of the registered character strings using zero suppression

Zero suppression setting	Calendar tolerance	Calculation tolerance	Note
None	06/08/25	00350	
Before Character	06/_8/25	_350	Use this when [Fixed] or [Auto (Ratio Spec.)] is selected.
After Character	06/8_/26	350_	
Remove Zeros	06/8/25	350	

The under bar "_" is treated as a space.

Specifying the method for converting a calculated value when using the value in the character string tolerance

Select [Calc Result Converted] from the [Tool Parameters] menu to modify these settings. Specify the base or number of digits for converting the numerical result of a calculation into the character string tolerance (calculated tolerance).

- **Count Base**: Sets the base (10 to 36) used for converting the calculation result of the reference into the calculation tolerance (default: base 10).

  Example: When numbers are changed to alphabets using base 36

Calculation result	0	to	9	10	to	35
Calculation result	0	to	9	A	to	Z

- **# of Digits**: Specify the number of digits (1 to 6) to use for the calculation tolerance conversion (default: 1).

► **Note**

The digits that run beyond the specified number of digits as a result of conversion are not reflected to the tolerance (Example of when two digits are specified in decimal: Calculation result 350 → Calculated tolerance 50)

Recognizing mirrored characters (Mirror Invert)

You can change this setting by selecting [Mirror Invert] on the [Tool Parameters] menu. Activating this mirror inversion feature will switch the internal processing to properly recognize inverted characters when capturing images with a mirror or through a prism.

- **OFF(default)**: Does not perform mirror inversion.
- **ON**: Performs mirror inversion.

Reference

The reading direction in the auto extraction mode will also be changed as a result of mirror inversion. You can check the reading direction with the icon displayed on the [Block Setup] menu (page 4-230).

Setting the threshold for extracting characters (Char Contrast Low Lmt)

Select [Char Contrast Low Lmt] in the [Tool Parameters] menu to adjust this setting. Specify the lower limit of character contrast deviation (0 to 255) with which to judge a block area as a space (default: 10).

If the noise elements in the background of the inspecting character string are recognized as characters, increase the lower limit to fix this problem. If the contrast of a character and its background is low and the character is recognized as a space, decrease the lower limit so that it can be properly recognized as a character.

Preventing Improper Fine-adjustment Caused by Noises on the Block Area (Noise Cancellation)

You can specify the [Noise Cancellation] on the [Tool Parameters] menu. This function excludes the noise on the border of the block area that cause malfunction when performing fine-adjustment (pages 4-244, 4-245) in the block area in the [Fixed] or [Auto (Ratio Spec.)] extraction mode.

- **ON(default)**: Excludes the noise on the border when fine-adjusting the image.
- **OFF**: Includes the noise on the boarder when fine-adjusting the image.

Displaying the projected waveform during operation using display pattern 1

Select [Waveform Display] from the [Tool Parameters] menu to set this item. Setting [Waveform Display] to ON displays the projected waveform for the input image during operation or setting

- **ON (default)**: Displays the projected waveform when display pattern 1 under operation is selected, or when an input image that is being set is displayed.
- **OFF**: Displays the projected waveform only during Block Setup using a registered image.

Specifying the primary target for the calculation from the multiple characters recognized

You can specify the primary target between 1 and 40 using [Primary Target] on the [Tool Parameters] menu (default: 1).

Reference

Specify the primary targets of characters using the sequential number from the first line to the second in the same order as the one in which they are read.

Setting the Execution Condition

The measurement window can be set to execute based on the OK/NG judgement of a specified window or calculation. This is useful for instances where the inspection needs to be skipped. Refer to "What are Execute Conditions?" (page 4-247) for details.
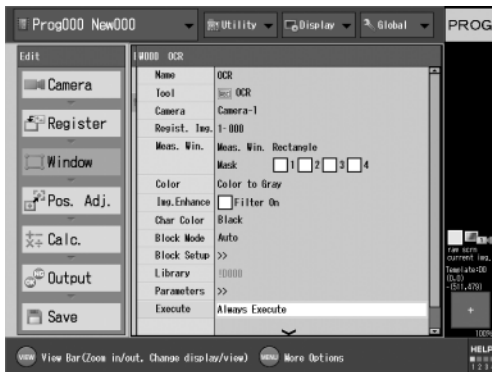
1 **Select [Execute].**

The [Window Execute Condition] menu appears.

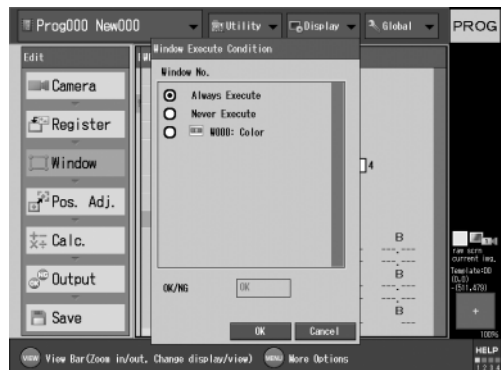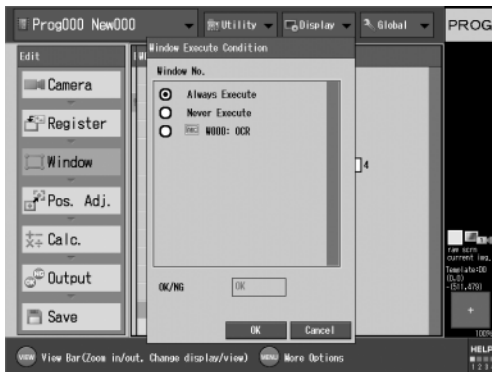**2** **Select one of the displayed items to apply for the window.**

- **Always Execute (default)**: Performs measurement every time a trigger is input.
- **Never Execute**: Does not perform measurement even when a trigger is input (skip).
- **Window No. (measurement/calculation)**: Performs or skips measurement according to the inspection status of the selected window.

<div class="reference">Reference</div>

If the measurement is skipped, the judgment and the measurement results for that window become 0, and the result will not be reflected to the total status.

► **Note**

- If you specify the same window for the reference window, the circular reference error occurs. In this case, all the execution conditions set in the same Program No. including other windows will be disabled (always executed).
- If the circular reference error occurs, the "!" symbol that indicates the execution condition error is displayed in front of the window No. and the execution condition.

3 **When [Window No.] is selected, select which window judgment result the measurement is to be performed for.**

- **OK**: Performs measurement when the inspection status of the selected window No. is OK.
- **NG**: Performs measurement when the inspection status of the selected window No. is NG.

<div class="reference">Reference</div>

If no tolerance is set for the selected window No., the inspection status is always OK.

4 **When the setting is complete, select [OK].**

Setting the Tolerance Limits

You can set the registered character string and the lower limit for the recognition result (Correlation and Stability). If the detected character string during inspection does not match the set registered string or the measurement value for correlation/stability is below the lower limits, the judgement will be "NG". If the detected character string matches the registered string and the measurement value for correlation/stability is equal to or above the lower limits, the judgement will be "OK". You can also limit the character types used for recognition by changing the [Ref. Character] setting.

1 **Select [Limits].**

The [Enter Limits] menu appears.
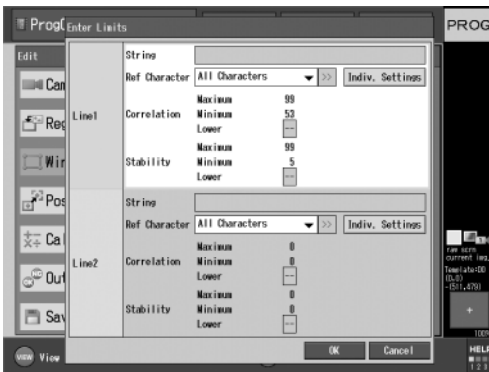
2 **Select the line for which to set the limit setup.**

3 **Select [String] and enter the registered character string to be used for verifying the detected content.**

Enter up to 20 characters or symbols as a fixed character string.

- You can combined fixed character content with characters that vary in content such as the calendar setting or a calculation value that is referenced.
- STD (standard value tolerance) can only be used by itself.

SPACE

Indicates a space.

*

Any character will be judged as OK except for the ones that cannot be recognized.

#

The character represented by this symbol will be judged as OK without any judgment regardless of recognition result.

Example: Difference between the inspection statuses of "*" and "#"

Recognition result		String	
		ABC*	ABC#
ABCD	→	OK	OK
ABC8	→	OK	OK
ABC?	→	NG	OK

The judgment results are different when the correlation or stability of the forth character goes below the lower limit and the character cannot be recognized and is displayed as "?".

Calendar Tolerance

Refers to the internal calendar.

- **Year4**: Displays the year with four digits.
- **Year2**: Displays the year with two digits.
- **Month**: Displays the month with two digits.
- **Day**: Displays the day with two digits.
- **Hour**: Displays the hour with two digits.

Example: When judging the year/month/date of the day (January 1, 2007) linked to the internal calendar using the calendar tolerance

String		Register String
Year4/Month/Day	→	2007/01/01

This example used both the calendar tolerance and a fixed character "/".

Reference

- A desired offset or allowable error for the transition can be set for the calendar tolerance. Refer to page 4-236 for details.
- Zero suppression (4-236) can be set for Month, Day, and Hour.

STD (standard value tolerance)

This setting will compare the detected character string from the inspection to that of the string detected on the registered image. If the two strings match, the judgement is "OK". If one or more characters differ, the judgement is "NG". Using this setting allows you to replace the registered character string all at once by simply re-registering the image on the new setting.

► Note

The standard value tolerance cannot be used in combination with other character strings or the reference tolerance.

Calc Result (calculation result tolerance)

Convert the numerical result of a calculation (page 4-253) into a character string (1 to 6 digits) before referring to it (default: 1 digit). Set the number of digits or base for converting the numerical result of calculation into a character string using [Char Result Converted] on the [Tool Parameters] menu.

Example: When the numerical calculation result is converted into two digits, decimal number for the calculation tolerance result

Calculation result		Register String
5120	$\rightarrow$	20

4 **Select [Correlation] and [Stability], and set the tolerance lower limit value.**

If the value is below the lower limit of correlation or stability after verification with the library, the character cannot be recognized and "?" is output.

- **Correlation**: Enter the lower limit for the minimum value of the correlation of all the recognized characters.
- **Stability**: Enter the lower limit for the minimum value of the stability of all the recognized characters.

Reference

When setting the lower limit for the correlation and stability, you can enter a value directly by choosing [Direct Input] or you can refer to a calculation value by choosing [Cal Ref] and selecting the desired calculation number.

5 **Select [Ref Character] as required, and then change the reference character setting.**

Normally, all the character types registered in the library are used for character recognition, but you can limit the characters to be referred to for recognizing or judging specific characters. Limiting reference characters may increase the processing speed or solve an incorrect recognition problem.

- **All Characters**: Recognition is performed with all the character types registered in the library (default).
- **Character Groups**: Recognition is performed only with the character types used as Register String. Character type includes alphabets, numbers, symbols, and user characters. For example, the library data of the alphabet character type that contains A to Z is used for the character "A".
- **Specified Order**: Recognition is performed only with the registered character strings.
- **Specified Character**: Recognition is performed only with the character strings selected as desired.

Reference

You can change the setting for each character by selecting [Indiv. Settings]. When the registered character string includes both fixed characters and dynamic characters, you can an apply individual setting only to the dynamic characters using [Indiv. Settings].

► Note

When STD (standard value tolerance) is used for the character string to be used for judgment, do not change the reference character from [All Characters]. Doing so may cause incorrect character recognition.

6 **Repeat steps 2 and 5 to set the limit setup of another line.**

7 **When the setting is complete, select [OK].**

Reference

- When a character is judged as "?" (recognition impossible), the result will be NG even if no setting is made for [String].
- "-----" displayed for the correlation lower limit and the stability lower limit indicates the state where no tolerance is set. During this display, the judgment will not be performed for measurement.
- To reset the setting values of the correlation lower limit and the stability lower limit, select [Clear].

If Character Recognition Is Not Stable with Auto Extraction (Detailed Setting)

Auto extraction method performs character extraction by detecting the space between characters on the projected waveform. If the character spaces are too narrow or the characters are slanted, the waveforms may overlap resulting in incorrect character extraction.
If this is the case, aside from changing the extraction method to [Fixed], the detailed auto extraction settings can be modified while checking the displayed waveforms for proper extraction.

Changing the detailed settings of line extraction

Change the settings related to the line extraction processing.

1 **Select [Block Settings] on the [Block Setup] menu.**
The [Block Settings] menu appears.

2 **Select [Line Count], and then specify the number of lines (1 or 2) to be extracted from the measurement window.**

3 **Select [Detect Dir] and then select the extraction direction.**
This is effective when extraction cannot be performed properly due to background noise.
- **Forward (default)**: Extracts the specified number of lines from the top with reference to the reading direction.
- **Reverse**: Extracts the specified number of lines from the bottom with reference to the reading direction.
- **Size**: Extracts the specified number of lines in the descending order of line height regardless of the reading direction.

4 **When the extracted line is tilted in the rotational direction with reference to the measurement window and the line height changes, select [ON] for [Enable Rotate].**
- **ON (default value)**: Enables the rotation correction
- **OFF**: Does not correct rotation.

▶ **Note**
The rotation correction can handle up to about ±15° of rotational displacement. If the angle of displacement is larger, use position adjustment (page 4-249).

Reference
The rotation correction result will also be reflected to the character block area.

5 **If the line extraction is unstable (when the line space is narrow, etc.), select [Detect Method], and then switch the auto extraction methods.**
- **Waveform (default)**: Detects the line space based on the changes in the projected waveform, and extracts the line.
- **Ratio Spec.**: Extracts the line at a specified ratio to the projected waveform width of the entire line. This is effective when the ratio of the line height is constant even when the line space is small.

▶ **Note**
When the number of lines changes, do not select [Ratio Spec.]. Ratio specification forcibly extracts the number of lines regardless of the actual number of lines in the measurement window, so selecting it may cause incorrect recognition.

Specifying ratio
When [Ratio Spec.] is selected, the [Ratio Setup] can be selected to set the detailed ratio parameters.
- **Start**: Specifies the start position of line extraction in the ratio (000.00 to 100.00) to the projected waveform of the entire line (default: 000.00).
- **Height (only when Line Num is 2)**: Specifies the boarder between the first and the second lines in the ratio (000.00 to 100.00) to the projected waveform of the entire line (default: 050.00).
- **End**: Specifies the end position of line extraction in the ratio (000.00 to 100.00) to the projected waveform of the entire line (default: 100.00).

▶ **Note**
The ratio specification returns to the default value if the number of characters is changed.

Specifying the Windows for Inspection and Measurement

6 **Change the detailed settings of the projected waveform as necessary.**

These settings normally do not need to be changed, but adjusting the waveform that serves as a basis for auto extraction may improve the extraction result.

Smooth Filter

Apply the expansion processing to the projected waveform a specified number of times (0 to 20) to smooth out the waveform shape (default: 0). This solves the problem where characters that consist of dots are separated from each other more than necessary, but the detection sensitivity for a narrow line space may be lowered.

Max Row Height

Specify the upper limit of the height of the line to be extracted with the ratio of the measurement window (0.100 to 1.00) (default: 1.00). If the line height exceeds this upper limit when two lines are mistakenly recognized as one line due to a narrow line space, the waveform is analyzed and the line extraction is performed within this upper limit, leading to a successful line extraction result.

Block Thrshld

Specify the lower limit threshold of the projected waveform used for extraction with the waveform intensity (0 to 255) (default: 40).
Lowering the threshold increases the extraction sensitivity, but may increase influences of noise.

Reference
This setting value is displayed with a green line on the waveform on the [Block Settings] menu.

Min Wave Width

Specify the lower limit of the projected waveform width used for line extraction with the number of pixels (0 to 255) (default: 10).
You can exclude the waveform below the lower limit generated due to noise information from the extraction target.

Reference
This setting value is displayed with a pink frame near the waveform on the [Block Settings] menu.

Min Wave Hght

Specify the lower limit of the projected waveform used for line extraction with the difference (0 to 255) from the extraction threshold (default: 25). You can exclude the waveform whose maximum intensity is below the lower limit from the extraction target.

Reference
This setting value is displayed with a yellow line on the waveform on the [Block Settings] menu.

7 **Select [OK].**
The [Block Setup] menu reappears.

Changing the detailed settings of character extraction

Change the settings related to the character extraction processing.

1 **Select [Char Settings] on the [Block Setup] menu.**
The [Char Settings] menu appears.

2 **Select [Line Num], and then select the line number (1 or 2) for which to make detailed settings.**

► Note

This cannot be selected when the number of lines is set to 1.

3 **Select [Char Count], and then specify the number of characters (1 to 20) to be extracted from the measurement window.**

4 **Select [Detect Dir] and then select the extraction direction.**
This is effective when extraction cannot be performed properly due to the background noise.
- **Forward (default)**: Extracts the specified number of characters from the left with reference to the reading direction.
- **Reverse**: Extracts the specified number of characters from the right with reference to the reading direction.
- **Size**: Extracts the specified number of characters in the descending order of character width regardless of the reading direction.

5 **If the extracted character is deformed at an angle, select [ON] for [Enable Slope].**
- **OFF (default)**: Does not correct the tilt.
- **ON**: Corrects the tilt.

► Note

The tilt correction can correct up to about ±20° of character tilt. This does not correct rotated characters.

6 **If the character extraction is unstable (when the character space is narrow, etc.), select [Detect Method], and then switch the auto extraction method.**
- **Waveform (default)**: Detects the character space based on the changes in the projected waveform, and extracts the character.
- **Ratio Spec.**: Extracts the character at a specified ratio to the projected waveform width of the entire character. This is effective when the ratio of the number of characters and the character width is constant even when the character space is small.

► Note

When the number of characters changes, do not select [Ratio Spec.]. Ratio specification forcibly extracts the number of characters regardless of the actual number of characters in the measurement window, so selecting it may cause incorrect recognition.

Specifying ratio
When [Ratio Spec.] is selected, the [Ratio Setup] can be selected to set the detailed ratio parameters.
- **Start**: Specifies the start position of character extraction in the ratio (000.00 to 100.00) to the projected waveform of the entire character (default: 000.00).
- **n-n+1**: Specifies the boarder between the "n"th character and the "n+1"th character in the ratio (000.00 to 100.00) to the projected waveform of the entire character (default: even ratio that corresponds to the specified number of characters).
- **End**: Specifies the end position of character extraction in the ratio (000.00 to 100.00) to the projected waveform of the entire character (default: 100.00).

► Note

The ratio specification returns to the default value if the number of characters is changed.

7 **Change the detailed settings of the projected waveform as necessary.**
These settings normally do not need to be changed, but adjusting the waveform that serves as a basis for auto extraction may improve the extraction result.

Smooth Filter
Apply the expansion processing to the projected waveform a specified number of times (0 to 20) to smooth out the waveform shape (default: 0). This solves the problem where characters that consist of dots are separated from each other more than necessary, but the detection sensitivity for a narrow character space may be lowered.

Max Char Width

Specify the upper limit of the width of the character to be extracted with the ratio of the character height (0.100 to 9.999) (default: 1.00). If the line width exceeds this upper limit when two characters are mistakenly recognized as one character due to a narrow character space, the waveform is analyzed and the character extraction is performed within this upper limit, leading to a successful character extraction result.

Reference

This setting value is displayed with a green (orange when selecting the item) frame near the waveform on the [Char Settings] menu.

Block Thrshld

Specify the lower limit threshold of the projected waveform used for extraction with the waveform intensity (0 to 255) (default: 40).
Lowering the threshold increases the extraction sensitivity, but may increase influences of noise.

Reference

This setting value is displayed with a green line on the waveform on the [Char Settings] menu.

Min Wave Width

Specify the lower limit of the projected waveform width used for character extraction with the number of pixels (0 to 255) (default: 5).
You can exclude the waveform below the lower limit generated due to noise information from the extraction target.

Reference

This setting value is displayed with a pink frame near the waveform on the [Char Settings] menu.

Min Wave Hght

Specify the lower limit of the projected waveform used for character extraction with the difference (0 to 255) from the extraction threshold (default: 25). You can exclude the waveform whose maximum intensity is below the lower limit from the extraction target.

Reference

This setting value is displayed with a yellow line on the waveform on the [Char Settings] menu.

Fine Adj.

Fine-adjust the block area size determined by the waveform with the actual character size to reduce the influence on the correlation when the character size fluctuates.

• **ON (default)**: Reflects the actual character size to the block area.

• **OFF**: Does not perform fine-adjustment.

8 **Select [OK].**

The [Block Set] menu reappears.

If Character Strings Cannot Be Extracted with Auto Extraction (Fixed Extraction)

The block area for each character (up to 20 characters) can be manually set with the Fixed Extraction mode.

► Note

In the fixed extraction mode, only one line can be extracted in one area.

1 **Select [Block Set].**

The [Block Set] menu appears.

2 **Select [Add] under [Block Area].**

You can manually draw the block area around the desired character.

Reference

Only a rotational rectangle can be drawn.

3 **Draw a block area.**

Draw a block area along the outline of the desired character. Refer to "Drawing a Measurement Window" (page 3-13) for details.

► Note

- Be sure that only one character is included in a block area. Proper recognition cannot be achieved if two or more characters are included.
- Be sure that the block is fully included in the measurement window. If a part is drawn outside the measurement window, that area will not be measured, so proper extraction may not be achieved.

Reference

When performing position adjustment (page 4-249) on the block area of fixed extraction, all the block areas in the same measurement window will be adjusted.

4 **When drawing is complete, press the [ESCAPE] key on the remote control console.**

Select [Close] to exit the [Edit] menu. Continue repeating steps 2 to 4 to add more character blocks as needed (up to 20 block areas can be added).

5 **To reflect the actual character size to the block area, select [Fine Adj.], and then select [ON].**

- **ON (default)**: Reflects the actual character size to the block area to reduce the influence on the correlation when the character size fluctuates.
- **OFF**: Extracts characters in a fixed size of the block area.

Reference

The fine-adjustment process is uniformly applied to all the fixed block area in the measurement window.

6 **Select [OK] to exit the [Block Set] menu.**

Specifying the Windows for Inspection and Measurement

Editing a block area

You can modify the specified block area.

1 **Select the block area number you want to edit on the [Block Set] menu.**
The block area drawing menu appears.

2 **Modify the area as necessary.**

3 **Select [Close].**

Deleting a block area

You can delete the specified block area.

1 **Select [Delete] on the [Block Set] menu.**
The [Delete] menu appears.

2 **Select the block area number you want to delete, and then select [OK].**
A confirmation screen appears.

3 **Select [OK].**
The block area selected in Step 2 is deleted.

Reference

The number of the deleted area will be assigned to the next block area and the block numbers that follow are re-numbered accordingly.

What are Execute Conditions?

Changing the [Execute Conditions] of the measurement window allows you to link the execution or skipping of any measurement to judgments of other measurement or calculation windows.

Main uses of execute conditions

Depending on the branching, inspection types can be changed (examples 1 and 2) or inspections can be skipped (example 3).

Example 1: Sorting items by color and automatically changing inspection contents.

Three windows are used to detect the color of an item (W00 to W002). These windows are coupled to the appropriate inspection window and only the correct inspection window for the condition is executed.
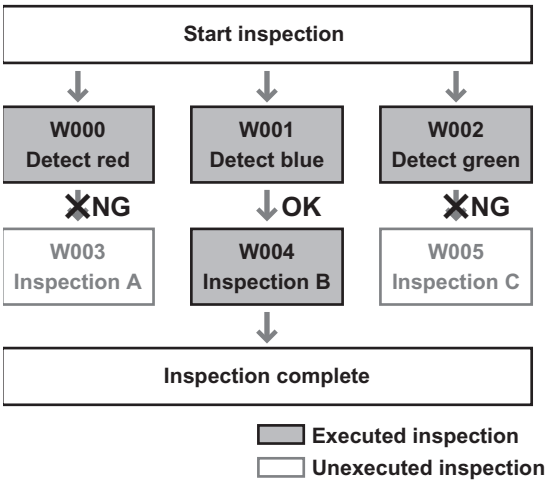
Because inspection filtering takes place automatically, inspections can be carried out on multiple types of targets without relying on manual sorting.

Example 2: Changing inspection type based on instructions from an external terminal.

While the inspection is running, the item number of the next target is fed into the calculation window via the command memory (Page 6-28) so that that calculation window can be referenced by the measurement window when the item is up for inspection. The judgment of the referenced calculation window is used to differentiate between items so that only items judged to be OK are inspected.
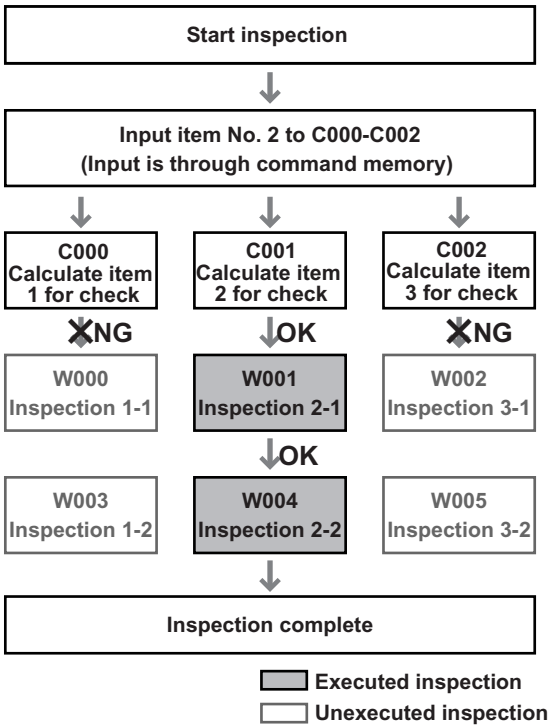
Unlike previous devices, this system allows you to change inspection types in real time without having to stop operation and load a new program. Also, by changing output settings beforehand, you can assure that only the measurement data of windows that are actually executed is output.

Specifying the Windows for Inspection and Measurement

Example 3: If a specific inspection item is NG, the processes that follow it are restricted to reduce processing time.

If a specific window of a target that has multiple inspection items returns NG, any detailed inspection that follows is skipped.

☐ **Executed inspection**
☐ **Unexecuted inspection**
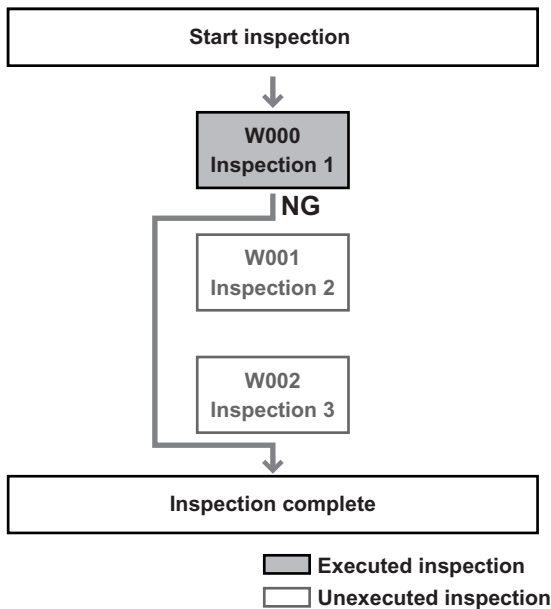
As it takes little time to skip a process, the process of time until for the inspection is reduced.

Cautions when using execute conditions

About skipped windows

- All measurement values are 0.
- Results are all 0 regardless of upper and lower limits and are not factored into overall results. However, if all windows are skipped, the overall judgment is NG.
- If there is a check next to [Skip unexecuted window] in output settings (Page 4-278), the measurement and judgment results of skipped windows are not output.
- Area and processing screens are not displayed.
- Standard output indicator 1 is shown as an unfilled circle.
- Position-corrected windows that are referenced are processed without the correction.
- Skipped results are not included in statistical analysis.
- When using multi-image (Page 4-17), skipped results are not included in the final image. However, if all images are skipped, a measurement error will occur and, unless [Never Execute] is selected, the output setting [Skip unexecuted window] will not be applied.

About execute condition errors

- If the reference window is set to itself, a circular reference error will result. If this happens, all windows in the same Program No. will have their settings validated (set to Always Execute), unless already set to [Never Execute].
- If a circular reference error is generated, a "!" symbol will appear before the window number to indicate an error.
- If the format of the window that is referred to is incorrect, the execute settings will automatically change to [Always Execute]. If the format of a calculation window is corrected, it will automatically revert to reference settings.
- Even if the measurement result of the referenced window is an error, the window will still be referenced as if its judgment result is OK.
- If a reference window's limits are undefined, it will return an OK judgment.

Overview of Position Adjustment

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.
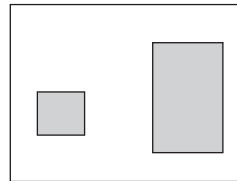
| Example of a reference image | Example of a misaligned image |
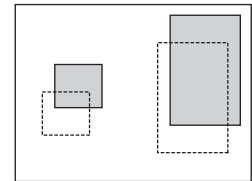
In order to make correct measurements, you can specify an adjustment window and have the adjustment window's misalignment information automatically use the new position data for the measurement areas in other windows. This capability is referred to as the position adjustment function. With this system, 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 Adj.] menu

To make position adjustment settings, display the [Position Adj.] menu by performing the following steps.

1 Select the Program No. to record from the initial settings screen.

2 Select [Pos. Adj.].
The [Position Adj.] menu appears.
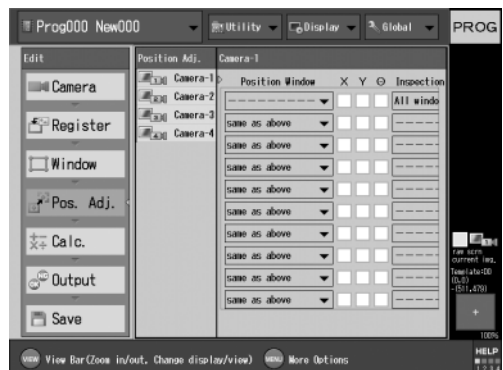
Reference

You can record up to 64 position corrections.

Making Position Adjustments for All Windows Collectively [ALL]

In this mode of adjustment, you specify a single adjustment window and perform position adjustments for all other windows at once.

► **Note**

Windows that use individual position adjustments (next page) cannot be included in batch adjustments.

1 **In the [Position Adj.] menu, select a camera to be used for position adjustment.**

► **Note**

It is not possible to reference a window connected to a different camera.

2 **In [Position Window], select a window that will be used to adjust the inspection window's position.**

3 **Select the items for which you want to perform adjustments and checkmark the box for each item.**

- **X**: Adjusts position along the horizontal (X) axis.

Inspection window

Position window

- **Y**: Adjusts position along the vertical (Y) axis.

Inspection window

Position window

- θ: Adjusts the horizontal (X) and vertical (Y) axes by θ degrees.
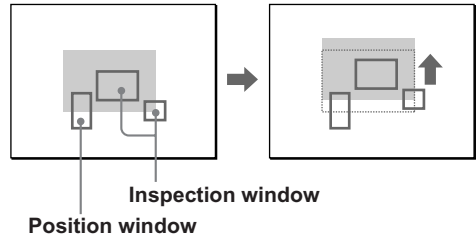
Inspection window
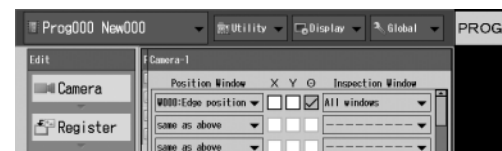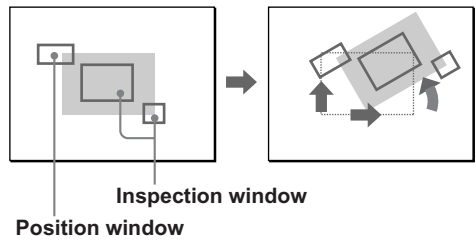
Position window

4 **Select [All windows] under [Inspection Window].**

5 **After completing the settings, select [OK].**

Reference

To change the position adjustment method for only some of the windows, use the individual adjustment settings that are described on the next page.

Making Position Adjustments for Each Window [Individual]

The individual position adjustment can be used to correct the position of each inspection window separately. This feature is useful when using edge positioning and when using two or more cameras. See "Hints for position adjustment" (on next page) for examples of using this function.

1 **In the [Position Adj.] menu, select a camera to be used for position adjustment.**

> ► **Note**
>
> It is not possible to reference a window connected to a different camera.

2 **In [Position Window], select a window that will be used to adjust the inspection window's position.**

3 **Select the items for which you want to perform adjustments and checkmark the box for each item.**

   • **X**: Adjusts position along the horizontal (X) axis.

Inspection window
Position window

   • **Y**: Adjusts position along the vertical (Y) axis.

Inspection window
Position window

   • θ: Adjusts the horizontal (X) and vertical (Y) axes by θ degrees.
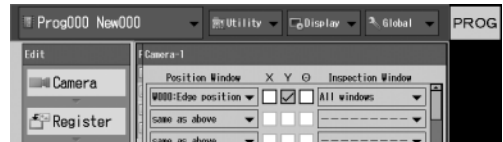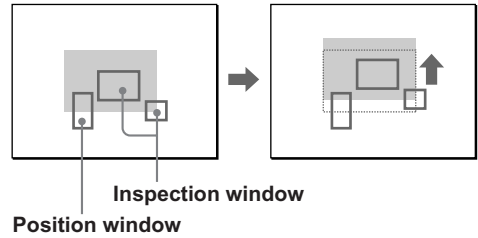
Inspection window
Position window
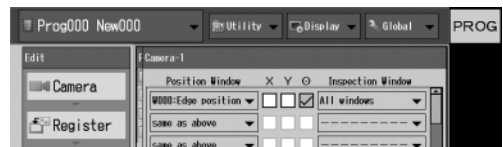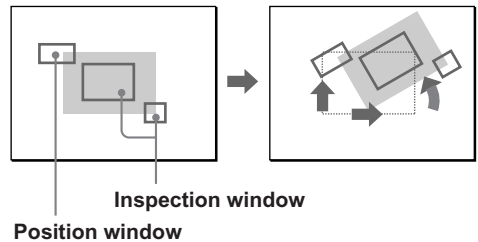
4 **In [Inspection Window], select the window (inspection window) that will follow the position window.**

5 **Repeat steps 2 through 4 for as many position adjustments that are required for the inspection.**

6 **After completing the settings, select [OK].**

Specifying the Windows for Inspection and Measurement

Hints for Individual Position Adjustment

Although most measurement inspections may be solved with batch position adjustment, individual position adjustment is useful in cases such as the following.

When giving high priority to displacement in the X-axis direction

This example is for cases where the following figure is to be measured and position adjustment for W002 is performed using different adjustment windows for the X and Y directions. First, the adjustment is made for the X-direction position using W000, and then for the Y-direction position using W001.
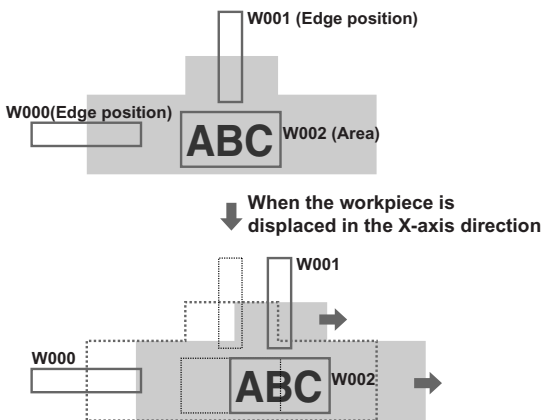
In such cases, the following adjustments procedure becomes necessary:
• First make W000 the adjustment window for W001(X-axis correction) .
• To correct misalignment in the X and Y directions of W002, use W001 as the reference window for both directions (using the adjustment amount from W001 for the X axis and the measurement amount from W001 for the Y axis).
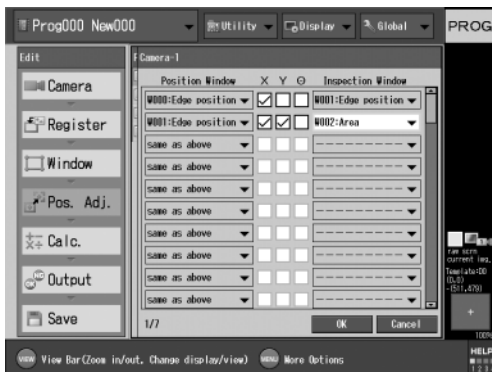
Example with multiple inspection windows

To apply a single correction, such as the one in the previous example, to multiple windows, select [same as above] in the [Position Window] field.
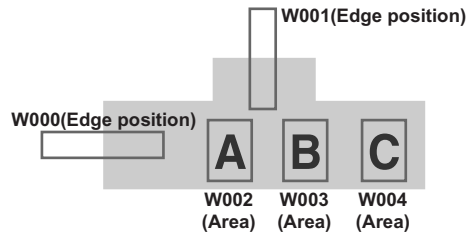
In such cases, the following adjustments procedure becomes necessary:
• First make W000 the adjustment window for W001(X-axis correction).
• To correct misalignment in the X and Y directions of W002, use W001 as the reference window for both directions (using the adjustment amount from W001 for the X axis and the measurement amount from W001 for the Y axis).
• To apply a correction to all windows after W002, set the inspection window to [same as above] to apply the same adjustment to W002-W004.

4-6

Applying Calculations to the Measurement Results [Calc]

Overview of the Calculation Settings

You can specify arithmetic expressions and make judgments ([OK] or [NG]) based on their outcomes. For both types of calculations, multiple calculation results can be substituted for other arithmetic expressions so that complex evaluations based on different results and measurement values can be covered.

Also, a command memory (Page 6-28) can be referenced to reflect external numerical input in the calculation results.

Displaying the [Calculation] menu

Calculation setting is performed in the [Calc] menu.

1 Select the Program No. from the initial settings screen.

2 Select [Calc].

The [Calculation] menu appears.
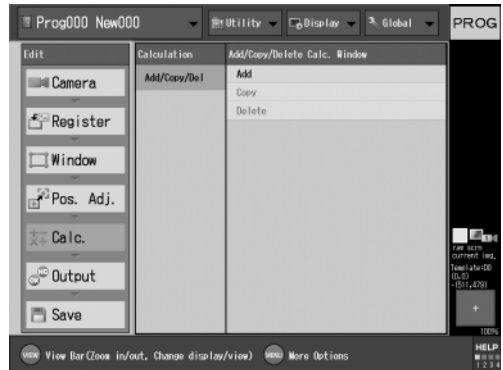
Add and record a numerical input window as shown starting on the next page, then make the calculation settings.

Adding a Calculation Window

With this system, calculations are made in the "Calculation Window". A unique window name in the format "Cxxx" (xxx is a three digit number ranging from 000-127) is given to each calculation window. A maximum of 128 calculation windows can be set for each Program No. Each of the 128 calculations windows can be assigned a unique calculation.

► **Note**

• If there is an error in an added calculation window, a "!" will be displayed before the window name, as in "!C000". The calculation results of a window with an error will be "0".
• Once the error is cleared, the "!" will disappear and the calculation result will be output.

Adding a calculation window

1 **Select [Add/Copy/Del] from the [Calculation] menu.**
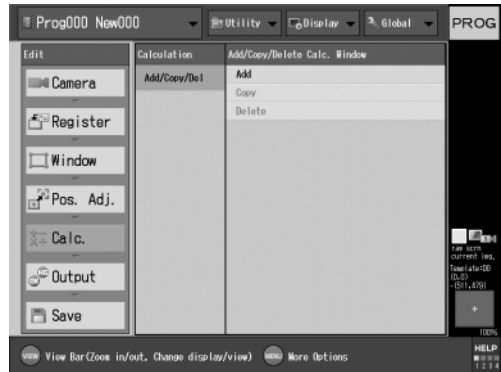
2 **Select [Add].**

The [Add Calc. Window] menu appears.
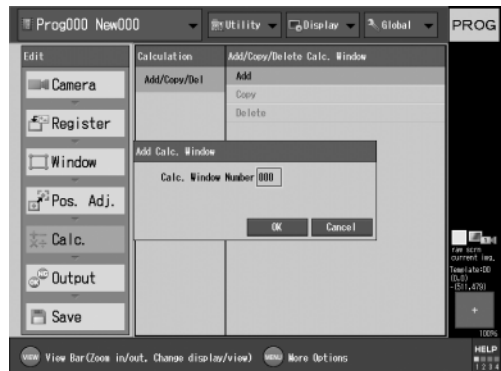
3 **Select [Calc. Window Number], then select the desired window number.**

Window numbers can be freely set at any value from 0 to 127 .

4 **Select [OK].**

The calculation window numbers specified in step 2 are added. See "Creating a Calculation in a Calculation Window" (Page 4-256) for details on setting calculations.

Reference

The calculation results of a window will be "0" until the calculation is set correctly.

Copying and using calculation window settings

All of the setting values that have been saved for one calculation window can be copied to multiple calculation windows.

1 Select [Add/Copy/Del] from the [Calculation] menu.

2 Select [Copy].

The [Copy Calc. Window] menu appears.

3 After selecting a location to copy from, place a check mark next to the calculation numbers to copy the data to.
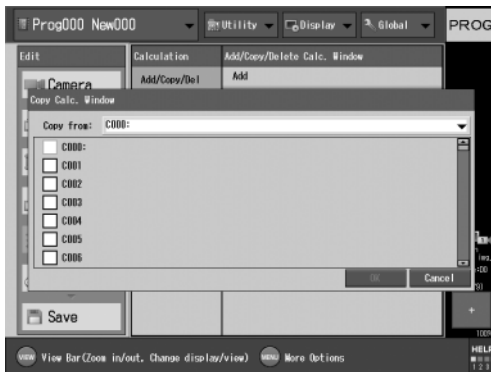
4 After selecting a location to copy to, select a new window number.

A confirmation screen appears.

5 Select [OK].

Copying will be executed.

6 Select [Cancel].

To stop copying, select [Cancel] instead of [OK] in Step 5.

Deleting a calculation window

1 Select [Add/Copy/Del] from the [Calculation] menu.

2 Select [Del].

The [Delete Calc. Window] menu appears.

3 Place a check mark next to the calculation window to be deleted.
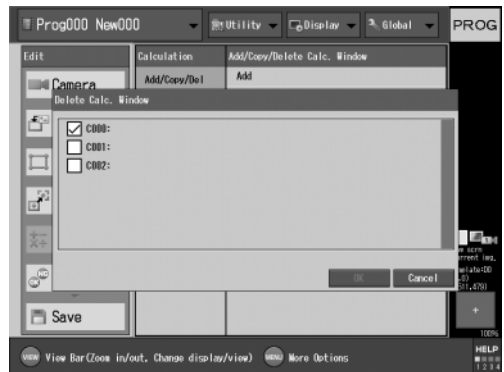
4 Select [OK].

A confirmation screen appears.

5 Select [OK].

The calculation window selected in Step 3 is deleted.

Specifying the Windows for Inspection and Measurement

Creating a Calculation in a Calculation Window

1 **In the [Calculation] menu, select a calculation window in which you want to record a calculation.**

The calculation registration menu appears.
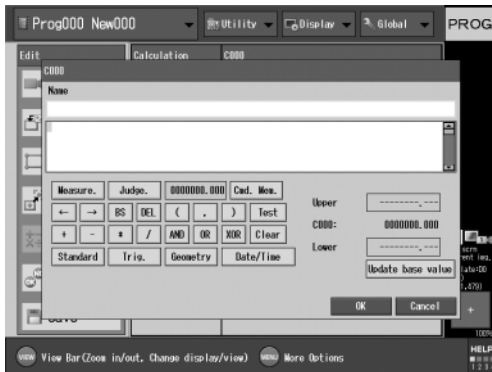
If there are no calculation windows registered, follow the steps in "Adding a calculation window" (Page 4-254) to register one.

2 **Enter a logic statement.**

As you enter the logic statement, it will appear in the box below the Calculation Window Number.

Reference

Equations can contain up to 512 elements, which are the building blocks that make up calculation items. The number of elements that each calculation item consists of is shown below.
- Operators, parentheses, functions and commas: 1 element
- Constants, measurements, judgments and command memory: 9 elements

Measured value

Select this when you enter the specified measurement value of the window.

The [Select Measurement Value] menu is displayed. Select the window and type of measurement values that you want to use for the equation. See "Using Measurement Values in Equations" (Page 4-257) for details.

Judge value

Select this when you want to use the judgment results of other windows as an arithmetic expression. The [Judge.] menu is displayed. Check the window for which you want to output the judgment result. See "Using Judgment Values in Equations" (Page 4-258) for details.

Reference

When using the judgment value in an arithmetic expression, "0" stands for OK, and "1" for NG.

Command memory

Select this to use a command memory, which can read in from an external device.

The [Memory] menu is displayed. Select the memory for which you want to use a variable. See "Using a Command Memory in Equations" (Page 4-259) for details.

Entering other operators and functions

Select this when you enter the symbols of operation. The selection menu will be displayed. Select the operation or function you wish to input.

This device supports the calculations listed in "Operator and Function List" (Page 4-259) .

Entering a constant input

Select this to enter a numeric constant.

Correcting the logic statement

- You can delete the previous character by pressing the BS (backspace) key and delete the character prompted by the cursor by pressing the DEL key.
- To move the cursor, use the arrow keys.

Reference

Move the [ENTER] button while pressing the [FNC] button to move the cursor.
- Move the [ENTER] button right and left while pressing the [FNC] button to move the cursor left and right in the equation.
- Move the [ENTER] button up while pressing the [FNC] button to move the cursor to the start of the equation.
- Move the [ENTER] button down while pressing the [FNC] button to move the cursor to the end of the equation.

3 **Set [Upper] and [Lower] as required.**

4 **After completing the settings, select [OK].**

The equation will be registered in the calculation window.

Reference

If there is an error in the registered equation, a confirmation screen will appear. The equation can be saved, but the calculation results of the window will be "0".

To confirm the result of the logic statement that has been entered

Enter the arithmetic expression and select [Test]. Using the registration screen as a base, the calculation results are displayed in the confirmation window.

Reference

If there is an error in the equation, a confirmation screen will appear.

To reflect changes to the setting of the registered screen in the base values

Select [Update base value].
Use this after inputting a new equation or changing an equation.

Reference

When a new image has been recorded, it will be automatically updated; no action is required.

Using Measurement Values in Equations

Reference

The available measurement values types vary with the selected window number.

1 Select [Measure.] from the register calculations menu.

The [Select Measurement Value] menu appears.
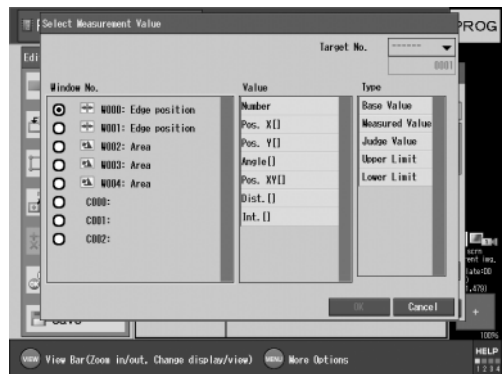
2 Under [Window No.], select the window number with the measurement value to be used in the calculation.

3 Under [Value], select the measurement value to be used in the calculation.

The items displayed vary depending on the items selected.

4 Under [Type], select the type of measurement value to be used in the calculation.

The items displayed vary depending on the items selected.

5 After completing the settings, select [OK].

The selected measurement value is input into the register calculation screen.

Specifying the Windows for Inspection and Measurement

Using a measurement value from a specific target

For example, the area of target 2 out of 10 in blob measurement can be used in a calculation.

Reference

If no target is specified, the judgment label [JG] will be specified automatically.

1 **Select [Number] in the upper right of the [Target No.] menu.**
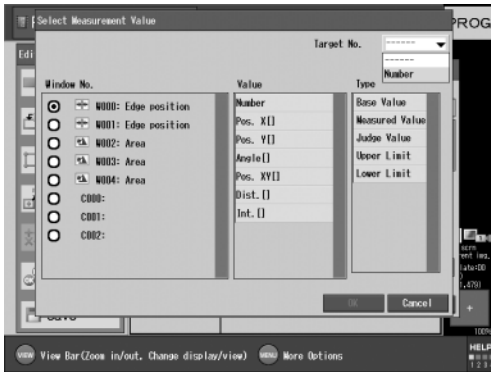
2 **Specify the number of the target to use in the calculation.**

► Note

- If there is an "X" in the "Target" column the "Calculation Symbol Table" (Page 4-267) of a measurement value, no target can be specified.
- Measurement values for which a target can be specified have a "O" displayed next to them in the measurement value list.
- Measurement values (MS) and absolute values (AB) are the only types for which a target can be specified.
- If the specified value is greater than the number of items returned, the measurement value will be "0", even for measurement values for which a target can be specified

Using Judgment Values in Equations

1 **Select [Judge.] from the calculations menu.**
The [Judge.] menu appears.
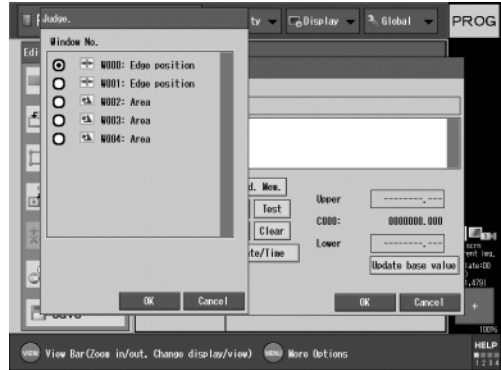
2 **Select the window number with the judgment value to be used in the calculation under [Window No].**

3 **After completing the settings, select [OK].**
The selected measurement value is input into the calculation screen.

► Note

When using the Multi-Image function (Page 4-17), the average is taken for both the judgment value and the measurement value.

Reference

Judgment values of OK are "0" and values of NG are "1".

Using a Command Memory in Equations

Ten digit integers imported from an external device into command memory can be used in calculations. See "Changing Command Memory Settings (Configure Command Memory)" (Page 6-28) for details on command memory.

1 **Select [Cmd. Mem.] from the calculations menu.**

The [Memory] menu appears.
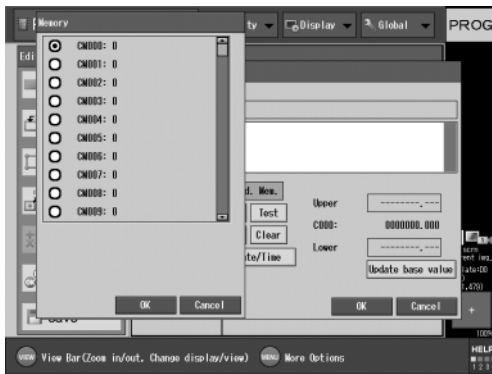
2 **Select the number of the command memory to be used in the calculation.**

3 **After completing the settings, select [OK].**

The selected command memory is input into the calculation screen.

▷ **Reference**

Command memory is displayed in an equation as CMnnn (nnn is the command memory number).

Operator and Function List

The alphabetic characters used in the table represents the following items:

• P: Number
• Q: XY coordinate
• T: Angle (Degrees)

► **Note**

• L (Line) and Q (XY coordinate) can be used as arguments in the calculation, but cannot be used as the final output of the calculation.
• Lines and points output from a calculation cannot be drawn on the screen

General calculations

+, -, *, /

> Four rules of arithmetic (addition, subtraction, multiplication and division)

AND

> Logical multiplication
> Example: Setting C001 to "1" if all judge values from W001 to W003 are NG.
> C001 = W001.JG AND W002.JG AND W003 JG

OR

> Logical add
> Example: Setting C001 to "1" if any judge values from W001 to W003 are NG.
> C001 = W001.JG OR W002.JG OR W003 JG

XOR

> Exclusive OR
> Example: Setting C001 to "1" if the judge values from W001 and W002 are different.
> C001 = W001.JG XOR W002.JG

Specifying the Windows for Inspection and Measurement

General functions

Not (P)

Returns 0 if P > 0, otherwise it returns 1.
Example: Not (4) = 0

Lt (P0, P1)

Returns 1 if P0 < P1, otherwise it returns 0.
Example: Lt (4, 6) = 1

Eq (P0 , P1)

Returns 1 if P0 = P1, otherwise it returns 0.
Example: Eq (4, 6) = 0

Max (P0, P1, ..., Pn)

Returns the largest value in P0-Pn (Maximum 40 items)
Example: Max (8, 9, 2, 3) = 9

Min (P0, P1, ..., Pn)

Returns the smallest value in P0-Pn (Maximum 40 items)
Example: Min (17, 7, 11, 20) = 7

Ave (P0, P1, ..., Pn)

Returns the average value of P0-Pn (Maximum 40 items)
Example: Ave (6, 8, 4, 2) = 5

Abs (P)

Absolute value of P
Example: Abs (-128) = 128

Mod (P0, P1)

Remainder of P1 into P0
Example: Mod (29, 7) = 1 (Because 29 = 7 $\times$ 4 +1)

Pow (P0, P1)

P0 to the power of P1
Example: Pow (2, 3) = 8 (Because 2^3)

Sqr (P)

P squared
Example: Sqr (2) = 4

Sqrt (P)

Square root of P
Example: Sqrt (256) = 16

AveR (Max, Min, P0, P1, ... Pn)

Returns the average value of items that fall between a specified Max (maximum) and Min (minimum) from P0-Pn (Maximum 38 items) .
Example: AveR (25, 20, 21, 26, 23) = 22

Reference
- Use the first and second values to specify the maximum and minimum.
- Returns 0 if only two values are specified, or if all values fall outside of the specified range.

Int (P)

Truncates the decimal place of P* and returns an integer.

Floor (P)

Rounds down and returns the integer value of P*.

Round (P)

Rounds using the first decimal place of P* and returns an integer.

Ceil (P)

Rounds up and returns the integer value of P*.

*The difference between Int, Round, Ceil, and Floor. These operations differ as follows.

Value of P	Int (P)	Round (P)	Ceil (P)	Floor (P)
1.5	1	2	2	1
1.4	1	1	2	1
-1.4	-1	-1	-1	-2
-1.5	-1	-2	-1	-2

Hist (P)

Refers to the value of P from previous trigger.
Example: Hist (P) = 0

Reference
- When using the Multi-Image function (Page 4-17), this refers to the previous multi-image results for the first image and to the results of the previous image for all subsequent images.
- When the device starts up, when Program Nos. are changed, or immediately after RESET, the value of P is always "0".
- The Hist function can be used to compare results of past image inspections with current results. For example, when trying to compare the hue color data from the previous trigger to the current trigger for windows W000, the setting could be "Hist (W000.HUA.MS)-W000.HUA.MS". From this equation you can determine the deviation from one trigger to the next.

MaxN (P0, P1, ..., Pn)

Returns the order number (from 0 to n) of the largest value in P0-Pn (Maximum 40 items)
Example: MaxN (11, 7, 4, 19, 12) = 3

MinN (P0, P1, ..., Pn)

Returns the order number (from 0 to n) of the smallest value in P0-Pn (Maximum 40 items)
Example: MinN (7, 2, 15, 3) = 1

*2 If there are multiple occurrences of the same maximum value or minimum value, the order number for the newest value in the index is returned.

Trigonometric functions

Cos (T)

Cosine value of T (degrees)
Example: Cos (60) = 0.5

Acos (P)

Arccosine value of P
Example: Acos (0.5) = 60

Sin (T)

Sine value of T (degrees)
Example: Sin (30) = 0.5

Asin (P)

Arcsine value of P
Example: Asin (0.5) = 30

Tan (T)

Tan value of T (degrees)
Example: Tan (45) = 1

Atan (P)

Arctangent value of P
Example: Atan (1) = 45

AngC (T1, T2)

Center angle as viewed from the angle T1 to T2 in the clockwise direction.
Center angle= (T1+T2) /2

Specifying the Windows for Inspection and Measurement
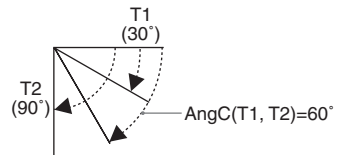
AngW (T1, T2)

Angular width as viewed from the angle T1 to T2 in the clockwise direction.

AngW(T1, T2)=60°

AngW(T1, T2)=300°
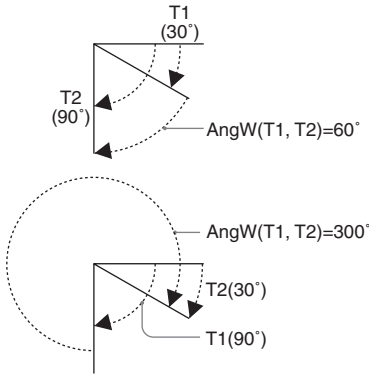
Rad (T)

Radian value of the angle value (T)
Example: Rad (30°) =30° ÷360° × 2π=0.524

Deg (P)

Angle value of the radian value P
Example: Deg (3.14) =3.14 ÷ 2π × 360 =179.909°

Pi ()

π value in double precision

Geometric functions

X (Q)

The X coordinate value of the coordinate Q (unit: pixels)

Y (Q)

The Y coordinate value of the coordinate Q (unit: pixels)

XY (P1, P2)

The X and Y coordinates of the two measurement results (P1, P2) are grouped respectively and converted to the pixel coordinates (unit: pixels)

► Note
This cannot be used as the final output of a calculation.

Dist (Q1, Q2)

The distance between Q1 and Q2 (unit: pixels) For Q1 and Q2, use the values calculated from the center of gravity of blobs or the center of patterns.

Line (Q1, Q2)

The line connecting Q1 and Q2 is calculated.

► Note
This cannot be used as the final output of a calculation.

ISect (Line (Q1, Q2), Line (Q3, Q4))

Outputs the coordinates of the intersection between the line connecting coordinates Q1 and Q2 and the line connecting coordinates Q3 and Q4.

ISect(L1,L2)=(100,100)
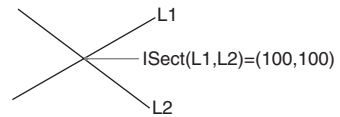
► Note
This cannot be used as the final output of a calculation.

LnDist (Line (Q1, Q2), Q3)

Outputs the distance in pixels from the line connecting coordinates Q1 and Q2 to the point Q3.
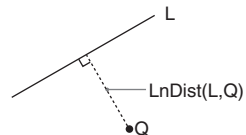
LnDist(L,Q)

► Note
The arguments should be designated in the order of L (straight line) and Q (point) .

LnDistP (Line (Q1, Q2), Q3)

Signed output of LnDist (unit: pixels)

LnDistXY (Line (Q1, Q2) Q3)

Outputs the coordinates of the intersection between a vertical line drawn from the intersection of the line connecting the coordinates Q1 and Q2 to the point Q3. and the X axis.

► Note

This cannot be used as the final output of a calculation.

Angl (Q1, Q2)

The angle that is made by the horizontal axis 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 clockwise from the horizontal line.
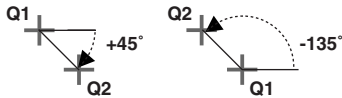
LnAngl (Line (Q1, Q2))

The angle that is made by the horizontal axis and the line segment from Q1 to Q2.
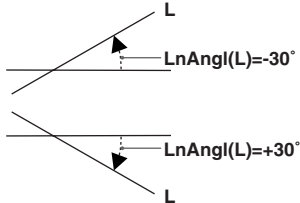
LLAngl (Line (Q1, Q2), Line (Q3, Q4))

Outputs the angle created by the intersection of the vector connecting coordinates Q1 and Q2 and the vector connecting coordinates Q3 and Q4.
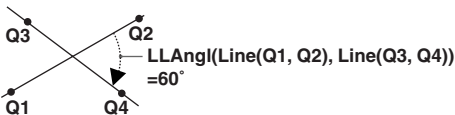
► Note

The angle created by the intersection of the line and the horizontal axis is $-90 \leq \theta < 90°$. The direction of the vector changes depending on different conditions.

CircXY (Q1, Q2, Q3)

The center coordinate of a circle calculated from the three coordinates, Q1, Q2, and Q3 (unit: pixels)
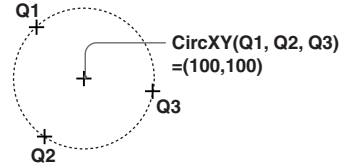
► Note

This cannot be used as the final output of a calculation.

CircR (Q1, Q2, Q3)

The radius of a circle calculated from the three coordinates, Q1, Q2, and Q3 (unit: pixels)
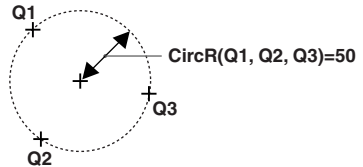
ConvCrd (Q1, Q2, D, P)

Outputs the position of Q1 in terms of an origin at Q2, rotated D degrees and measured in terms of P (Coordinate conversion) . The output is in the form of Q.
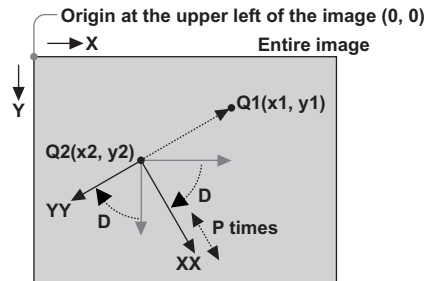
► Note

This cannot be used as the final output of a calculation.

Rotate (Q, D)

Outputs the coordinates of Q after rotation D degrees, with the upper left of the image as the origin.(For applying a rotation matrix) The output is in the form of Q.
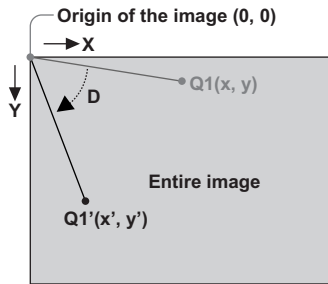
► Note

This cannot be used as the final output of a calculation.

MidXY (Q1, Q2)

Finds the point halfway between Q1 and Q2.
Example: X (MidXY (XY (0, 0), XY (10, 10))) = 5
The center point is (5,5), so the result of MidXY is (5,5) .

► Note

This cannot be used as the final output of a calculation.

BSect (Q1, Q2)

Outputs L, the line bisecting the line connecting Q1 and Q2 is calculated.
Example: LnAngle (BSect (XY (0, 0), XY (8.660, 5))) = -60
A line that makes a 30 degree angle with the horizontal would be bisected by a line at -60 degrees.

► Note

- This cannot be used as the final output of a calculation.
- If Q1=Q2, the equation will be considered correct, but no line will be output and the calculation result will be 0.

System variables

► Note

No arguments are placed between the parentheses in the functions below.

Year ()

The year at the time of trigger input (4 digit)

Month ()

The month at the time of trigger input

Day ()

The day at the time of trigger input

Hour ()

The hour at the time of trigger input

Minute ()

The minute at the time of trigger input

Second ()

The second at the time of trigger input

Count ()

Total Count

Time ()

Measurement time (msec)

► Note

- When using the Multi-Image function (Page 4-17), the time output is the time between the start of the multi-image scan and this image.
- This may be shorter than the time displayed on the screen because it does not include the processing time for post-image enhancement result output.
- Each setting uses one calculation window.

Hints for Calculation

Example 1

Under the following conditions, the length of a, b, c, and an angle θ are to be calculated.

- **W000**: Pattern search
- **W001**: Pattern search
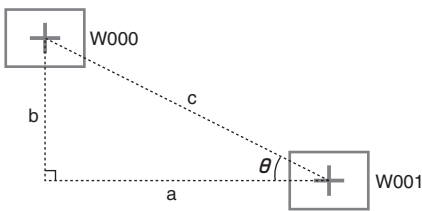
1). **An example of the arithmetic expression to calculate the length of a.**

C000 = W001.X.MS [JG] - W000.X.MS [JG]

> **Reference**
> - [JG] indicates primary target specification.
> - If the absolute value needs to be calculated, the following arithmetic expression is used.
>   C000=Abs (W001.X.MS [JG] -W000.X.MS [JG])

2). **An example of the arithmetic expression to calculate the length of b.**

C001=W001.Y.MS [JG] - W000.Y.MS [JG]

> **Reference**
> If the absolute value needs to be calculated, the following arithmetic expression is used.
> C001=Abs (W001.Y.MS [JG] -W000.Y.MS [JG])

3). **An example of the arithmetic expression to calculate the length of c.**

C002=Dist (W000.XY.MS [JG], W001.XY.MS [JG])

4). **An example of the arithmetic expression to calculate the angle θ.**

C003=Angl (W000.XY.MS [JG], W001.XY.MS [JG])

> **Reference**
> The following arithmetic expression is used when applying the arctangent function.
> C04=Atan ((W001.Y.MS [JG] -W000.Y.MS [JG]) /
> (W001.X.MS [JG] -W000.X.MS [JG])

Example 2

Under the following conditions, the length of A and an angle θ are to be calculated.

- **W01**: Pattern search
- **W02**: Pattern search
- **W03**: Pattern search
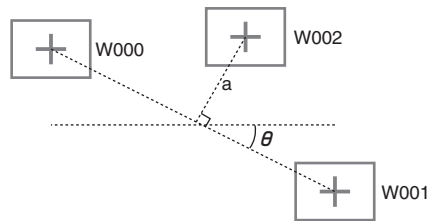
1). **An example of the arithmetic expression to calculate the angle θ.**

C000=LnAngl (Line (W000.XY.AB [JG], W001.XY.AB [JG]))

2). **An example of the arithmetic expression to calculate the length of a.**

C001=LnDist (Line (W000.XY.AB [JG], W001.XY.AB [JG]), W002.XY.AB [JG])

> **Reference**
> It is recommended to use absolute value (AB) when calculating a position or angle that has no correlation with position adjustment.

Specifying the Windows for Inspection and Measurement

Example 3

Under the following conditions, the X and Y coordinate of the intersect A are to be calculated.

- **W000**: Edge angle
- **W001**: Edge angle
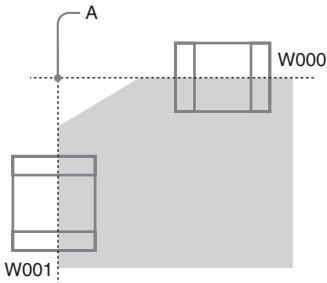
1). **An example of the arithmetic expression to calculate the X coordinate of the intersect A.**

C000=X (ISect (Line (W000.XY1.AB , W000.XY2.AB) , Line (W001.XY1.AB , W001.XY2.AB)))

2). **An example of the arithmetic expression to calculate the Y coordinate of the intersect A.**

C001=Y (ISect (Line (W000.XY1.AB , W000.XY2.AB) , Line (W001.XY1.AB , W001.XY2.AB)))

Example 4

Under the following conditions, the radius R of the virtual circle calculated from three points and the X and Y coordinates of the center coordinate A are to be calculated.

- **W000**: Edge position
- **W001**: Edge position
- **W002**: Edge position
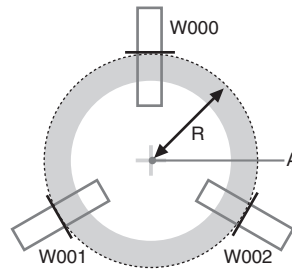
1). **An example of the arithmetic expression to calculate the radius R of the virtual circle.**

C000=CircR (W000.XY.AB [JG], W001.XY.AB [JG], W002.XY.AB [JG])

2). **An example of the arithmetic expression to calculate the X coordinate of the center A of the virtual circle.**

C001=X (CircXY (W000.XY.AB [JG], W001.XY.AB [JG], W002.XY.AB [JG]))

3). **An example of the arithmetic expression to calculate the Y coordinate of the center A of the virtual circle.**

C002=Y (CircXY (W000.XY.AB [JG], W001.XY.AB [JG], W002.XY.AB [JG]))

Calculation Symbol Table

Reference

- **ST (Base Value)** : The value obtained from the registered image.
- **MS (Measurement Value)** : Measurement result from the captured image.
- **JG (Judge Value)** : Judgment results (OK=0, NG=1)
- **AB (Absolute Measurement Value)** : The value before origin is specified. If position adjustment has been applied, the pre-adjustment position is used.
- **HL (Upper Limit)** : The upper limit for judgment.
- **LL (Lower Limit)** : The lower limit for judgment.

► Note

MS (Measurement Values) and AB (Absolute Values) are the only types for which a target can be specified. (✕=NO, O=YES)

Measured Value

Measurement Tool	Item	Symbol	Available Types	Target
Area	Area	AR	ST, MS, JG, HL, LL	✕
Pattern Search	Number	N	ST, MS, JG, HL, LL	✕
	Position X	X	ST, MS, JG, HL, LL, AB	O
	Position Y	Y	ST, MS, JG, HL, LL, AB	O
	Angle	T	ST, MS, JG, HL, LL, AB	O
	Correlation Value	C	ST, MS, JG, HL, LL	O
	Position XY	XY	ST, MS, AB	O
Pattern Sort	Number	N	ST, MS, JG, HL, LL	✕
	Group No.	GR	ST, MS, JG, HL, LL	O
	Element No.	EL	ST, MS	O
	Position X	X	ST, MS, JG, HL, LL, AB	O
	Position Y	Y	ST, MS, JG, HL, LL, AB	O
	Angle	T	ST, MS, JG, HL, LL, AB	O
	Correlation value	C	ST, MS, JG, HL, LL	O
	Position XY	XY	ST, MS, AB	O
	Pattern No. 1	GR1	ST, MS, JG, HL, LL	✕
	Pattern No. 2	GR2	ST, MS, JG, HL, LL	✕
	Pattern No. 3	GR3	ST, MS, JG, HL, LL	✕
	Pattern No. 4	GR4	ST, MS, JG, HL, LL	✕
	Pattern No. 5	GR5	ST, MS, JG, HL, LL	✕
	Pattern No. 6	GR6	ST, MS, JG, HL, LL	✕
	Pattern No. 7	GR7	ST, MS, JG, HL, LL	✕
	Pattern No. 8	GR8	ST, MS, JG, HL, LL	✕
ShapeTrax	Number	N	ST, MS, JG, HL, LL	✕
	Position X	X	ST, MS, JG, HL, LL, AB	O
	Position Y	Y	ST, MS, JG, HL, LL, AB	O
	Angle	T	ST, MS, JG, HL, LL, AB	O
	Correlation Value	C	ST, MS, JG, HL, LL	O
	Position XY	XY	ST, MS, AB	O
	Scale	S	ST, MS	O

Measurement Tool	Item	Symbol	Available Types	Target
Edge Position	Number of Edges	N	ST, MS, JG, HL, LL	×
	Position X	X	ST, MS, JG, HL, LL, AB	O
	Position Y	Y	ST, MS, JG, HL, LL, AB	O
	Angle	T	ST, MS, JG, HL, LL, AB	O
	Position XY	XY	ST, MS, AB	O
	Distance	P	ST, MS, AB	O
	Intensity	I	ST, MS	O
Edge Width	Pairs	N	ST, MS	×
	Edge Width	W	ST, MS, JG, HL, LL, AB	×
	Position 1X	X1	ST, MS, AB	×
	Position 1Y	Y1	ST, MS, AB	×
	Angle 1	T1	ST, MS, AB	×
	Position 1XY	XY1	ST, MS, AB	×
	Distance 1	P1	ST, MS, AB	×
	Intensity 1	I1	ST, MS	×
	Position 2X	X2	ST, MS, AB	×
	Position 2Y	Y2	ST, MS, AB	×
	Angle 2	T2	ST, MS, AB	×
	Position 2XY	XY2	ST, MS, AB	×
	Distance 2	P2	ST, MS, AB	×
	Intensity 2	I2	ST, MS	×
Edge Pitch	Pitches	N	ST, MS, JG, HL, LL	×
	Pitch (Max)	WH	ST, MS, JG, HL, LL, AB	×
	Pitch (Min)	WL	ST, MS, JG, HL, LL, AB	×
	Pitch (Avg)	WA	ST, MS, AB	×
	Pitch	W	ST, MS, JG, HL, LL, AB	O
	Position 1X	X1	ST, MS, AB	O
	Position 1Y	Y1	ST, MS, AB	O
	Angle 1	T1	ST, MS, AB	O
	Position 1XY	XY1	ST, MS, AB	O
	Distance 1	P1	ST, MS, AB	O
	Intensity 1	I1	ST, MS	O
	Position 2X	X2	ST, MS, AB	O
	Position 2Y	Y2	ST, MS, AB	O
	Angle 2	T2	ST, MS, AB	O
	Position 2XY	XY2	ST, MS, AB	O
	Distance 2	P2	ST, MS, AB	O
	Intensity 2	I2	ST, MS	O
Number of Edges	Number of Edges	N	ST, MS, JG, HL, LL	×

Measurement Tool	Item	Symbol	Available Types	Target
Edge Angle	Angle	T	ST, MS, JG, HL, LL, AB	×
	Position 1X	X1	ST, MS, AB	×
	Position 1Y	Y1	ST, MS, AB	×
	Position 1XY	XY1	ST, MS, AB	×
	Distance 1	P1	ST, MS, AB	×
	Intensity 1	I1	ST, MS	×
	Position 2X	X2	ST, MS, AB	×
	Position 2Y	Y2	ST, MS, AB	×
	Position 2XY	XY2	ST, MS, AB	×
	Distance 2	P2	ST, MS, AB	×
	Intensity 2	I2	ST, MS	×
	Center X	X	ST, MS, AB	×
	Center Y	Y	ST, MS, AB	×
	Center XY	XY	ST, MS, AB	×
Edge Pairs	Pairs	N	ST, MS, JG, HL, LL	×
	Pair Width (Max)	WH	ST, MS, JG, HL, LL, AB	×
	Pair Width (Min)	WL	ST, MS, JG, HL, LL, AB	×
	Pair Width (Avg)	WA	ST, MS, AB	×
	Pair Width	W	ST, MS, JG, HL, LL, AB	O
	Position 1X	X1	ST, MS, AB	O
	Position 1Y	Y1	ST, MS, AB	O
	Angle 1	T1	ST, MSG, AB	O
	Position 1XY	XY1	ST, MS, AB	O
	Distance 1	P1	ST, MS, AB	O
	Intensity 1	I1	ST, MS	O
	Position 2X	X2	ST, MS, AB	O
	Position 2Y	Y2	ST, MS, AB	O
	Angle 2	T2	ST, MS, AB	O
	Position 2XY	XY2	ST, MS, AB	O
	Distance 2	P2	ST, MS, AB	O
	Intensity 2	I2	ST, MS	O
Stain	Detected Stain Level:	SL	ST, MS	×
	Total Area	SA	ST, MS, JG, HL, LL	×
	Position X	X	ST, MS, AB	×
	Position Y	Y	ST, MS, AB	×
	Position XY	XY	ST, MS, AB	×
	Groups	N	ST, MS, JG, HL, LL	×
	Stain Area	GSA	ST, MS, JG, HL, LL	O
	Group Center X	GX	ST, MS, JG, HL, LL, AB	O
	Group Center Y	GY	ST, MS, JG, HL, LL, AB	O
	Group Center XY	GXY	ST, MS, AB	O

Specifying the Windows for Inspection and Measurement

Measurement Tool	Item	Symbol	Available Types	Target
Blob	Number of Blobs	N	ST, MS, JG, HL, LL	×
	Group Center X	X	ST, MS, JG, HL, LL, AB	O
	Group Center Y	Y	ST, MS, JG, HL, LL, AB	O
	Group Center XY	XY	ST, MS, AB	O
	Main Axis Angle	T	ST, MS, JG, HL, LL, AB	O
	Area	AR	ST, MS, JG, HL, LL	O
	Feret Diameter X	FX	ST, MS, JG, HL, LL, AB	O
	Feret Diameter Y	FY	ST, MS, JG, HL, LL, AB	O
	Perimeter	CL	ST, MS, JG, HL, LL, AB	O
	Roundness	CD	ST, MS, JG, HL, LL	O
	RLU XY	RLUXY	ST, MS, AB	O
	RRU XY	RRUXY	ST, MS, AB	O
	RLD XY	RLDXY	ST, MS, AB	O
	RRD XY	RRDXY	ST, MS, AB	O
	Group Center X (Max)	XH	ST, MS, JG, HL, LL	×
	Group Center X (Min)	XL	ST, MS, JG, HL, LL	×
	Group Center Y (Max)	YH	ST, MS, JG, HL, LL	×
	Group Center Y (Min)	YL	ST, MS, JG, HL, LL	×
	Main Axis Angle (Max)	TH	ST, MS, JG, HL, LL	×
	Main Axis Angle (Min)	TL	ST, MS, JG, HL, LL	×
	Area (Max)	ARH	ST, MS, JG, HL, LL	×
	Area (Min)	ARL	ST, MS, JG, HL, LL	×
	Feret Diameter X (Max)	FXH	ST, MS, JG, HL, LL, AB	×
	Feret Diameter X (Min)	FXL	ST, MS, JG, HL, LL, AB	×
	Feret Diameter Y (Max)	FYH	ST, MS, JG, HL, LL, AB	×
	Feret Diameter Y (Min)	FYL	ST, MS, JG, HL, LL, AB	×
	Perimeter (Max)	CLH	ST, MS, JG, HL, LL, AB	×
	Perimeter (Min)	CLL	ST, MS, JG, HL, LL, AB	×
	Roundness (Max)	CDH	ST, MS, JG, HL, LL	×
	Roundness (Min)	CDL	ST, MS, JG, HL, LL	×

Measurement Tool	Item	Symbol	Available Types	Target
	Segments	SGN	ST, MS	×
	Detected Segments	DSGN	ST, MS, JG, HL, LL	×
	Number of Edges	N	ST, MS	O
	Position X	X	ST, MS, JG, HL, LL, AB	O
	Position Y	Y	ST, MS, JG, HL, LL, AB	O
	Angle	T	ST, MS, AB	O
	Position XY	XY	ST, MS, AB	O
	Distance	P	ST, MS, JG, HL, LL, AB	O
	Radius	RW	ST, MS, JG, HL, LL, AB	O
	Intensity	I	ST, MS	O
	Number of Edges (Max)	NHI	ST, MS	×
	Number of Edges (Min)	NLO	ST, MS	×
	Position X(Max)	XHI	ST, MS, JG, HL, LL, AB	×
	Position X(Min)	XLO	ST, MS, JG, HL, LL, AB	×
	Position X (Avg)	XA	ST, MS, AB	×
	Position Y(Max)	YHI	ST, MS, JG, HL, LL, AB	×
	Position Y(Min)	YLO	ST, MS, JG, HL, LL, AB	×
	Position Y (Avg)	YA	ST, MS, AB	×
	Angle (Max)	THI	ST, MS, AB	×
	Angle (Min)	TLO	ST, MS, AB	×
	Position XY(Max)	XYHI	ST, MS, AB	×
	Position XY (Min)	XYLO	ST, MS, AB	×
Trend Edge Position	Position XY (Avg)	XYA	ST, MS, AB	×
	Distance (Max)	PHI	ST, MS, JG, HL, LL, AB	×
	Distance (Min)	PLO	ST, MS, JG, HL, LL, AB	×
	Distance (Avg)	PA	ST, MS, AB	×
	Radius (Max)	RWHI	ST, MS, JG, HL, LL, AB	×
	Radius (Min)	RWLO	ST, MS, JG, HL, LL, AB	×
	Radius (Avg)	RWA	ST, MS, AB	×
	Intensity (Max)	IHI	ST, MS	×
	Intensity (Min)	ILO	ST, MS	×
	Circle Radius	DCR	ST, MS, AB	×
	Circle Center X	DCX	ST, MS, AB	×
	Circle Center Y	DCY	ST, MS, AB	×
	Circle Center XY	DCXY	ST, MS, AB	×
	Line X1	DLX1	ST, MS, AB	×
	Line Y1	DLY1	ST, MS, AB	×
	Line XY1	DLXY1	ST, MS, AB	×
	Line X2	DLX2	ST, MS, AB	×
	Line Y2	DLY2	ST, MS, AB	×
	Line XY2	DLXY2	ST, MS, AB	×
	Line Center X	DLX	ST, MS, AB	×
	Line Center Y	DLY	ST, MS, AB	×
	Line Angle	DLT	ST, MS, AB	×
	Line Center XY	DLXY	ST, MS, AB	×

Measurement Tool	Item	Symbol	Available Types	Target
Trend Edge Width	Segments	SGN	ST, MS	×
	Detected Segments	DSGN	ST, MS, JG, HL, LL	×
	Pairs	N	ST, MS	O
	Edge Width	W	ST, MS, JG, HL, LL, AB	O
	Position 1X	X1	ST, MS, AB	O
	Position 1Y	Y1	ST, MS, AB	O
	Angle 1	T1	ST, MS, AB	O
	Position 1XY	XY1	ST, MS, AB	O
	Distance 1	P1	ST, MS, AB	O
	Intensity 1	I1	ST, MS	O
	Position 2X	X2	ST, MS, AB	O
	Position 2Y	Y2	ST, MS, AB	O
	Angle 2	T2	ST, MS, AB	O
	Position 2XY	XY2	ST, MS, AB	O
	Distance 2	P2	ST, MS, AB	O
	Intensity 2	I2	ST, MS	O
	Pairs (Max)	NHI	ST, MS	×
	Pairs (Min)	NLO	ST, MS	×
	Edge Width (Max)	WHI	ST, MS, JG, HL, LL, AB	×
	Edge Width (Min)	WLO	ST, MS, JG, HL, LL, AB	×
	Edge Width (Avg)	WA	ST, MS, AB	×
	Position 1X (Max)	X1HI	ST, MS, AB	×
	Position 1X (Min)	X1LO	ST, MS, AB	×
	Position 1Y (Max)	Y1HI	ST, MS, AB	×
	Position 1Y (Min)	Y1LO	ST, MS, AB	×
	Angle 1 (Max)	T1HI	ST, MS, AB	×
	Angle 1 (Min)	T1LO	ST, MS, AB	×
	Position 1XY(Max)	XY1HI	ST, MS, AB	×
	Position 1XY(Min)	XY1LO	ST, MS, AB	×
	Distance 1 (Max)	P1HI	ST, MS, AB	×
	Distance 1 (Min)	P1LO	ST, MS, AB	×
	Intensity 1 (Max)	I1HI	ST, MS	×
	Intensity 1 (Min)	I1LO	ST, MS	×
	Position 2X (Max)	X2HI	ST, MS, AB	×
	Position 2X (Min)	X2LO	ST, MS, AB	×
	Position 2Y (Max)	Y2HI	ST, MS, AB	×
	Position 2Y (Min)	Y2LO	ST, MS, AB	×
	Angle 2 (Max)	T2HI	ST, MS, AB	×
	Angle 2 (Min)	T2LO	ST, MS, AB	×
	Position 2XY (Max)	XY2HI	ST, MS, AB	×
	Position 2XY (Min)	XY2LO	ST, MS, AB	×
	Distance 2 (Max)	P2HI	ST, MS, AB	×
	Distance 2 (Min)	P2LO	ST, MS, AB	×
	Intensity 2 (Max)	I2HI	ST, MS	×
	Intensity 2 (Min)	I2LO	ST, MS	×

Measurement Tool	Item	Symbol	Available Types	Target
Intensity	Intensity Average	DA	ST, MS, JG, HL, LL	×
	Intensity Deviation	DD	ST, MS, JG, HL, LL	×
	Maximum Intensity	DH	ST, MS, JG, HL, LL	×
	Minimum Intensity	DL	ST, MS, JG, HL, LL	×
Color	R-Average	RA	ST, MS, JG, HL, LL	×
	R-Deviation	RD	ST, MS, JG, HL, LL	×
	R-Maximum	RH	ST, MS, JG, HL, LL	×
	R-Minimum	RL	ST, MS, JG, HL, LL	×
	G-Average	GA	ST, MS, JG, HL, LL	×
	G-Deviation	GD	ST, MS, JG, HL, LL	×
	G-Maximum	GH	ST, MS, JG, HL, LL	×
	G-Minimum	GL	ST, MS, JG, HL, LL	×
	B-Average	BA	ST, MS, JG, HL, LL	×
	B-Deviation	BD	ST, MS, JG, HL, LL	×
	B-Maximum	BH	ST, MS, JG, HL, LL	×
	B-Minimum	BL	ST, MS, JG, HL, LL	×
	H-Average	HUA	ST, MS, JG, HL, LL	×
	H-Deviation	HUD	ST, MS, JG, HL, LL	×
	H-Maximum	HUH	ST, MS, JG, HL, LL	×
	H-Minimum	HUL	ST, MS, JG, HL, LL	×
	S-Average	SAA	ST, MS, JG, HL, LL	×
	S-Deviation	SAD	ST, MS, JG, HL, LL	×
	S-Maximum	SAH	ST, MS, JG, HL, LL	×
	S-Minimum	SAL	ST, MS, JG, HL, LL	×
	V-Average	VAA	ST, MS, JG, HL, LL	×
	V-Deviation	VAD	ST, MS, JG, HL, LL	×
	V-Maximum	VAH	ST, MS, JG, HL, LL	×
	V-Minimum	VAL	ST, MS, JG, HL, LL	×

Specifying the Windows for Inspection and Measurement

Measurement Tool	Item	Symbol	Available Types	Target
OCR	1st line text *1 *2	STR1	MS	×
	2nd line text *1 *2	STR2	MS	×
	1st line judged tex t *1 *2	JG_STR1	MS, JG, HL*3 *4, LL*3 *4	×
	2nd line judged text *1 *2	JG_STR2	MS, JG, HL*3 *4, LL*3 *4	×
	Recognized character [] *1	RCG_CHR	MS	O
	1st possible character [] *1	CHR1	MS	O
	2nd possible character [] *1	CHR2	MS	O
	Rate of recognition for 1st possibility []	CRR1	MS	O
	Rate of recognition for 2nd possibility []	CRR2	MS	O
	Stability []	STBL	MS	O
	No. of captured lines	CLN	MS	×
	No. of 1st line captured characters	CCN1	MS	×
	No. of 2nd line captured characters	CCN2	MS	×
	1st line rate of recognition (Max.)	L1CRR1_H	ST, MS, JG, HL*5, LL	×
	1st line rate of recognition (Min.)	L1CRR1_L	ST, MS, JG, HL*5, LL	×
	2nd line rate of recognition (Max.)	L2CRR1_H	ST, MS, JG, HL*5, LL	×
	2nd line rate of recognition (Min.)	L2CRR1_L	ST, MS, JG, HL*5, LL	×
	1st line stability (Max.)	L1STBL_H	ST, MS, JG, HL*5, LL	×
	1st line stability (Min.)	L1STBL_L	ST, MS, JG, HL*5, LL	×
	2nd line stability (Max.)	L2STBL_H	ST, MS, JG, HL*5, LL	×
	2nd line stability (Min.)	L2STBL_L	ST, MS, JG, HL*5, LL	×
Draw Shape	None	None	MS, HL, LL	×

*1 When characters are referenced with calculation, ASCII code is output in decimal form. Ex.: "K" = "4B" (hexadecimal) becomes "75" (decimal)

*2 When text is referenced with calculation, the ASCII code for the first character on each line in the reading direction is output in decimal form.

*3 Normally, the same value (the first character in the reading direction for the judged text on each line) is output in decimal format ASCII code for HH/LL. However, when two values are produced for the judged text according to the allowable error settings of the calendar function, the first text string produced under the allowable error is used as the upper limit.

*4 The upper or lower limit for the text cannot be used when writing the tolerance that includes reference characters for calendars and other functions.

*5 When rate of recognition and stability are set for HL, zero (0) is also output.

Measurement Area

	Item	Symbol	Available Types	Target
Rectangle	LUX	LUX	ST, MS, AB	×
	LUY	LUY	ST, MS, AB	×
	LUXY	LUXY	ST, MS, AB	×
	LDX	LDX	ST, MS, AB	×
	LDY	LDY	ST, MS, AB	×
	LDXY	LDXY	ST, MS, AB	×
	RUX	RUX	ST, MS, AB	×
	RUY	RUY	ST, MS, AB	×
	RUXY	RUXY	ST, MS, AB	×
	RDX	RDX	ST, MS, AB	×
	RDY	RDY	ST, MS, AB	×
	RDXY	RDXY	ST, MS, AB	×
Rotated Rectangle	LUX	LUX	ST, MS, AB	×
	LUY	LUY	ST, MS, AB	×
	LUXY	LUXY	ST, MS, AB	×
	LDX	LDX	ST, MS, AB	×
	LDY	LDY	ST, MS, AB	×
	LDXY	LDXY	ST, MS, AB	×
	RUX	RUX	ST, MS, AB	×
	RUY	RUY	ST, MS, AB	×
	RUXY	RUXY	ST, MS, AB	×
	RDX	RDX	ST, MS, AB	×
	RDY	RDY	ST, MS, AB	×
	RDXY	RDXY	ST, MS, AB	×
Circle	Rad	CR	ST, MS, AB	×
	Wnd.Cent.X	CX	ST, MS, AB	×
	Wnd.Cent.Y	CY	ST, MS, AB	×
	Wnd.Cent.XY	CXY	ST, MS, AB	×
Oval (Radius 1 is the X radius) (Radius 2 is the Y radius)	Rad 1	CR1	ST, MS, AB	×
	Rad 2	CR2	ST, MS, AB	×
	Wnd.Cent.X	CX	ST, MS, AB	×
	Wnd.Cent.Y	CY	ST, MS, AB	×
	Wnd.Cent.XY	CXY	ST, MS, AB	×
Ring (Radius 1 is the outer radius) (Radius 2 is the inner radius)	Rad 1	CR1	ST, MS, AB	×
	Rad 2	CR2	ST, MS, AB	×
	Wnd.Cent.X	CX	ST, MS, AB	×
	Wnd.Cent.Y	CY	ST, MS, AB	×
	Wnd.Cent.XY	CXY	ST, MS, AB	×
Arc	Start Angle	AS	ST, MS, AB	×
	End Angle	AE	ST, MS, AB	×
	Rad 1	CR1	ST, MS, AB	×
	Rad 2	CR2	ST, MS, AB	×
	Wnd.Cent.X	CX	ST, MS, AB	×
	Wnd.Cent.Y	CY	ST, MS, AB	×
	Wnd.Cent.XY	CXY	ST, MS, AB	×

	Item	Symbol	Available Types	Target
Polygon	Non-compliant			
Edge Detection Region (Rectangle)	LUX	LUX	ST, MS, AB	×
	LUY	LUY	ST, MS, AB	×
	LUXY	LUXY	ST, MS, AB	×
	LDX	LDX	ST, MS, AB	×
	LDY	LDY	ST, MS, AB	×
	LDXY	LDXY	ST, MS, AB	×
	RUX	RUX	ST, MS, AB	×
	RUY	RUY	ST, MS, AB	×
	RUXY	RUXY	ST, MS, AB	×
	RDX	RDX	ST, MS, AB	×
	RDY	RDY	ST, MS, AB	×
	RDXY	RDXY	ST, MS, AB	×
	Edge Position 1X	RX1	ST, MS, AB	×
	Edge Position 1Y	RY1	ST, MS, AB	×
	Edge Position 1XY	RXY1	ST, MS, AB	×
	Edge Distance 1	RP1	ST, MS, AB	×
	Edge Intensity 1	RI1	ST, MS	×
	Edge Position 2X	RX2	ST, MS, AB	×
	Edge Position 2Y	RY2	ST, MS, AB	×
	Edge Position 2XY	RXY2	ST, MS, AB	×
	Edge Distance 2	RP2	ST, MS, AB	×
	Edge Intensity 2	RI2	ST, MS	×
	Edge Position 3X	RX3	ST, MS, AB	×
	Edge Position 3Y	RY3	ST, MS, AB	×
	Edge Position 3XY	RXY3	ST, MS, AB	×
	Edge Distance 3	RP3	ST, MS, AB	×
	Edge Intensity 3	RI3	ST, MS	×
	Edge Position 4X	RX4	ST, MS, AB	×
	Edge Position 4Y	RY4	ST, MS, AB	×
	Edge Position 4XY	RXY4	ST, MS, AB	×
	Edge Distance 4	RP4	ST, MS, AB	×
	Edge Intensity 4	RI4	ST, MS	×

	Item	Symbol	Available Types	Target
Auto-Adjust Circle	Rad	CR	ST, MS, AB	×
	Wnd.Cent.X	CX	ST, MS, AB	×
	Wnd.Cent.Y	CY	ST, MS, AB	×
	Wnd.Cent.XY	CXY	ST, MS, AB	×
	Edge Position 1X	RX1	ST, MS, AB	×
	Edge Position 1Y	RY1	ST, MS, AB	×
	Edge Position 1XY	RXY1	ST, MS, AB	×
	Edge Distance 1	CRP1	ST, MS, AB	×
	Edge Intensity 1	RI1	ST, MS, AB	×
	Edge Position 2X	RX2	ST, MS, AB	×
	Edge Position 2Y	RY2	ST, MS, AB	×
	Edge Position 2XY	RXY2	ST, MS, AB	×
	Edge Distance 2	CRP2	ST, MS, AB	×
	Edge Intensity 2	RI2	ST, MS, AB	×
	Edge Position 3X	RX3	ST, MS, AB	×
	Edge Position 3Y	RY3	ST, MS, AB	×
	Edge Position 3XY	RXY3	ST, MS, AB	×
	Edge Distance 3	CRP3	ST, MS, AB	×
	Edge Intensity 3	RI3	ST, MS, AB	×
Auto-Adjust Ring	Rad 1	CR1	ST, MS, AB	×
	Rad 2	CR2	ST, MS, AB	×
	Wnd.Cent.X	CX	ST, MS, AB	×
	Wnd.Cent.Y	CY	ST, MS, AB	×
	Wnd.Cent.XY	CXY	ST, MS, AB	×
	Edge Position 1X	RX1	ST, MS, AB	×
	Edge Position 1Y	RY1	ST, MS, AB	×
	Edge Position 1XY	RXY1	ST, MS, AB	×
	Edge Distance 1	CRP1	ST, MS, AB	×
	Edge Intensity 1	RI1	ST, MS	×
	Edge Position 2X	RX2	ST, MS, AB	×
	Edge Position 2Y	RY2	ST, MS, AB	×
	Edge Position 2XY	RXY2	ST, MS, AB	×
	Edge Distance 2	CRP2	ST, MS, AB	×
	Edge Intensity 2	RI2	ST, MS	×
	Edge Position 3X	RX3	ST, MS, AB	×
	Edge Position 3Y	RY3	ST, MS, AB	×
	Edge Position 3XY	RXY3	ST, MS, AB	×
	Edge Distance 3	CRP3	ST, MS, AB	×
	Edge Intensity 3	RI3	ST, MS	×

Overview of Output Settings

Judgment and measurement values on this device can be written to memory cards as well as output through the parallel I/O, RS-232 port, USB port, or Ethernet port. In addition to these measurement value outputs, image screens can also be output.

- **Total Status**: Specifies the window judgement value that is linked to the OR terminal (Page 4-279).
- **Terminal**: Specifies data to be output over the parallel/IO port (Page 4-280).
- **RS-232C/PLC link**: Specifies data to be output over the PLC link or the RS-232C no protocol mode (Page 4-282).
- **Ethernet**: Specifies data to be output over the Ethernet port in No protocol mode (Page 4-284).
- **USB**: Specifies data to be output over the USB port (Page 4-285).
- **Memory card**: Specifies data to be saved to a memory card (Page 4-287).
- **Output Image**: Specifies the location to output images during operation (Page 4-289).
- **Scaling**: Specifies whether the measurement value is displayed to scale(Page 4-290).

▶ Note

Data is only output during Run mode.

Display the [Output] menu

To make output settings, display the [Output] menu by performing the following steps.

1 Select the Program No. from the initial settings screen.

2 Select [Output].

The [Output] menu appears.

Selecting a Window Judgment Value for Total Status [Total Status]

The total status represents the overall OK/NG status of all of the inspection windows and calculations in the current Program No.
By default, all of the inspection windows and calculations that are created are active.

1 **Select [Total Status] on the [Output] menu.**
The [Total Status] menu appears.
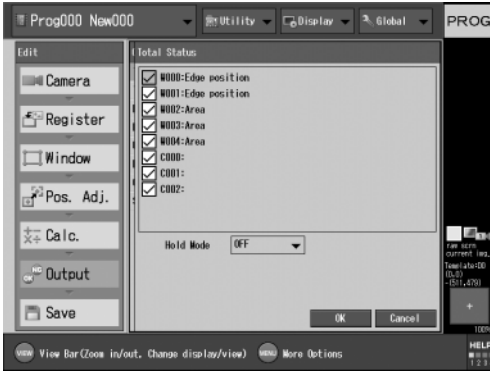
2 **Select the windows that you want to use as part of the total status and check the checkbox next to it.**
A logical add (OR output) of the checked windows is used for the total status.

> **Reference**
>
> The default is all windows are checked.

3 **Select [Hold Mode] to [ON] to maintain an NG judgment for the terminal output.**
When [Hold Mode] is set to [ON], the NG state is maintained on the OR terminal until there is input on the TEST terminal (page 11-5), regardless of other conditions.

> **Reference**
>
> Hold mode is cancelled and the OR terminal set to OK when the power is cut, the Program No. is changed, the device is switched to Program mode, or the system is reset.
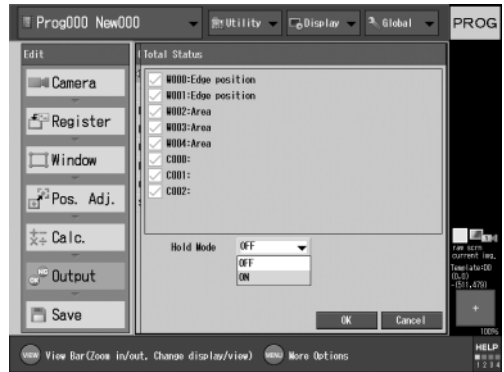
4 **After completing the settings, select [OK].**

► **Note**

• If you remove all the checkmarks, NG is output as the total status.
• When all of the checked windows are unexecuted due to the settings for execute conditions (page 4-224), the total status is output as NG.

Specifying the Windows for Inspection and Measurement

Changing Output Settings for the Parallel I/O [Terminal]

You can specify the output contents when outputting the number of measurements, judgment results, or measurement values to the parallel I/O connector.
Set output content and order based on the operating environment.

If multiple output items are set, data output time for a single measurement may be longer than the trigger interval and may have an effect on the image processing time. Output item selection and [Cycle Time] (Page 7-2) settings should be carefully considered.

1 **Select [Terminal] on the [Output] menu.**
The [Terminal] menu appears.

By default, no data is output.
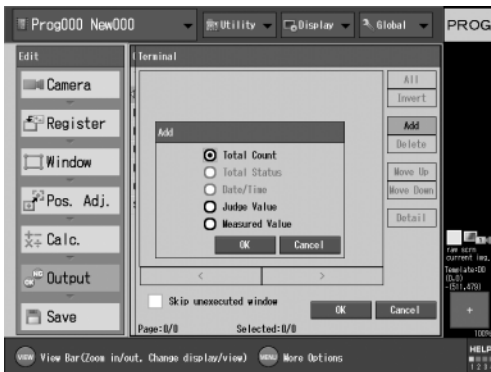
2 **Select [Add].**
The [Add] menu appears.

3 **Select an item to output, then select [OK].**
The selected output item is added.
Added items are displayed on the list. Items are output in order from the top of the list.

Total Count
Outputs the number of measurements. (0 to 65535)

Judge Value
The judgment values of the selected windows are output (0: OK, 1: NG).
The [Judge Value] menu is displayed. Select the window for which the judgment value is to be output, then select [OK] (Each item can be applied to up to 32 windows).

Reference

Judgment values are output 16 windows per cycle, so 17 or more windows will increase the number of outputs. Note that output starts with the lowest window number and proceeds in order.

Measured Value
Only the integer portions of the specified measurement values are output.
The [Measured Value] menu is displayed. Select the window and measurement value that you want to output, then select [OK].
Select [Number] in the upper left of the [Measured Value] screen to output only the value of specific targets. Select [All] to output the measurement values set in [Count]. If [Count] for each measurement setting is changed after the output items are selected on this screen, the output items must be completely deleted and reset.

► Note
If there is an "X" in the "Target" column of "Output Data List" (Page 4-294) of a measurement value, no target can be specified.

4 **Repeat steps 2-3 to register additional output items.**

5 **To make the output of the measurement set in step 3 conditional on execute conditions (Page 4-294), check the box next to [Skip unexecuted window],**

6 **After completing the settings, select [OK].**

Changing order of output

Changing the order of items on the output item list on the [Terminal] menu changes the order in which the items are output.

> **Select an item to reorder, then select [Move Up] or [Move Down].**

Deleting items to end output

Any or all items on the [Terminal] menu can be deleted.

> **Select an item to remove from output, then select [Delete].**
>
> You can select more than one item at a time.

Reference

- Select [All] to select all items at once.
- Select [Invert] to toggle the setting of each item.

Confirming the item information (judge values only)

The contents of items on the [Terminal] menu can be confirmed.

> **Select an item to confirm, then select [Detail].**
>
> The information for the selected item appears.

Specifying the Windows for Inspection and Measurement

Changing Output Settings for the RS-232C/PLC Link (RS-232C/PLC Link)

You can specify the output contents when outputting the number of measurements, judgment results, or measurement values to the PLC link or the RS-232C No protocol mode.
Set output content and order based on the operating environment.

► Note

- If RS-232C is specified under [Output Image] (Page 4-289), settings cannot be made for the PLC link or the RS-232C No protocol mode.
- If multiple output items are set, data output time for a single measurement may be longer than the trigger interval and may have an effect on the image processing time. Output item selection and [Speed] (Page 7-3) settings should be carefully considered.

Reference

RS-232C No protocol mode and PLC link mode cannot be used at the same time.

1 Select [RS-232C/PLC Link] on the [Output] menu.

The [RS-232C/PLC Link] menu appears.

By default, no data is output.

2 Select [Add].

The [Add] menu appears.

3 Select an item to output, then select [OK].

The selected output item is added.
Added items are displayed on the list. Items are output in order from the top of the list.

Total Count
Outputs the number of measurements.
(0 to 1000000000)

Total Status
Outputs the total status result set on the [Total Status] menu (Page 4-279) (0: OK, 1: NG).

Date/Time
Outputs the internal date and time of the device at the time of measurement (Year, Month, Day, Hour, Minute, Second (Each 2 digits))

Judge Value
The judgment values of the selected windows are output (0:OK, 1:NG).
The [Judge Value] menu is displayed. Select the window and judgment value that you want to output, then select [OK].

Measured Value

Outputs the set measurement value.

The [Measured Value] menu is displayed. Select the window and measurement value that you want to output, then select [OK].

Select [Number] in the upper left of the [Measured Value] screen to output only the value of specific targets. Select [All] to output the measurement values set in [Count]. If [Count] for each measurement setting is changed after the output items are selected on this screen, the output items must be completely deleted and reset.

► **Note**

If there is an "X" in the "Target" column of "Output Data List" (Page 4-294) of a measurement value, no target can be specified.

4 **Repeat steps 2-3 to register additional output items.**

5 **To make the output of the measurement set in step 3 conditional on execute conditions (Page 4-247), check the box next to [Skip unexecuted window],**

6 **After completing the settings, select [OK].**

Changing order of output

Changing the order of items on the output item list on the [RS-232C/PLC Link] menu changes the order in which the items are output.

Select an item to reorder, then select [Move Up] or [Move Down].

Deleting items to end output

Any or all items on the [RS-232C/PLC Link] menu can be deleted.

Select an item to remove from output, then select [Delete].

You can select more than one item at a time.

Reference

• Select [All] to select all items at once.
• Select [Invert] to toggle the setting of each item.

Confirming the item information (judgment values only)

The contents of items on the [RS-232C/PLC Link] menu can be confirmed.

Select an item to confirm, then select [Detail].

The information for the selected item appears.

Specifying the Windows for Inspection and Measurement

Changing Output Settings for Ethernet Communication [Ethernet]

You can specify the output contents when outputting the number of measurements, judgment results, or measurement values in no protocol mode to the Ethernet port.
Set output content and order based on the operating environment.

Reference

When outputting to the PLC link via Ethernet, change the settings in the [RS-232C/PLC Link] menu (page 7-3) in the Global settings.

► Note

If multiple output items are set, data output time for a single measurement may be longer than the trigger interval and may have an effect on the image processing time. Output items should be carefully considered.

1 **Select [Ethernet] from the [Output] menu.**
The [Ethernet] menu appears.

By default, no data is output.

2 **Select [Add].**
The [Add] menu appears.

3 **Select an item to output, then select [OK].**
The selected output item is added.
Added items are displayed on the list. Items are output in order from the top of the list.

Total Count
Outputs the number of measurements. (0 to 1000000000)

Total Status
Outputs the total status result set on the [Total Status] menu (Page 4-279) (0: OK, 1: NG).

Date/Time
Outputs the internal date and time of the device at the time of measurement (Year, Month, Day, Hour, Minute, Second (Each 2 digits))

Judge Value
The judgment values of the selected windows are output (0:OK, 1:NG).
The [Judge Value] menu is displayed. Select the window and judgment value that you want to output, then select [OK].

Measured Value
Outputs the set measurement value.
The [Measured Value] menu is displayed. Select the window and measurement value that you want to output, then select [OK].
Select [Number] in the upper left of the [Measured Value] screen to output only the value of specific targets. Select [All] to output the measurement values set in [Count]. If [Count] for each measurement setting is changed after the output items are selected on this screen, the output items must be completely deleted and reset.

► Note

If there is an "X" in the "Target" column of "Output Data List" (Page 4-294) of a measurement value, no target can be specified.

4 **Repeat steps 2-3 to register additional output items.**

5 **To make the output of the measurement set in step 3 conditional on execute conditions (Page 4-247), check the box next to [Skip unexecuted window].**

6 **After completing the settings, select [OK].**

Changing order of output

Changing the order of items on the output item list on the [Ethernet] menu changes the order in which the items are output.

Select an item to reorder, then select [Move Up] or [Move Down].

Deleting items to end output

Any or all items on the [Ethernet] menu can be deleted.

Select an item to remove from output, then select [Delete].

You can select more than one item at a time.

Reference
- Select [All] to select all items at once.
- Select [Invert] to toggle the setting of each item.

Confirming the item information (judgment values only)

The contents of items on the [Ethernet] menu can be confirmed.

Select an item to confirm, then select [Detail].

The information for the selected item appears.

Changing Output Settings for USB [USB]

You can specify the output contents when outputting the number of measurements, judgment results, or measurement values to the USB port. Set output content and order based on the operating environment.

▶ **Note**
- If USB is specified under [Output Image] (Page 4-289), USB output settings cannot be made.
- If multiple output items are set, data output time for a single measurement may be longer than the trigger interval and may have an effect on the image processing time. Output item selection and [Speed] (Page 7-7) settings should be carefully considered.

1 Select [USB] on the [Output] menu.

The [USB] menu appears.

By default, no data is output.

2 Select [Add].

The [Add] menu appears.

3 **Select an item to output, then select [OK].**

The selected output item is added.

Added items are displayed on the list. Items are output in order from the top of the list.

Total Count

Outputs the number of measurements. (0 to 1000000000)

Total Status

Outputs the total status result set on the [Total Status] menu (Page 4-279) (0: OK, 1: NG).

Date/Time

Outputs the internal date and time of the device at the time of measurement (Year, Month, Day, Hour, Minute, Second (Each 2 digits))

Judge Value

The judgment values of the selected windows are output (0: OK, 1: NG).

The [Judge Value] menu is displayed. Select the window and judgment value that you want to output, then select [OK].

Measured Value

Outputs the set measurement value.

The [Measured Value] menu is displayed. Select the window and measurement value that you want to output, then select [OK].

Select [Number] in the upper left of the [Measured Value] screen to output only the value of specific targets. Select [All] to output the measurement values set in [Count]. If [Count] for each measurement setting is changed after the output items are selected on this screen, the output items must be completely deleted and reset.

► **Note**

If there is an "X" in the "Target" column of "Output Data List" (Page 4-294) of a measurement value, no target can be specified.

4 **Repeat steps 2-3 to register additional output items.**

5 **To make the output of the measurement set in step 3 conditional on execute conditions (Page 4-247), check the box next to [Skip unexecuted window],**

6 **After completing the settings, select [OK].**

Changing order of output

Changing the order of items on the output item list on the [USB] menu changes the order in which the items are output.

> **Select an item to reorder, then select [Move Up] or [Move Down].**

Deleting items to end output

Any or all items on the [USB] menu can be deleted.

> **Select an item to remove from output, then select [Delete].**
>
> You can select more than one item at a time.

Reference

• Select [All] to select all items at once.
• Select [Invert] to toggle the setting of each item.

Confirming the item information (judgment values only)

The contents of items on the [USB] menu can be confirmed.

> **Select an item to confirm, then select [Detail].**
>
> The information for the selected item appears.

Output Settings for Memory Cards [Memory Card]

You can specify the output contents when outputting the number of measurements, judgment results, or measurement values to a memory in the memory card slot.
Set output content and order based on the operating environment.

► Note

If the output buffer of this system overflows, the measured data (measurement values and status values) may be skipped until the buffer is cleared.

Outputting data to a memory card
The following files are output to a memory card from the system (Output to folder [/CV]) .

• The output data file containing measurement results: Rhhmmss_yymmdd.csv (hhmmss is the time the file was made, yymmdd is the date the file was made)
  Example: R070000_050101.csv
See "Types of Files that can be Saved in the Memory Card" (Page 8-9) for details.

Reference

Measurement result output files are created at the first trigger after the following events:

• Power on
• RESET
• Changing Program No.
• An output file is not saved to the memory card.

1 **Select [Memory Card] on the [Output] menu.**
The [Memory Card] menu appears.

By default, no data is output.

2 **Select [Add].**
The [Add] menu appears.

Specifying the Windows for Inspection and Measurement

3 **Select an item to output, then select [OK].**

The selected output item is added.

Added items are displayed on the list. Items are output in order from the top of the list.

Total Count

Outputs the number of measurements. (0 to 1000000000)

Total Status

Outputs the total status result set on the [Total Status] menu (Page 4-279) (0: OK, 1: NG).

Date/Time

Outputs the internal date and time of the device at the time of measurement (Year, Month, Day, Hour, Minute, Second (Each 2 digits))

Judge Value

The judgment values of the selected windows are output (0: OK, 1: NG) .

The [Judge Value] menu is displayed. Select the window and judgment value that you want to output, then select [OK].

Measured Value

Outputs the set measurement value.

The [Measured Value] menu is displayed. Select the window and measurement value that you want to output, then select [OK].

Select [Number] in the upper left of the [Measured Value] screen to output only the value of specific targets. Select [All] to output the measurement values set in [Count]. If [Count] for each measurement setting is changed after the output items are selected on this screen, the output items must be completely deleted and reset.

► Note

If there is an "X" in the "Target" column of "Output Data List" (Page 4-294) of a measurement value, no target can be specified.

4 **Repeat steps 2-3 to register additional output items.**

5 **To make the output of the measurement set in step 3 conditional on execute conditions (Page 4-247), check the box next to [Skip unexecuted window].**

6 **After completing the settings, select [OK].**

Changing order of output

Changing the order of items on the output item list on the [Memory Card] menu changes the order in which the items are output.

> **Select an item to reorder, then select [Move Up] or [Move Down].**

Deleting items to end output

Any or all items on the [Memory Card] menu can be deleted.

> **Select an item to remove from output, then select [Delete].**
>
> You can select more than one item at a time.

Reference

• Select [All] to select all items at once.
• Select [Invert] to toggle the setting of each item.

Confirming the item information (judgment values only)

The contents of items on the [Memory Card] menu can be confirmed.

> **Select an item to confirm, then select [Detail].**
>
> The information for the selected item appears.

Changing Output Settings for Image [Output Image]

You can output the screen images that were used for measurement to an external device via the RS-232 connector, the Ethernet connector, or the USB connector, or save them to a memory card.

► **Note**

• If the command to output a subsequent image is issued while the current image is being output, the new request for image data is ignored.
• If there are a large number of files in the output folder, the time required to save the files increases.

1 **Select [Output Image] on the [Output] menu.**

The [Output Image] menu appears.

By default, no data is output.

2 **Select the camera image to output next to [Camera].**

Images from cameras with checks next to them will be output.

Reference

If there are no checks next to any cameras or a camera that is not connected is specified, no image will be output.

3 **Select an output method for the image next to [Output Method].**

• **RS-232C**: Outputs the image data to the RS-232 connector.
• **Ethernet**: Outputs the image data to the Ethernet connector.
• **USB**: Outputs the image data to the USB connector.
• **Memory Card** (Default): Outputs the image data to the memory card.

► **Note**

The port specified to output the image to (other than Ethernet or memory card) cannot be used to output normal measurement values or judge values.

4 **If [Memory Card] is the selected [Output Method], the output file name will be created from [Filename] and [Header].**

If [Memory Card] is not selected in step 3, this process does not occur.

Reference

The output folder will be [/CV].

Filename

• **Auto** (Default): Filenames take the form "Hour, minute and second_Date_Camera number_measurement count.bmp".
• **Header + Auto**: Filenames take the form "Specifed Header_Hour, minute and second_Date_Camera number_measurement count.bmp".
• **Fixed Name**: Filenames take the form "Specifed Header_Camera number.bmp". This setting will overwrite the previous file with that name.

Header

If [Filename] is set to [Header + Auto] or [Fixed Name], the header can be up to 32 characters long.

5 **To output a compressed image, specify a compression ratio next to [Compress].**

This is convenient when you do not have to store the raw image data but want to retain thumbnail images for confirmation in case a problem occurs.

► **Note**

You cannot import images that have been compressed and saved in the system because the size of the images is changed by the compression.

Reference

• It takes less time to output image data if it is compressed and saved. On the contrary, it takes longer to output if the image data is saved without compression.
• The condition of the memory card affects the time required for output.

6 **After completing the settings, select [OK].**

Specifying the Windows for Inspection and Measurement

Specifying image output conditions

Images can be set to be output only when the specified conditions are met.

1 **Select [Condition] on the [Output Image] menu.**
The [Select output condition] menu appears.

2 **Select the output conditions for:**
   • **Every Trigger** (Default): Outputs an image for every measurement.
   • **Total NG**: Outputs images only when the total status is NG.
   • **(Window Name)**: Outputs images only when the selected window's status is NG.

3 **After completing the settings, select [OK].**

Reference⬎

To output based on the judgment values of multiple specified windows, use the calculation function (Page 4-253).

Displaying Measurement Values in Absolute Sizes [Scaling]

The system processes data in pixels internally, but it is possible to convert the display or the measurement values used for judgment and calculation to any desired unit value, including absolute size. (This process is called "scaling.")
In this system, you can use either of the following two methods to convert measurement values:
   • Manual: Measurement values are multiplied by the coefficients you specify (Page 4-291).
   • Auto: The ratios are automatically set based on the measurement values from the registered screen (Page 4-292).

Reference⬎

Only items that indicate a position or length can be scaled. To confirm data types, see the measurement data type field in "Output Data List" (Page 4-294).

Calculating Standard Conversion Factors for Measurement Values (Specifying Ratios)

1 **Select [Scaling] on the [Output] menu.**
The [Scaling] menu appears.
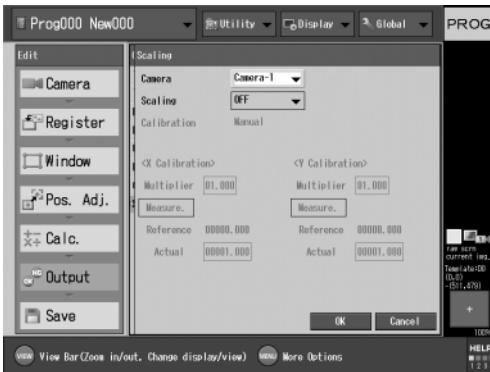
2 **Select [Camera], and then select a camera for scaling.**
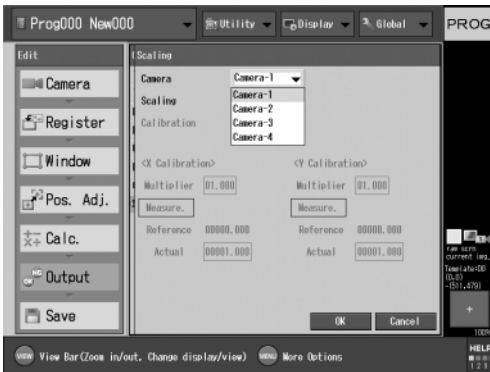
3 **Select [Scaling], and then select [ON].**
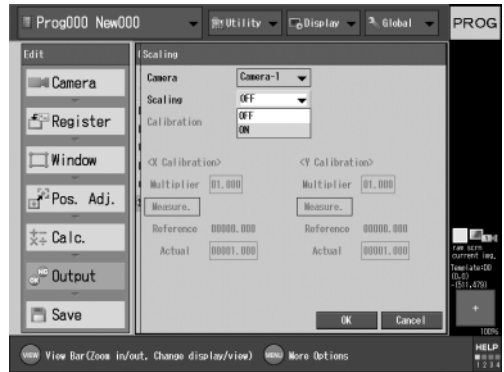
4 **Select [Calibration], then select [Manual].**
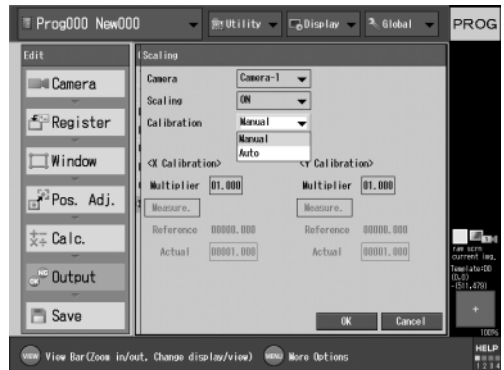
5 **Select [X Calibration], and then specify the desired ratio. Repeat the same process for [Y Calibration].**

The ratios you specify here are multipliers for the actual measurement values. The results are displayed on the screen or output to external devices. Specify ratios that produce values close to the actual sizes. (The default value for both coefficients is 1.000. The range you can specify is from 0.001 to 10.000.)

For example, if you specify "2.000" for a coefficient and the actual measurement value is "30 pixels", the measurement value is displayed as "60" on the screen and external devices. (The unit is arbitrary, such as a millimeter.)

- **X Multiplier**: Specifies the ratio for the X-axis (horizontal).
- **Y Multiplier**: Specifies the ratio for the Y-axis (vertical).

Reference

Depending on the detection direction, conversion factors in the X and Y directions can be applied to Items that indicate length (including pitch and width) .

6 To apply scaling to another camera, repeat steps 2 through 5.

7 After completing the settings, select [OK].

To deactivate scaling

Select a camera to deactivate scaling for, then set [Scaling] to [OFF].

Specifying the Desired Absolute Size Based on the Actual Measurement Value (Auto)

1 Select [Scaling] on the [Output] menu.
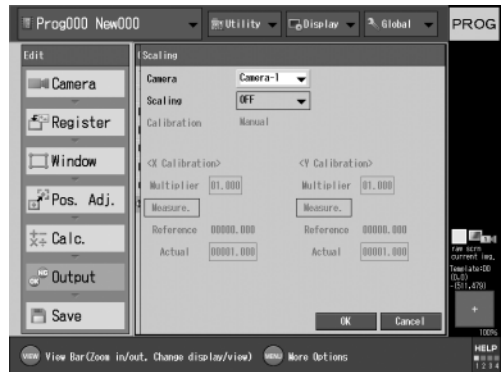
The [Scaling] menu appears.

2 Select [Camera], and then select a camera for scaling.
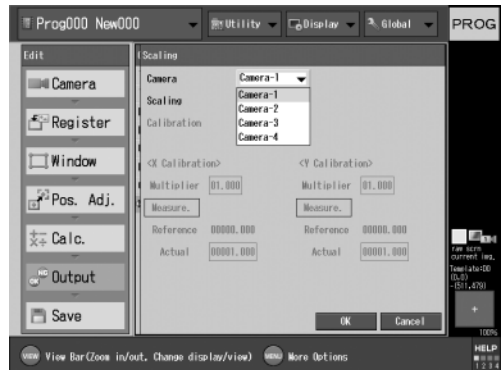
3 **Select [Scaling], and then select [ON].**
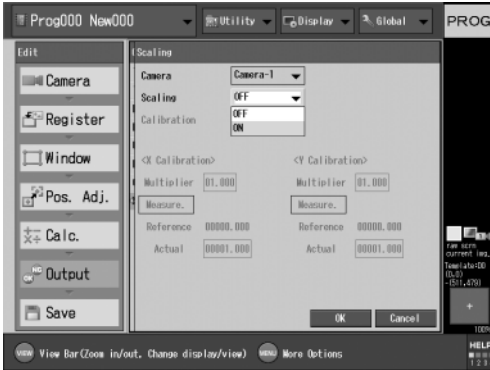
4 **Select [Calibration], then select [Auto].**
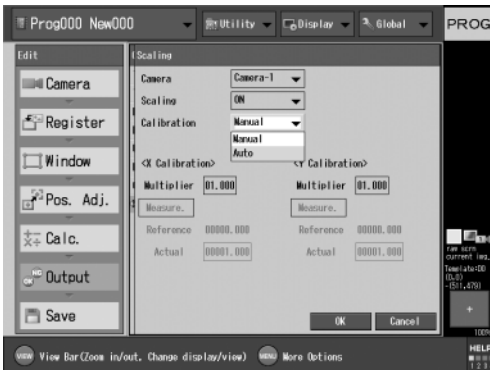
► **Note**

If the system is switched to auto after a multiplier has been entered in manual mode, the input factor is automatically changed to the value specified by auto mode.

5 **Select [Measure] in the [X Calibration] field.**

The [Select Measurement Value] menu appears.

► **Note**

When setting a calculation window, use [Absolute measurement value] as the measurement value type for [Position] and [Length] in the calculation. Other types of measurement values are corrected by scaling, and the values may not be converted correctly when used in calculations.

6 **Select a measurement value and window to use in the calibration, then select [OK].**

Specify a measurement value to be displayed on the registration screen in the [Reference] field.

7 **Select [Actual], then specify the absolute size that you want the reference value to be.**

The conversion ratio is automatically set based on the reference value and the specified conversion value. (The default value for the conversion value is 1.000.) For example, if you specify "60.000" as the conversion value when the reference value is "30", the conversion ratio is automatically set to "2.000" and a measurement value of "60" is displayed on the screen and external devices.

Reference

• Depending on the detection direction, conversion factors in the X and Y directions can be applied to Items that indicate length (including pitch and width) .

• If the registered image in the window being used in the calibration changes, the conversion factor is also updated automatically.

► **Note**

If the window being used in the conversion is deleted, the scaling in that direction is cleared and the object is rescaled with a conversion factor of 1.000.

8 **Repeat steps 5-7 for [Y Calibration] to specify the settings for conversion of the Y-axis.**

9 **To apply scaling to another camera, repeat steps 2 through 8.**

10 **After completing the settings, select [OK].**

To deactivate scaling

Select a camera to deactivate scaling for, then set [Scaling] to [OFF]

Specifying the Windows for Inspection and Measurement

Output Data List

Reference

• Items for which the format of the measurement data is [X, Y] or [X, Y, T] output multiple types of data from one item with comma delimitation.
• A period (.) is inserted between integers and decimal numbers.

	Item	Symbol	Measurement Data Type	Measurement Data Format	Target No.
Total Count	None	None	Number of triggers	10 digit integer	✕
Total Status	None	None	Judgment Result	1 digit integer	✕
Day/Time	None	None	Year/Month/Day/Hour/Minute/Second	yy, mo, dd, hh, mi, ss (2 digit integers, separated by commas)	✕
Judge Value	None	None	Judgment Result	1 digit integer (when more than one is selected, up to 32 comma-separated items can be output)	✕
Area	Area	AR	The number of pixels	7 digit integer	✕
Pattern Search	Number	N	Number	2 digit integer	✕
	Position X	X	Length	Sign, 5 integer places, 3 decimal places	O
	Position Y	Y	Length	Sign, 5 integer places, 3 decimal places	O
	Angle	T	Angle	Sign, 3 integer places, 3 decimal places	O
	Correlation Value	C	Correlation value	2 integer places, 3 decimal places	O
	Position XY	XY	Length (Position X), Length (Position Y)	X, Y	O
	Position XY, Angle	XYT	Length (Position X), Length (Position Y), Angle	X, Y, T	O
Pattern Sort	Number	N	Number	2 digit integer	✕
	Group No.	GR	Number	3 digit integer	O
	Element No.	EL	Number	3 digit integer	O
	Position X	X	Length	Sign, 5 digit integer places, 3 decimal places	O
	Position Y	Y	Length	Sign, 5 digit integer places, 3 decimal places	O
	Angle	T	Angle	Sign, 3 digit integer places, 3 decimal places	O
	Correlation value	C	Correlation value	2 digit integer places, 3 decimal places	O
	Position XY	XY	Length (Position X), Length (Position Y)	X, Y	O
	Position XY, Angle	XYT	Length (Position X), Length (Position Y), Angle	X, Y, T	O
	Pattern No. 1	GR1	Number	3 digit integer	✕
	Pattern No. 2	GR2	Number	3 digit integer	✕
	Pattern No. 3	GR3	Number	3 digit integer	✕
	Pattern No. 4	GR4	Number	3 digit integer	✕
	Pattern No. 5	GR5	Number	3 digit integer	✕
	Pattern No. 6	GR6	Number	3 digit integer	✕
	Pattern No. 7	GR7	Number	3 digit integer	✕
	Pattern No. 8	GR8	Number	3 digit integer	✕

	Item	Symbol	Measurement Data Type	Measurement Data Format	Target No.
ShapeTrax	Number	N	Number	2 digit integer	×
	Position X	X	Length	Sign, 5 integer places, 3 decimal places	O
	Position Y	Y	Length	Sign, 5 integer places, 3 decimal places	O
	Angle	T	Angle	Sign, 3 integer places, 3 decimal places	O
	Correlation Value	C	Correlation value	2 integer places, 3 decimal places	O
	Position XY	XY	Length (Position X), Length (Position Y)	X, Y	O
	Position XY, Angle	XYT	Length (Position X), Length (Position Y), Angle	X, Y, T	O
Edge Position	Number of Edges	N	Number	4 digit integer	×
	Position X	X	Length	Sign, 5 integer places, 3 decimal places	O
	Position Y	Y	Length	Sign, 5 integer places, 3 decimal places	O
	Angle	T	Angle	Sign, 3 integer places, 3 decimal places	O
	Position XY	XY	Length (Position X), Length (Position Y)	X, Y	O
	Distance	P	Length	5 integer places, 3 decimal places	O
	Intensity	I	Intensity	3 integer places, 3 decimal places	O
Edge Width	Pairs	N	Number	4 digit integer	×
	Edge Width	W	Length Or Angle	5 integer places, 3 decimal places	×
	Position 1X	X1	Length	Sign, 5 integer places, 3 decimal places	×
	Position 1Y	Y1	Length	Sign, 5 integer places, 3 decimal places	×
	Angle 1	T1	Angle	Sign, 3 integer places, 3 decimal places	×
	Position 1XY	XY1	Length (Position X), Length (Position Y)	X, Y	×
	Distance 1	P1	Length Or Angle	5 integer places, 3 decimal places	×
	Intensity 1	I1	Intensity	3 integer places, 3 decimal places	×
	Position 2X	X2	Length	Sign, 5 integer places, 3 decimal places	×
	Position 2Y	Y2	Length	Sign, 5 integer places, 3 decimal places	×
	Angle 2	T2	Angle	Sign, 3 integer places, 3 decimal places	×
	Position 2XY	XY2	Length (Position X), Length (Position Y)	X, Y	×
	Distance 2	P2	Length Or Angle	5 integer places, 3 decimal places	×
	Intensity 2	I2	Intensity	3 integer places, 3 decimal places	×

Specifying the Windows for Inspection and Measurement

	Item	Symbol	Measurement Data Type	Measurement Data Format	Target No.
Edge Pitch	Pitches	N	Number	4 digit integer[a]	×
	Pitch (Max)	WH	Length Or Angle	5 integer places, 3 decimal places	×
	Pitch (Min)	WL	Length Or Angle	5 integer places, 3 decimal places	×
	Pitch (Avg)	WA	Length Or Angle	5 integer places, 3 decimal places	×
	Pitch	W	Length Or Angle	5 integer places, 3 decimal places	O
	Position 1X	X1	Length	Sign, 5 integer places, 3 decimal places	O
	Position 1Y	Y1	Length	Sign, 5 integer places, 3 decimal places	O
	Angle 1	T1	Angle	Sign, 3 integer places, 3 decimal places	O
	Position 1XY	XY1	Length (Position X), Length (Position Y)	X, Y	O
	Distance 1	P1	Length Or Angle	5 integer places, 3 decimal places	O
	Intensity 1	I1	Intensity	3 integer places, 3 decimal places	O
	Position 2X	X2	Length	Sign, 5 integer places, 3 decimal places	O
	Position 2Y	Y2	Length	Sign, 5 integer places, 3 decimal places	O
	Angle 2	T2	Angle	Sign, 3 integer places, 3 decimal places	O
	Position 2XY	XY2	Length (Position X), Length (Position Y)	X, Y	O
	Distance 2	P2	Length Or Angle	5 integer places, 3 decimal places	O
	Intensity 2	I2	Intensity	3 integer places, 3 decimal places	O
Number of Edges	Number of Edges	N	Number	4 digit integer	×
Edge Angle	Angle	T	Angle	Sign, 3 integer places, 3 decimal places	×
	Position 1X	X1	Length	Sign, 5 integer places, 3 decimal places	×
	Position 1Y	Y1	Length	Sign, 5 integer places, 3 decimal places	×
	Position 1XY	XY1	Length (Position X), Length (Position Y)	X, Y	×
	Distance 1	P1	Length	Sign, 5 integer places, 3 decimal places	×
	Intensity 1	I1	Intensity	3 integer places, 3 decimal places	×
	Position 2X	X2	Length	Sign, 5 integer places, 3 decimal places	×
	Position 2Y	Y2	Length	Sign, 5 integer places, 3 decimal places	×
	Position 2XY	XY2	Length (Position X), Length (Position Y)	X, Y	×
	Distance 2	P2	Length	Sign, 5 integer places, 3 decimal places	×
	Intensity 2	I2	Intensity	3 integer places, 3 decimal places	×
	Center X	X	Length	Sign, 5 integer places, 3 decimal places	×
	Center Y	Y	Length	Sign, 5 integer places, 3 decimal places	×
	Center XY	XY	Length (Position X), Length (Position Y)	X, Y	×

	Item	Symbol	Measurement Data Type	Measurement Data Format	Target No.
Edge Pairs	Pairs	N	Number	4 digit integer	×
	Pair Width (Max)	WH	Length or Angle	5 integer places, 3 decimal places	×
	Pair Width (Min)	WL	Length or Angle	5 integer places, 3 decima places	×
	Pair Width (Avg)	WA	Length or Angle	5 integer places, 3 decimal places	×
	Pair Width	W	Length or Angle	5 integer places, 3 decimal places	O
	Position 1X	X1	Length	Sign, 5 integer places, 3 decimal places	O
	Position 1Y	Y1	Length	Sign, 5 integer places, 3 decimal places	O
	Angle 1	T1	Angle	Sign, 3 integer places, 3 decimal places	O
	Position 1XY	XY1	Length (Position X), Length (Position Y)	X, Y	O
	Distance 1	P1	Length or Angle	5 integer places, 3 decimal places	O
	Intensity 1	I1	Intensity	3 integer places, 3 decimal places	O
	Position 2X	X2	Length	Sign, 5 integer places, 3 decimal places	O
	Position 2Y	Y2	Length	Sign, 5 integer places, 3 decimal places	O
	Angle 2	T2	Angle	Sign, 3 integer places, 3 decimal places	O
	Position 2XY	XY2	Length (Position X), Length (Position Y)	X, Y	O
	Distance 2	P2	Length or Angle	5 integer places, 3 decimal places	O
	Intensity 2	I2	Intensity	3 integer places, 3 decimal places	O
Stain	Total Area	SA	The Number of Pixels	7 digit integer	×
	Position X	X	Length	Sign, 5 integer places, 3 decimal places	×
	Position Y	Y	Length	Sign, 5 integer places, 3 decimal places	×
	Position XY	XY	Length (Position X), Length (Position Y)	X, Y	×
	Detected Stain Level:	SL	Intensity	3 digit integer	×
	Groups	N	Number	2 digit integer	×
	Stain Area	GSA	The Number of Pixels	7 digit integer	O
	Group Center X	GX	Length	Sign, 5 integer places, 3 decimal places	O
	Group Center Y	GY	Length	Sign, 5 integer places, 3 decimal places	O
	Group Center XY	GXY	Length (Group Center Position X) Length (Group Center Position Y)	X, Y	O

Specifying the Windows for Inspection and Measurement

	Item	Symbol	Measurement Data Type	Measurement Data Format	Target No.
Blob	Number of Blobs	N	Number	4 digit integer	×
	Group Center X	X	Length	Sign, 5 integer places, 3 decimal places	O
	Group Center Y	Y	Length	Sign, 5 integer places, 3 decimal places	O
	Group Center XY	XY	Length (Position X), Length (Position Y)	X, Y	O
	Group Center XY, Main Angle	XYT	Length (Position X) Length (Position Y), Angle	X, Y, T	O
	Main Axis Angle	T	Angle	Sign, 3 integer places, 3 decimal places	O
	Area	AR	The Number of Pixels	7 digit integer	O
	Feret Diameter X	FX	Length	Sign, 5 integer places, 3 decimal places	O
	Feret Diameter Y	FY	Length	Sign, 5 integer places, 3 decimal places	O
	Perimeter	CL	Length	7 digit integer	O
	Roundness	CD	Roundness	1 integer places, 3 decimal places	O
	Group Center X (Max)	XH	Length	Sign, 5 integer places, 3 decimal places	×
	Group Center X (Min)	XL	Length	Sign, 5 integer places, 3 decimal places	×
	Group Center Y (Max)	YH	Length	Sign, 5 integer places, 3 decimal places	×
	Group Center Y (Min)	YL	Length	Sign, 5 integer places, 3 decimal places	×
	Main Axis Angle (Max)	TH	Angle	Sign, 3 integer places, 3 decimal places	×
	Main Axis Angle (Min)	TL	Angle	Sign, 3 integer places, 3 decimal places	×
	Area (Max)	ARH	The Number of Pixels	7 digit integer	×
	Area (Min)	ARL	The Number of Pixels	7 digit integer	×
	Feret Diameter X (Max)	FXH	Length	Sign, 5 integer places, 3 decimal places	×
	Feret Diameter X (Min)	FXL	Length	Sign, 5 integer places, 3 decimal places	×
	Feret Diameter Y (Max)	FYH	Length	Sign, 5 integer places, 3 decimal places	×
	Feret Diameter Y (Min)	FYL	Length	Sign, 5 integer places, 3 decimal places	×
	Perimeter (Max)	CLH	The Number of Pixels	7 digit integer	×
	Perimeter (Min)	CLL	The Number of Pixels	7 digit integer	×
	Roundness (Max)	CDH	Roundness	1 integer places, 3 decimal places	×
	Roundness (Min)	CDL	Roundness	1 integer places, 3 decimal places	×

	Item	Symbol	Measurement Data Type	Measurement Data Format	Target No.
Trend Edge Position	Segments	SGN	Number	4 digit integer	×
	Detected Segments	DSGN	Number	4 digit integer	×
	Number of Edges	N	Number	4 digit integer	O
	Position X	X	Length	Sign, 5 integer places, 3 decimal places	O
	Position Y	Y	Length	Sign, 5 integer places, 3 decimal places	O
	Angle	T	Angle	Sign, 3 integer places, 3 decimal places	O
	Position XY	XY	Length (Position X), Length (Position Y)	X, Y	O
	Distance	P	Length	5 integer places, 3 decimal places	O
	Radius	RW	Length	5 integer places, 3 decimal places	O
	Intensity	I	Intensity	3 integer places, 3 decimal places	O
	Number of Edges (Max)	NHI	Number	4 digit integer	×
	Number of Edges (Min)	NLO	Number	4 digit integer	×
	Position X(Max)	XHI	Length	Sign, 5 integer places, 3 decimal places	×
	Position X(Min)	XLO	Length	Sign, 5 integer places, 3 decimal places	×
	Position X (Avg)	XA	Length	Sign, 5 integer places, 3 decimal places	×
	Position Y(Max)	YHI	Length	Sign, 5 integer places, 3 decimal places	×
	Position Y(Min)	YLO	Length	Sign, 5 integer places, 3 decimal places	×
	Position Y (Avg)	YA	Length	Sign, 5 integer places, 3 decimal places	×
	Angle (Max)	THI	Angle	Sign, 3 integer places, 3 decimal places	×
	Angle (Min)	TLO	Angle	Sign, 3 integer places, 3 decimal places	×
	Position XY(Max)	XYHI	Length (Position X), Length (Position Y)	X, Y	×
	Position XY (Min)	XYLO	Length (Position X), Length (Position Y)	X, Y	×
	Position XY (Avg)	XYA	Length (Position X), Length (Position Y)	X, Y	×
	Distance (Max)	PHI	Length	5 integer places, 3 decimal places	×
	Distance (Min)	PLO	Length	5 integer places, 3 decimal places	×
	Distance (Avg)	PA	Length	5 integer places, 3 decimal places	×
	Radius (Max)	RWHI	Length	5 integer places, 3 decimal places	×
	Radius (Min)	RWLO	Length	5 integer places, 3 decimal places	×
	Radius (Avg)	RWA	Length	5 integer places, 3 decimal places	×
	Intensity (Max)	IHI	Intensity	3 integer places, 3 decimal places	×
	Intensity (Min)	ILO	Intensity	3 integer places, 3 decimal places	×
	Circle Radius	DCR	Length	5 integer places, 3 decimal places	×
	Circle Center X	DCX	Length	Sign, 5 integer places, 3 decimal places	×
	Circle Center Y	DCY	Length	Sign, 5 integer places, 3 decimal places	×
	Circle Center XY	DCXY	Length (Position X), Length (Position Y)	X, Y	×
	Line X1	DLX1	Length	Sign, 5 integer places, 3 decimal places	×
	Line Y1	DLY1	Length	Sign, 5 integer places, 3 decimal places	×
	Line XY1	DLXY1	Length (Position X), Length (Position Y)	X, Y	×
	Line X2	DLX2	Length	Sign, 5 integer places, 3 decimal places	×
	Line Y2	DLY2	Length	Sign, 5 integer places, 3 decimal places	×
	Line XY2	DLXY2	Length (Position X), Length (Position Y)	X, Y	×
	Line Center X	DLX	Length	Sign, 5 integer places, 3 decimal places	×
	Line Center Y	DLY	Length	Sign, 5 integer places, 3 decimal places	×
	Line Center XY	DLXY	Length (Position X), Length (Position Y)	X, Y	×
	Line Angle	DLT	Angle	Sign, 3 integer places, 3 decimal places	×

	Item	Symbol	Measurement Data Type	Measurement Data Format	Target No.
Trend Edge Width	Segments	SGN	Number	4 digit integer	×
	Detected Segments	DSGN	Number	4 digit integer	×
	Pairs	N	Number	4 digit integer	O
	Edge Width	W	Length	5 integer places, 3 decimal places	O
	Position 1X	X1	Length	Sign, 5 integer places, 3 decimal places	O
	Position 1Y	Y1	Length	Sign, 5 integer places, 3 decimal places	O
	Angle 1	T1	Angle	Sign, 3 integer places, 3 decimal places	O
	Position 1XY	XY1	Length (Position X), Length (Position Y)	X, Y	O
	Distance 1	P1	Length	5 integer places, 3 decimal places	O
	Intensity 1	I1	Intensity	3 integer places, 3 decimal places	O
	Position 2X	X2	Length	Sign, 5 integer places, 3 decimal places	O
	Position 2Y	Y2	Length	Sign, 5 integer places, 3 decimal places	O
	Angle 2	T2	Angle	Sign, 3 integer places, 3 decimal places	O
	Position 2XY	XY2	Length (Position X), Length (Position Y)	X, Y	O
	Distance 2	P2	Length	5 integer places, 3 decimal places	O
	Intensity 2	I2	Intensity	3 integer places, 3 decimal places	O
	Pairs (Max)	NHI	Number	4 digit integer	×
	Pairs (Min)	NLO	Number	4 digit integer	×
	Edge Width (Max)	WHI	Length	5 integer places, 3 decimal places	×
	Edge Width (Min)	WLO	Length	5 integer places, 3 decimal places	×
	Edge Width (Avg)	WA	Length	5 integer places, 3 decimal places	×
	Position 1X(Max)	X1HI	Length	Sign, 5 integer places, 3 decimal places	×
	Position 1X(Min)	X1LO	Length	Sign, 5 integer places, 3 decimal places	×
	Position 1Y(Max)	Y1HI	Length	Sign, 5 integer places, 3 decimal places	×
	Position 1Y(Min)	Y1LO	Length	Sign, 5 integer places, 3 decimal places	×
	Angle 1 (Max)	T1HI	Angle	Sign, 3 integer places, 3 decimal places	×
	Angle 1 (Min)	T1LO	Angle	Sign, 3 integer places, 3 decimal places	×
	Position 1XY(Max)	XY1HI	Length (Position X), Length (Position Y)	X, Y	×
	Position 1XY(Min)	XY1LO	Length (Position X), Length (Position Y)	X, Y	×
	Distance 1 (Max)	P1HI	Length	5 integer places, 3 decimal places	×
	Distance 1 (Min)	P1LO	Length	5 integer places, 3 decimal places	×
	Intensity 1 (Max)	I1HI	Intensity	3 integer places, 3 decimal places	×
	Intensity 1 (Min)	I1LO	Intensity	3 integer places, 3 decimal places	×
	Position 2X (Max)	X2HI	Length	Sign, 5 integer places, 3 decimal places	×
	Position 2X (Min)	X2LO	Length	Sign, 5 integer places, 3 decimal places	×
	Position 2Y (Max)	Y2HI	Length	Sign, 5 integer places, 3 decimal places	×
	Position 2Y (Min)	Y2LO	Length	Sign, 5 integer places, 3 decimal places	×
	Angle 2 (Max)	T2HI	Angle	Sign, 3 integer places, 3 decimal places	×
	Angle 2 (Min)	T2LO	Angle	Sign, 3 integer places, 3 decimal places	×
	Position 2XY (Max)	XY2HI	Length (Position X), Length (Position Y)	X, Y	×
	Position 2XY (Min)	XY2LO	Length (Position X), Length (Position Y)	X, Y	×
	Distance 2 (Max)	P2HI	Length	5 integer places, 3 decimal places	×
	Distance 2 (Min)	P2LO	Length	5 integer places, 3 decimal places	×
	Intensity 2 (Max)	I2HI	Intensity	3 integer places, 3 decimal places	×
	Intensity 2 (Min)	I2LO	Intensity	3 integer places, 3 decimal places	×

	Item	Symbol	Measurement Data Type	Measurement Data Format	Target No.
Intensity	Intensity Average	DA	Average	3 integer places, 3 decimal places	×
	Intensity Deviation	DD	Deviation	3 integer places, 3 decimal places	×
	Maximum Intensity	DH	Intensity	3 digit integer	×
	Minimum Intensity	DL	Intensity	3 digit integer	×
Color	R-Average	RA	Average	3 integer places, 3 decimal places	×
	R-Deviation	RD	Deviation	3 integer places, 3 decimal places	×
	R-Maximum	RH	Intensity	3 digit integer	×
	R-Minimum	RL	Intensity	3 digit integer	×
	G-Average	GA	Average	3 integer places, 3 decimal places	×
	G-Deviation	GD	Deviation	3 integer places, 3 decimal places	×
	G-Maximum	GH	Intensity	3 digit integer	×
	G-Minimum	GL	Intensity	3 digit integer	×
	B-Average	BA	Average	3 integer places, 3 decimal places	×
	B-Deviation	BD	Deviation	3 integer places, 3 decimal places	×
	B-Maximum	BH	Intensity	3 digit integer	×
	B-Minimum	BL	Intensity	3 digit integer	×
	H-Average	HUA	Average	3 integer places, 3 decimal places	×
	H-Deviation	HUD	Deviation	3 integer places, 3 decimal places	×
	H-Maximum	HUH	Intensity	3 digit integer	×
	H-Minimum	HUL	Intensity	3 digit integer	×
	S-Average	SAA	Average	3 integer places, 3 decimal places	×
	S-Deviation	SAD	Deviation	3 integer places, 3 decimal places	×
	S-Maximum	SAH	Intensity	3 digit integer	×
	S-Minimum	SAL	Intensity	3 digit integer	×
	V-Average	VAA	Average	3 integer places, 3 decimal places	×
	V-Deviation	VAD	Deviation	3 integer places, 3 decimal places	×
	V-Maximum	VAH	Intensity	3 digit integer	×
	V-Minimum	VAL	Intensity	3 digit integer	×

Specifying the Windows for Inspection and Measurement

	Item	Symbol	Measurement Data Type	Measurement Data Format	Target No.
OCR	1st line text *1*2	STR1	Text	ASCII (1 to 20 characters)	×
	2nd line text *1*2	STR2	Text	ASCII (1 to 20 characters)	×
	1st line judged text *1*2	JG_STR1	Text	ASCII (1 to 20 characters)	×
	2nd line judged tex *1*2	JG_STR2	Text	ASCII (1 to 20 characters)	×
	Recognized character [] *1	RCG_CHR	Character	ASCII (1 character)	O
	1st possible character []	CHR1 *1	Character	ASCII (1 character)	O
	2nd possible character []	CHR2 *1	Character	ASCII (1 character)	O
	Rate of recognition for 1st possibility []	CRR1	Rate of recognition	2 digit integer	O
	Rate of recognition for 2nd possibility []	CRR2	Rate of recognition	2 digit integer	O
	Stability []	STBL	Stability	2 digit integer	O
	No. of captured lines	CLN	Line count	2 digit integer	×
	No. of 1st line captured characters	CCN1	Character count	2 digit integer	×
	No. of 2nd line captured characters	CCN2	Character count	2 digit integer	×
	1st line rate of recognition (Max.)	L1CRR1_H	Rate of recognition	2 digit integer	×
	1st line rate of recognition (Min.)	L1CRR1_L	Rate of recognition	2 digit integer	×
	2nd line rate of recognition (Max.)	L2CRR1_H	Rate of recognition	2 digit integer	×
	2nd line rate of recognition (Min.)	L2CRR1_L	Rate of recognition	2 digit integer	×
	1st line stability (Max.)	L1STBL_H	Stability	2 digit integer	×
	1st line stability (Min.)	L1STBL_L	Stability	2 digit integer	×
	2nd line stability (Max.)	L2STBL_H	Stability	2 digit integer	×
	2nd line stability (Min.)	L2STBL_L	Stability	2 digit integer	×
Calculation			Calculation Results	Sign, 7 integer places, 3 decimal places	×

*1 When outputting characters from a terminal, the value that represents the ASCII code in decimal form is output in binary format.

Ex.: "K" = "4B" (hexadecimal) becomes "75" (decimal)

The custom characters (1) to (20) are output as the lower case letters a to t.

*2 When outputting text from a terminal, binary output is used to repeatedly output the number of characters specified with the captured settings, regardless of the number of character that are actually recognized.

Saving Settings

4-8

Saving the Settings (Save)

You can save the settings specified in the [Program] menu as follows.

► **Note**

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

Reference

Settings can also be saved from the function menu (page 3-12)

1 Finish making Program No. settings.

2 Select [Save].

A confirmation screen appears.
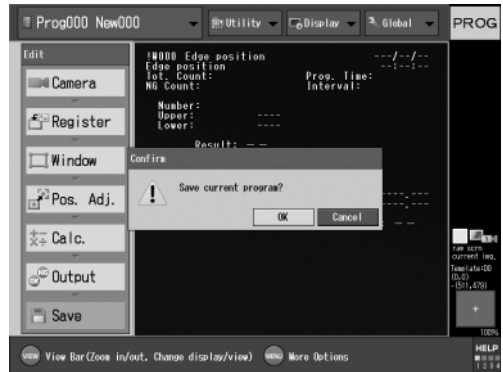
3 Select [OK].

The following settings can be saved in the internal flash memory or on a memory card:

- All settings of the current program No. (camera, registered image, window, position adjustment settings, calculations, etc.)
- Image archive condition settings (Page 6-15)
- Menu customization settings (Page 6-23)
- Window limit settings (Page 6-27)
- Command memory settings (Page 6-28)
- Display settings (6-31-Page 6-48)

► **Note**

When saving a program No. created with a version earlier than second edition II, the file format is changed and the settings cannot be read by previous versions. For more details, see "Compatibility of program data for the previous edition and second edition III" (page 9).

Reference

Global settings (page 7-1) and the position of the current Program No. are saved whenever they are changed with the remote control console, so there is no need to save them.

Saving program files created with the second edition/second edition II in second edition III format

When saving files created with a past version (second edition and second edition II), the system (second edition III) converts the format of the program files and overwrites them. When the format is changed for the program files, files created with past versions gain the ability to make settings for functions added to second edition III.

Reference

The format for settings on the system is different than for previous versions. The second version III is forward compatible, so program files created on previous versions can be read and executed.

► Note

• Program files created with the first edition are automatically converted to second edition III program file format when they are saved. Therefore, the saved program files will not longer be readable with the second edition II or earlier.

• When program files created with the second edition or second edition II are changed to second edition III program file format, they can no longer be read by previous versions. The program file also cannot be returned to its original state.

1 Finish settings for the program No.

2 While pressing the [FNC] button, select [Save].

A confirmation message appears, saying that the old version program files will be overwritten.

3 Select [OK].

The program file is converted to second edition III program file format and saved to the internal memory or the memory card. The same settings that are saved for normal save operations (previous page) are saved.

After saving is complete, a confirmation message appears, saying that the file updating is complete.

Reference

Immediately after saving, second edition III functions can be used with the program files.

Starting and Ending Operations

Performs an actual inspection based on the specified settings.

Performing an Inspection

1 Turn on power to the CV.

After the opening screen appears on the monitor, the initial screen for the program mode should appear.
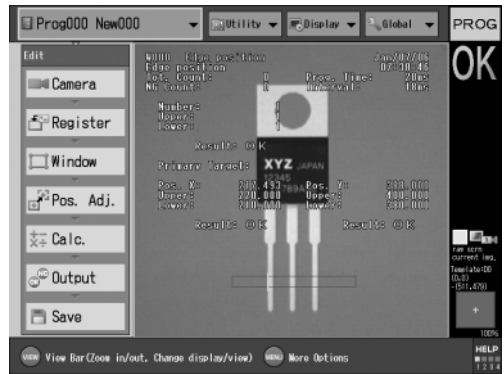
2 Press the selector switch on the remote control console to switch the CV to Run Mode.
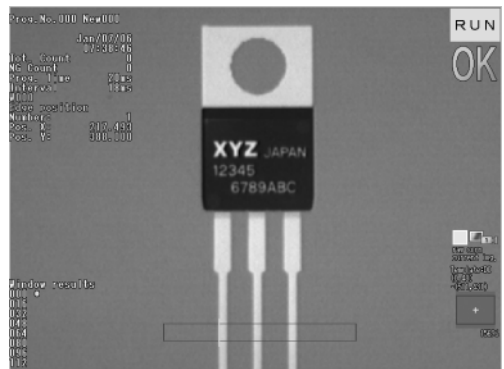
- When [Internal] is selected for the trigger (Page4-14), an image is continvally captured and processed.
- When [Continuous] is selected for the screen update (Page7-9), the window is continuously updated.

Reference

The mode can be switched between Program mode and Run mode using a command input from the communication part (9-15 page).

3 **Input a trigger. (Only when using an external trigger.)**

The image is captured and judged.

When you want to set display for the window when switching to Run mode

The default settings can be registered for the screen when switching the setting numbers for starting up Run mode or during Run mode. See "Selecting the Information to Display at the Initial Startup of the System (Select Initial Run-Mode Display)" (Page 6-45) for more details.

To startup in Run mode after turning on power

When [Run mode] is selected for the Startup mode (Page7-8), the CV starts in Run mode after turning on power. This function is useful for performing inspections without needing to switch odes.

▶ **Note**

- The program number used for startup is the last program number chosen when the CV was turned off.
- If the CV cannot start up with the previously chosen program number, the CV starts up using the program number 000 on the internal memory. In this case, a confirmation message appears and a signal is output from the ERR terminal.

To change the opening screen displayed during startup

- Save the desired image in the CV internal memory or memory card root folder (uppermost level) as an 800x600 pixel 24-bit bitmap format image entitled "Logo.bmp". The saved image file appears as the opening screen during CV startup.
- To have a blank opening screen appear, create a solid black image file using commercial graphics software and save it as "Logo.bmp" in the CV flash memory or memory card root folder (uppermost level).

Reference

A file saved as "Logo.bmp" with a file size of 0 cannot be displayed.

Ending Operations

To stop operations, turn off the power to the CV.

▶ **Note**

Turning off the CV while it is accessing a memory card may corrupt the memory card or the data being saved.

To only end outputting of judgments and results

- Press the selector switch on the remote control console to switch the CV to Program Mode.
- The CV can be switched to Program Mode by entering a command from the communication port (Page9-14).
- Shorting the TEST input terminal can also stop just the result outputs while remaining in Run mode (Page11-7).

▶ **Note**

When switching to Program Mode while outputting measurement results, the switch does not actually take place until the output has entirely finished for one measurement.

To end image capture and processing

- Stop the trigger input from receiving information by turning on the EXT input terminal (Page11-7).
- It can also be stopped by entering a command from the communication port (Page9-30).

Run Mode Display Screens

Press the [VIEW] button on the console to display the View Bar.
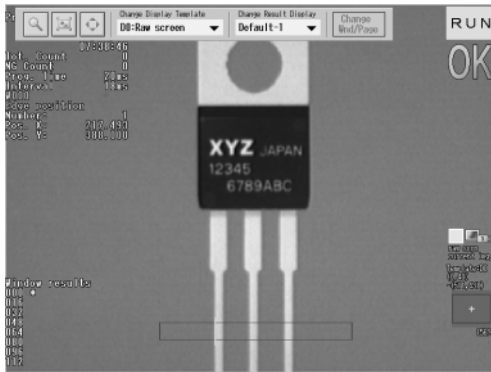
From [Change Result Display] on the View Bar, choose a desired display.

- None
- Default-1 (Default setting)
- Default-2
- Calc. results
- Custom display

See the explanation below for more details on each display.

Reference

See "Switching the Display Template" (Page 5-5) for the displays that can be shown with [Change Display Template] in the View Bar.

Changing the default display when switching to Run mode

The default settings after switching to Run mode can all be specified. See "Selecting the Information to Display at the Initial Startup of the System (Select Initial Run-Mode Display)" (Page 6-45) for more details.

Default-1 (Run mode default setting)

The following information is displayed:
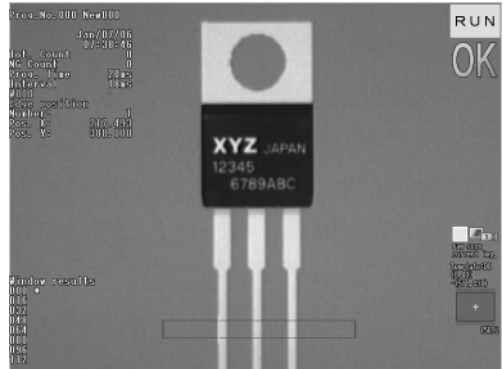
- Image from the camera
- Run mode display
- Measurement date and time
- PROG number. and name
- Total Status
- Tot. Count
- NG Count
- Prog. time
- Interval
- Selected window number and name
- Selected window measurement value
- Window results (000 to 127)
- Camera icon
- Zoom ratio

► Note

When a window has not been created, the information does not appear on the left side of the display.

To change to a different window number
Move the [ENTER] button on the remote control console up and down.

Changing windows when multiple windows are displayed
Move the [ENTER] button up and down or left and right while pressing the [FNC] button on the remote control console.

Reference

When multiple windows are displayed at once, the results for the selected window are displayed.

Run

Default-2

The following information is displayed:
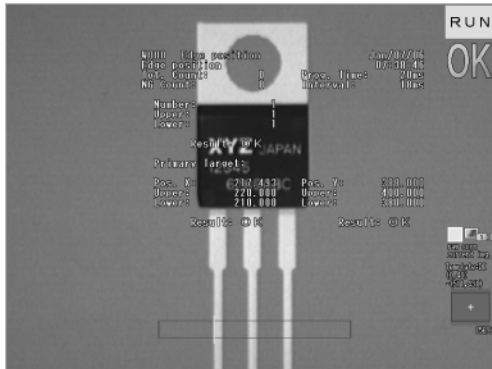
- Image from the camera
- Run mode display
- Tot. Status
- Measurement Tool
- Total Count
- Measurement date and time
- NG Count
- Prog. Time:Interval
- Window number and name
- Measurement value and inspection result of the window (handled by switching pages)
- Camera icon
- Zoom ratio

To change to a different window number
Move the [ENTER] button on the remote control console up and down.

To see multiple measurement values
In the case of the multi pattern position or the blob measurement mode, the measurement values are displayed on multiple pages. If you want to view all of the measurement values, move the [ENTER] button on the remote control console to the right and left.

Changing windows when multiple windows are displayed
Move the [ENTER] button up and down or left and right while pressing the [FNC] button on the remote control console.

Reference

When multiple windows are displayed at once, the results for the selected window are displayed.

Calculation Results

A list of measurement values from the calculation results is displayed on the left side of the screen. The results for 18 calculation windows are displayed at once.
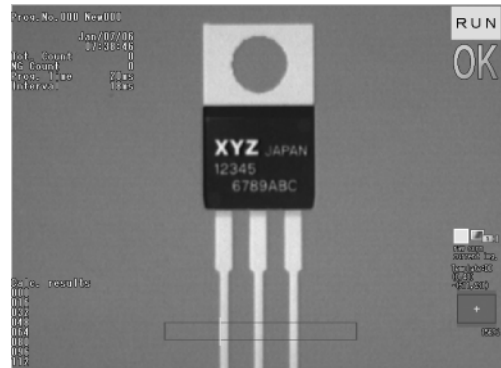
To see the measurement value of a calculation window that is not displayed
Move the [ENTER] button on the remote control console to the right and left.

Custom display

Displays the items that are created in the [Custom Screen] menu.
See "Selecting the Contents of the Custom Display (Create Custom Screen)" (Page 6-37) for more details.

None

Only displays the following:
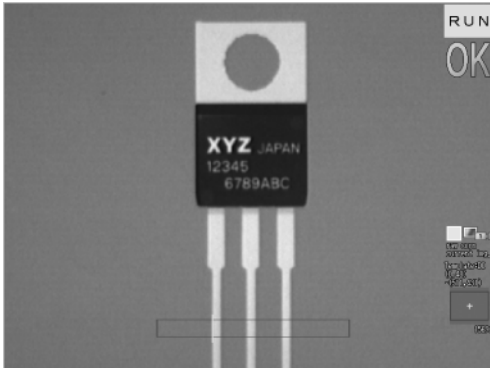
- Run mode display
- Image from the camera
- Camera icon
- Zoom ratio
- Total Status

Operation during Run Mode

Switching the Display Template

Press the [SCREEN] button on the console to switch the display template in the following order.

- D0: Raw screen
- D1: Filtered screen 1 (Processing screen for selected window)
- D2: Filtered screen 2 (Processing screen for all windows)
- D3: Contrast view

The name of the current display template is displayed in the lower right portion of the screen (this example shows when [D1: Filtered screen 1] is selected).
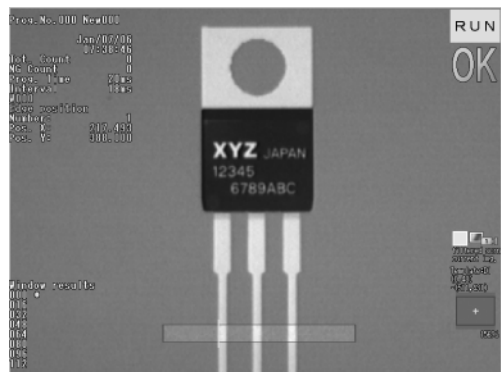
Reference

- The default settings include four standard display templates, D0 to D3. Custom display templates can also be created for display templates D4 to D9.
- The settings can also be changed so that only specified display templates are displayed when the [SCREEN] button is pressed. See "Creating Templates for Run Mode (Configure Image Options)" (Page 6-31) for more details.
- The display templates can also be switched from the View Bar, which can be accessed by pressing the [VIEW] button on the remote control console.
- Windows are not displayed if they are set with the execute condition ( ) to not execute.

D0: Raw screen

- Displays the captured image from the camera.
- Displays the measurement area of the current window.

D1: Filtered Screen 1

- Displays the measurement area of the current window. When the position adjustment is set, the position window for the current window is also displayed.
- Displays the camera image of the current window.
- When color or image enhancements are used, the image displayed is the one after the processing is complete.

D2: Filtered Screen 2

- Displays the measurement area of all the windows.
- Displays the camera image of the current window.
- When measurement windows overlap, the top window in the processing screen is shown.

D3: Contrast view

- Displays the stain level distribution in the selected window when using the stain tool.
- When not measuring stains in the selected window, this display acts the same as Filtered Screen 1.

Zooming IN/OUT on the processed image

The image on the screen can be enlarged. The zoom ratios can be set from $x^1/_{25}$ (4%) to x16 (1600%) (for full screen, the range is $x^1/_{17}$ (6%) to x25 (2500%)). When using multiple screens, a different zoom ratio can be set for each screen. See "Zooming In and Out on the Image and Scrolling on the Magnified Image (VIEW bar)" (Page 3-10) for more details.

Other operations

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

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

Reference

The image capture settings can be changed on the [Global] menu. See "Changing the USB Communication Settings (USB)" (7-7 page) for more details.

To display the VIEW bar

Press the [VIEW] button.
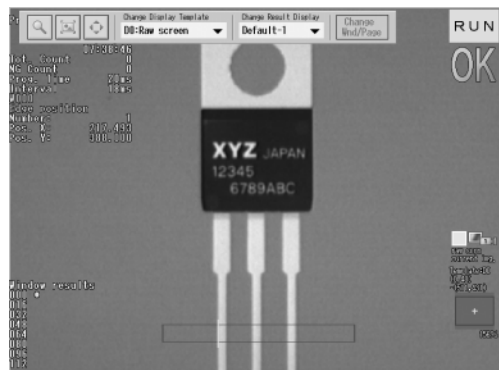
See "Zooming In and Out on the Image and Scrolling on the Magnified Image (VIEW bar)" (Page3-9) for more details about view.

Displaying the Menu Bar and Help Bar.

Press the [MENU] button.
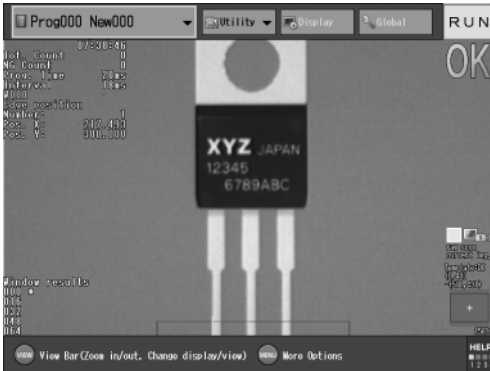
See "Using the Menu Bar/ Help Bar" (Page 3-12) for more details.

Displaying the Function Menu

Press the [FNC] button.
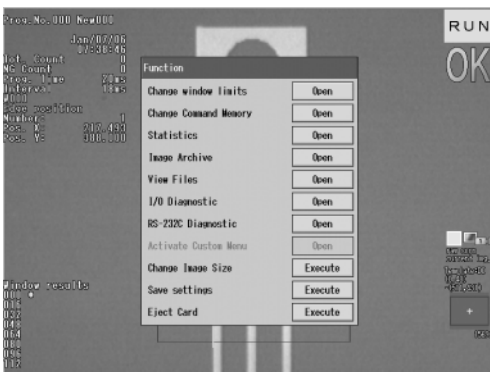
See "Using the Menu Bar/ Help Bar" (Page 3-12) for more details on the function menu.

Switching the Program Number

Display the Menu Bar and select the program number you want to display.

Reference

- You can lock the ability to switch from the console during Run mode in the [Global] menu. See "Selecting the Internal Clock (Date/Time)" (7-12 page) for more details.
- When switching from the remote control console, the program number that is used after performing the switching continues to be used even after the power is reset.

Inputting a reset signal to the CV (resets measured/status values)

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

Performance during Run Mode

When program number is switched or when there is a RESET input

- Resets the count, the NG count, the statistical values, the trigger delay, and the image archive.

Run

What are the Utility/ Display Menus

Functions for the CV that do not directly relate to the measurement tools are gathered in the [Utility] menu and the [Display] menu. This chapter describes how to use the functions in these menus. See the pages below for more details on each function.

[Utility] Menu

[Display] Menu

Analyzing Results (Statistics)

This function allows you to record desired measurement results into the CV internal memory during Run mode. It also allows you to view and save statistical results while in Run mode or Program mode.

While viewing the real-time graphs that are updated during Run mode, you can change the upper and lower limits or directly reference the NG images in the image archive. This function is useful in many situations, such as checking the optimum tolerance levels before introducing a test run, checking the conditions during inspection, or performing real-time adjustment.

▶ **Note**

- Up to 20,000 pieces of measurement data can be recorded. Increasing the number of items recorded will decrease the overall statistical memory capacity.
- When the amount of data exceeds the number of times a measurement can be recorded, the old data is overwritten so that only the newest 20,000 pieces of data remain.
- Up to 128 items can be recorded at one time. When the measurement items are measuring multiple results, all primary targets become targets for recording.
- Only the measurement results during Run mode are targets for recording. However, measurements that are skipped (unexecuted) under [Execute Condition] are eliminated from the statistical calculations, even if they are performed during Run mode.
- Recorded data is deleted in the following situations.
  - When the power to CV is turned off
  - When the reset communication command is input from the terminal block interface or the console
  - When the program number is switched
  - When the recorded targets are changed
- The statistical data can be viewed during Run mode without affecting image processing, but operations or the screen refresh rate for the [Statistics] menu may become slow depending on the program settings.

Setting the Items to Record (Select Data)

This function sets the measurement window or calculation window that the statistics should be taken from.

▶ **Note**

- Only measurement windows or calculation windows that are already created can be specified.
- Measurement items that are not used for measurement are not used in statistics.
- Changing the currently selected items will cause all of the gathered statisical data to be cleared.
- The recognized text and characters for OCR measurement are not used in statistics.

1 **Select [Statistics] from [Utility] in the menu bar.**
The [Statistics] menu appears.
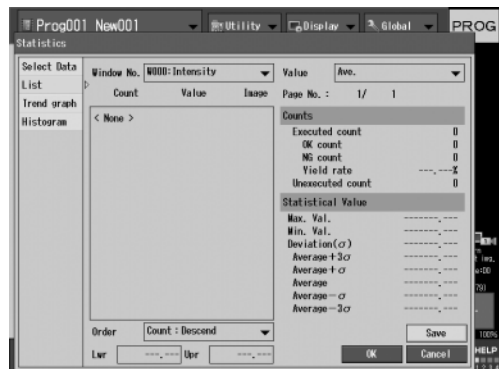
2 **Select [Select Data].**
The setup menu for selecting data is displayed.

3 **Select [Add].**
The [Target item] menu appears.

4 **Select your statistical processing targets and then select [OK].**

▶ **Note**

- Up to 128 items can be recorded at one time.
- When the measurement items contain multiple results, the measurement values of all primary targets become the targets for recording.

5 **If there are other items that you want to add, repeat steps 3 and 4.**

6 **After completing the settings, select [OK].**

Deleting items

Part or all of the measurement items displayed on the setting menu for selecting data can be deleted.

> **Select the items that you want to eliminate and press [Delete].**
>
> You can select multiple items at once.

> **Reference**
>
> • Select [Select all] to select all of the items.
> • Select [Select inv.] to reverse the items that are currently selected.

> **► Note**
>
> Even if the targeted items are deleted in the measurement window, the targeted items for statistics do not change. Remove unnecessary items manually.

Displaying Statistics (List)

This function allows the user to view the statistical results of items that have selected for statistical processing. Not only can the user view statistical values and change measurement tolerances on the fly, but all of the gathered data can be saved to the Compact Flash memory card. Also, by cross-checking the gathered data with images stored in the image archive, you can easily troubleshoot errors on the product line or analyze failed parts.

1 **Select [Statistics] from [Utility] in the menu bar.**
The [Statistics] menu appears.
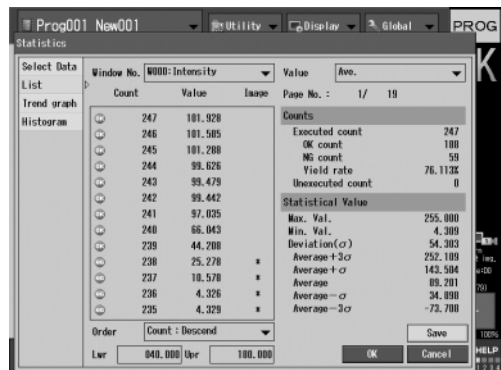
2 **Select [List].**
The list menu appears.

3 **Select the desired window number and measurement value.**
The selected measurement values appear.

> **► Note**
>
> Only the window or measurement values that are selected under [Select Data] are displayed in the pull down menu.

Applying Functions for the CV ([Utility]/[Display])

4 **Move the cursor on the list to view the measurement results for each item.**

- Move the [ENTER] button right and left with the list selected to scroll through the statistical data.
- When an NG occurs during measurement, an NG icon appears to the right side of the [Count] item. If the item is OK or the tolerance is undefined, an OK icon appears.

▊ Reference ▱

If the item cannot be measured, one of the following occurs.

- The value "0" appears in the measurement value field in the list (but the total area for stain measurements appears as "9999999" and the group number and element number for pattern sort measurement appears as "999".).
- The results are reflected in the [Count] field for the judgments of windows that cannot be measured.
- The [Statistical Value] field is eliminated from calculation.

5 **To sort the displayed order by count, value, or presence of an image, select [Order].**
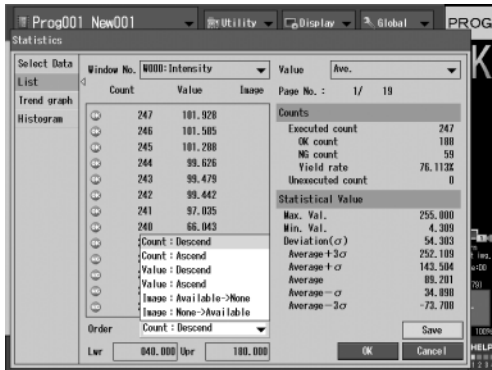
- **Count:(Ascend/Descend):** Displays the list in order (ascending or descending) by number of counts.
- **Value:(Ascend/Descend):** Displays the list in order (ascending or descending) by the size of the value.
- **Image:(Available→None/None→Available):** Displays the list in order giving priority to whether the measurement has a recorded image (ascending or descending).

6 **To display the image captured during measurement, select the [Count] value with a "*" mark displayed.**

- Select a [Count] value with a "*" mark displayed and press the [ENTER] button to display the images saved during data gathering.
- When the image is displayed, moving the [ENTER] button left and right while holding down the [SCREEN] button scrolls through images saved for other measurements.
- When accessing the statistics function during Program mode, pressing the [TRG] button while the image is displayed in test mode performs the measurement again. The measurement windows associated with the test results and processed images can be checked in test mode.
- To exit test mode, press the [ESCAPE] button.

► Note

- When a "*" does not appear in the [Count] columu, there is no image associated with that particular data.
- When continuously saving images during Run mode, the list updates after the images are actually saved, so images may not be saved for measurements with a "*" mark displayed.
- When [Archive Triggers (Min.)] in the [Image Archive] menu (Page 6-15) is "0", "*" does not appear during Run mode.

7 **To adjust the measurement limits, change the values for [Upr] and [Lwr], then select [OK].**

The judgment counts change when the upper and lower limits are changed. Adjust the values while looking at the changes to the yield rate.

▊ Reference ▱

- When changing the tolerance, the judgment counts are displayed with the simulation values for the program. After the [Statistics] menu is closed once and reopened, selecting the items again from the list returns the judgment counts to the actual result history.
- The changes to the tolerance become effective on the trigger input after selecting [OK] in the [List] menu.

► Note

The only upper and lower limit values for the window that can be changed during Run mode are the ones set in [Change window limits] (Page 6-27).

8 **After checking the statistics, select [OK].**

Saving Recorded Results to a Memory Card (Save)

Selecting [Save] with a memory card inserted into the CV saves the currently recorded measurement results or judgment results as text data.
The following two csv text files are saved into the "/cv/stat" folder of the memory card.

- "**[save time]_[save date]_dat.csv**":
  Measurement result (Count/Total Status/
  Statistics target item/Individual judgment)

- "**[save time]_[save date]_idx.csv**":
  Name of measurement item

Reference

- The saved files can be checked or edited using a text editor or spreadsheet software.
- The CV keeps the saved measurement count in memory until it is reset, so unsaved measurement counts can resume when saved again. The upper limit for measurement counts on the CV is 1,000,000,000.

► Note

If the data exceeds the maximum amount of data for statistics, the oldest results are overwritten, so part of the results may not be saved.

Displaying Values Along a Time Axis (Trend graph)

This function is useful when checking how the values change over time during Run mode.
The upper and lower measurement limits can be changed during Run mode while looking at the changes in the yield rate and at the graph that is updated in real time. The graph also displays whether or not an image has been recorded for a specified piece of data, and allows the stored image to be viewed during operation.

1 Select [Statistics] from [Utility] in the menu bar.
The [Statistics] menu appears.
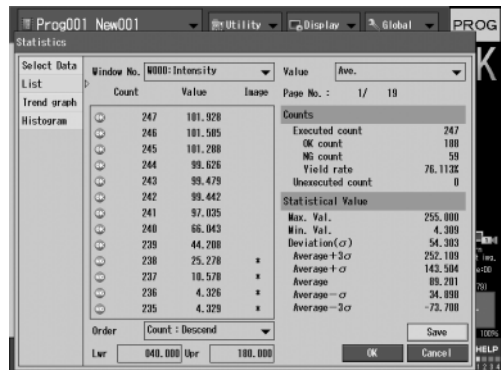
2 Select [Trend graph].
The [Trend graph] menu appears.

Applying Functions for the CV ([Utility]/[Display])
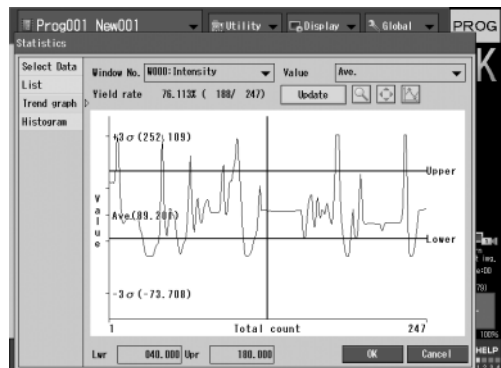
3 **Select the desired window number and measurement value.**

The trend graph for the selected measurement values appears.

► Note

Only the window or measurement values that are selected under [Select Data] are displayed in the pull down menu.

4 **To adjust the measurement limits, change the values for [Upr] and [Lwr], then select [OK].**

Select the bar for upper limit and lower limit, then move the [ENTER] button up and down to adjust the tolerance.

The judgment results and yield rate change when the upper and lower limits are changed. Adjust the values while looking at the changes to the yield rate.

Reference

• When changing the tolerance, the yield rate is displayed with the simulation values for the program. After the [Statistics] menu is closed once and reopened, selecting the items again from the list returns the yield rate to the actual result history.

• The changes to the tolerance become effective on the trigger input after selecting [OK] in the [Trend graph] menu.

► Note

The only upper and lower measurement limits values that can be changed during Run mode are the ones set in [Change window limits] (Page 6-27).

5 **After checking the statistics, select [OK].**

Zooming IN/OUT on the Displayed Trend Graph

During Run mode, select [Stop] to stop updating the screen, and then zoom in or zoom out on the trend graph.

• Select the zoom in icon (magnifying glass) and move it to a location by moving the [ENTER] button. The position of the zoom cursor becomes the center for the zoomed in or zoomed out display.

• Select the move icon to move the range of the zoomed in or zoomed out display to any location.

• Select the fit icon to return to the initial automatically adjusted state in the direction of the Y-axis.

Reference

The initial setting for the display size is automatically adjusted to display the range below.

• X direction: Previous 515 counts

• Y direction: Results ±3σ or the range between the upper and lower limits, whichever is wider

► Note

• After closing the [Trend Graph] menu or after updating the screen in Run mode, the zoom ratio in the Y direction returns to the initial setting (automatically adjusted display).

• The zoom radio in the X direction is maintained until the power is turned off.

Checking the Values on the Trend Graph

Select the perpendicular cursor on the screen and move the [ENTER] button left and right. The count and value at the position of the cursor are displayed.
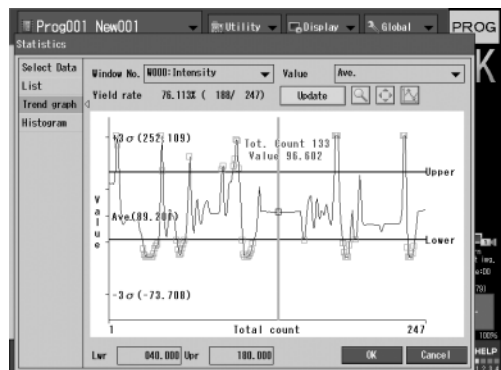
Viewing the Saved Images on the Trend Graph

To check an image saved in the image archive (Page 6-10), select the cursor bar. Squares appear on the trend graph.

- Place the cursor on a location with a square displayed and press the [ENTER] button to display the image saved during measurement.
- When the image is displayed, moving the [ENTER] button left and right while holding down the [SCREEN] button scrolls through images saved for other measurements.
- When accessing the statistics function during Program mode, pressing the [TRG] button while the image is displayed in test mode performs the measurement again. The test results and processed images can be viewed in test mode.
- To exit test mode, press the [ESCAPE] button.

► **Note**

- When a square is not displayed on the trend graph,there is no image associated with that particular data.
- When continuously saving images during Run mode, the list updates after the images are actually saved, so images may not be saved for measurements with a square displayed.
- When [Archive Triggers (Min.)] in the [Image Archive] menu (Page 6-15) is "0", squares do not appear during Run mode.

Reference

Moving the cursor bar while holding down the [FNC] button jumps between locations that have images.

Displaying a Distribution of Values (Histogram)

A distribution of values can be displayed as a histogram. This function allows the user to grasp the overall dispersion of values, so it is useful when adjusting measurement limits.

The upper and lower measurement limits can be changed during Run mode while looking at the changes in the yield rate and at the real time graph. The graph also displays whether or not an image has been recorded for a specified piece of data, and allows the stored image to be viewed during operation.

1 **Select [Statistics] from [Utility] in the menu bar.**
The [Statistics] menu appears.
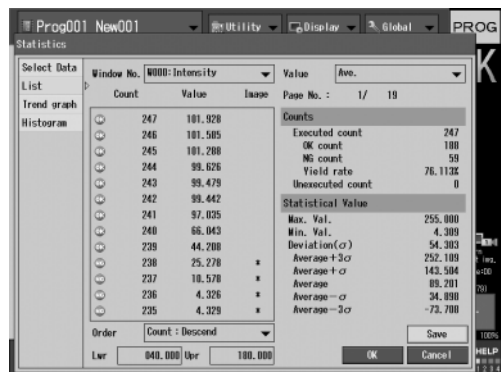
2 **Select [Histogram].**
The [Histogram] menu appears.

Applying Functions for the CV ([Utility]/[Display])
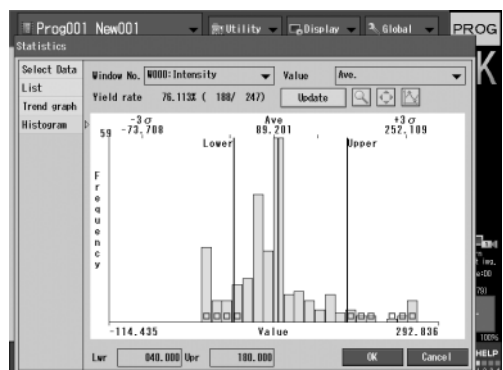
3 **Select the desired window number and measurement value.**

The histrogram for the selected measurement values appears.

► Note

Only the window or measurement values that are selected under [Select Data] are displayed in the pull down menu.

4 **To adjust the measurement limits, change the values for [Upr] and [Lwr], then select [OK].**

Select the bar for upper limit and lower limit, then move the [ENTER] button up and down to adjust the tolerance.

The judgment results and yield rate change when the upper and lower limits are changed. Adjust the values while looking at the changes to the yield rate.

Reference

• When changing the tolerance, the yield rate is displayed with the simulation values for the program. After the [Statistics] menu is closed once and reopened, selecting the items again from the list returns the yield rate to the actual result history.

• The changes to the tolerance become effective on the trigger input after selecting [OK] in the [Histogram] menu.

► Note

The only upper and lower measurement limits that can be changed during Run mode are the ones set in [Change window limits] (Page 6-27).

5 **After checking the statistics, select [OK].**

Zooming IN/OUT on the Displayed Histogram

During Run mode, select [Stop] to stop updating the screen, and then zoom in or zoom out on the trend graph.

• Select the zoom in icon (magnifying glass) and move it to a location by moving the [ENTER] button left and right. The position of the zoom cursor becomes the center for the zoomed in or zoomed out display.

• Select the move icon to move the range of the zoomed in or zoomed out display to any location.

• Select the fit icon to return to the initial automatically adjusted state in the direction of the Y-axis.

Reference

The initial setting for the display size is automatically adjusted to display the range below.

• X direction: Results ±3σ or the range between the upper and lower limits, whichever is wider

• Y direction: Maximum frequency

► Note

After closing the [Histogram] menu or after updating the screen in Run mode, the zoom ratio returns to the initial setting (automatically adjusted display).

Checking the Values on the Histogram

Select the cursor bar on the screen and move the [ENTER] button left and right. The recorded count and value range at the position of the cursor are displayed.
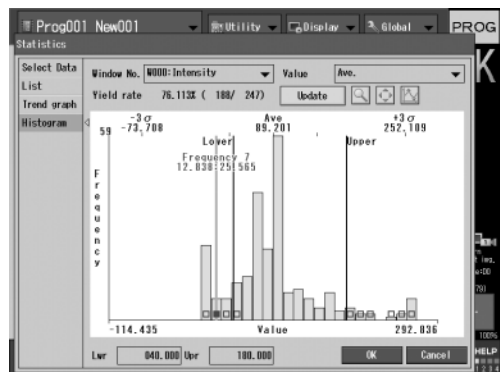
Viewing the Saved Images on the Histogram

To check an image saved in the image archive (Page 6-10), select the cursor bar. Squares appear on the histogram.

- Place the cursor on a location with a square displayed and press the [ENTER] button to display the image saved during measurement.
- When the image is displayed, moving the [ENTER] button left and right while holding down the [SCREEN] button scrolls through images saved for other measurements.
- When accessing the statistics function during Program mode, pressing the [TRG] button while the image is displayed in test mode performs the measurement again. The test results and processed images can be viewed in test mode.
- To exit test mode, press the [ESCAPE] button.

► Note
- When a square is not displayed on the trend graph,there is no image associated with that particular data.
- When continuously saving images during Run mode, the list updates after the images are actually saved, so images may not be saved for measurements with a square displayed.
- When [Archive Triggers (Min.)] in the [Image Archive] menu (Page 6-15) is "0" , squares do not appear during Run mode.

Reference
Moving the cursor bar while holding down the [FNC] button jumps between locations that have images.

Applying Functions for the CV ([Utility]/[Display])

Reviewing the Saved Inspection Images (Image Archive)

The CV can save up to 511 images captured during Run mode in the image buffer memory. You can retrieve the images to re-measure and verify measurement values. This is a useful troubleshooting tool for reviewing failed parts.

► Note

- Images can only be saved to the image archive during Run mode. They cannot be saved during Program mode.
- The image archive is saved in the image buffer of the CV, but the saved images are cleared during the following situations. (Page 8-1).
  - When the power to CV is turned off
  - When RESET is performed
  - When you switch to a different program
  - When a new camera is added to the program
  - When the camera specifications are altered

  If you need to keep the screens, save them to a memory card.
- When [Archive Triggers (Min.)] in the [Image Archive] menu (Page 6-15) is "0", the list does not appear during Run mode.

Reference

- You can retrieve a saved image and use it as the registered screen (Page 6-11).
- Saving images has no effect on the process time.
- When multiple cameras are connected, the images from the multiple cameras are all be saved at once.

Number of Images that can be Saved

The number of images that can be saved is different depending on the camera settings and the combination of connected cameras. The maximum number of images that can be saved into the image buffer memory for the system is as follows.

For CV-3501

	When using a monochrome camera	When using a color camera
Standard mode	Maximum 511 images	Maximum 169 images
1 million pixel mode	Maximum 127 images	Maximum 41 images
2 million pixel mode	Maximum 63 images	Maximum 22 images

For CV-3001

- When using a monochrome camera: Maximum 511 images
- When using a color camera: Maximum 169 images

► Note

The above values represent the maximum values for one connected camera with [Condition] set to [All Images] during Run mode.

Browsing the Saved Images in the Image Archive (List)

1 Select [Image Archive] from [Utility] in the menu bar.

The [Image Archive] menu appears.
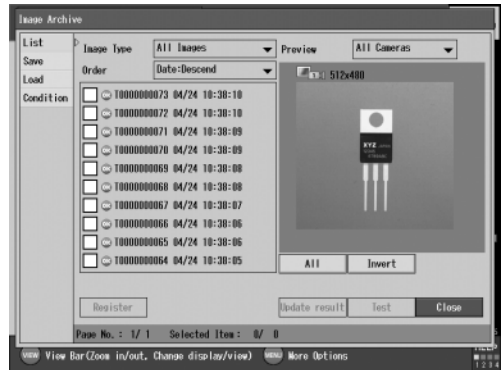
2 Select [List].

The [List] settings appear.
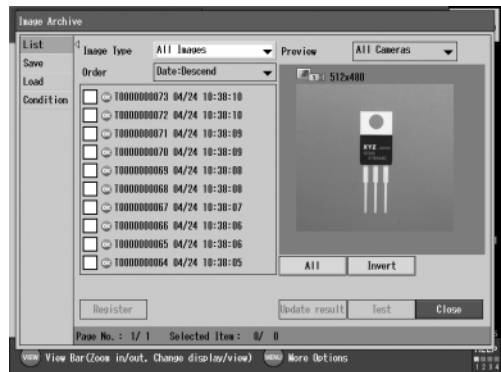
3 To specify a type of image to display, select [Image Type] .

- **[All Images]** (default): Displays images for each measurement.
- **[NG Images]**: Only displays the images when the result is evaluated as NG.
- **[OK Images]**: Only displays the images when the result is evaluated as OK.
- **[Loaded Images]**: Only displays the images loaded from an external device.

4 **To change the display order of the image files, select [Order].**

5 **After reviewing the images, select [Close].**

Registering an Image from the Image Archive

1 **Select an image that you want to save as a registered image, and place a check mark next to it.**

2 **Select [Register].**
The [Register] menu appears.
See "Registering an Image" (Page 4-19) for more details.

► Note

When multiple images are checked in the image list, [Regist. er] cannot be selected.

Using an Image in the Image Archive to Remeasure

You can use the images saved in the image archive (or images loaded from an external device) to retest inspection results.This function is useful when trying to troubleshoot inspection errors or test recent changes to the program.

Retesting the judgment status of multiple images at the same time
Use this function to check the judgment status of multiple images when changes have been made to the program.

1 **Specify multiple images to test from the image list.**

2 **Select [Update results].**
The specified images are remeasured in order, and the total status is displayed to the right of the image list. The detailed measurement values of each image do not appear with [Update results].

Retesting the measurement values of an individual image
Use this function to evaluate the effects of recent program changes or review old measurement data.

1 **Specify an image to test from the image list.**

2 **Select [Test].**
The image will be displayed in full, with all of the measurement data available for review. [TEST] will appear in the upper right corner of the screen.

Reference

The measurement time that appears during the test includes image capture time and transfer time.

3 **When you finish reviewing the test results, press the [ESCAPE] button.**

Retesting the measurement values of multiple images.
This function can be used as an emulator to test the results of multiple images at the same time.

1 **Specify multiple images to test from the image list.**

2 **Select [Test].**
The processed results for the first image are displayed.

3 **While holding down the [SCREEN] button, move the [ENTER] button left and right. Select the image that you want to test and then press the [TRG] button.**
The displayed image is tested.

4 **When you finish reviewing the test results, press the [ESCAPE] button.**

Reference

The results displayed during testing cannot be output to an external device.

Applying Functions for the CV ([Utility]/[Display])

Saving Images Saved in the Image Archive to a Memory Card (Save)

1 Select [Image Archive] from [Utility] in the menu bar.

The [Image Archive] menu appears.
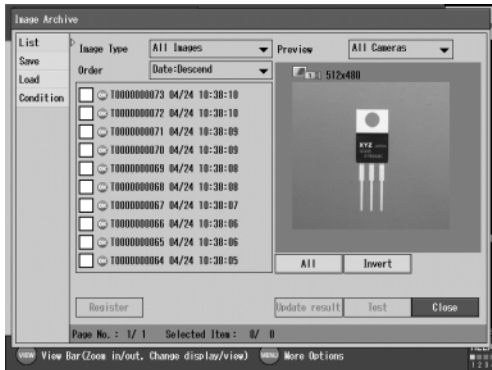
2 Select [Save].

The [Save] settings appear.
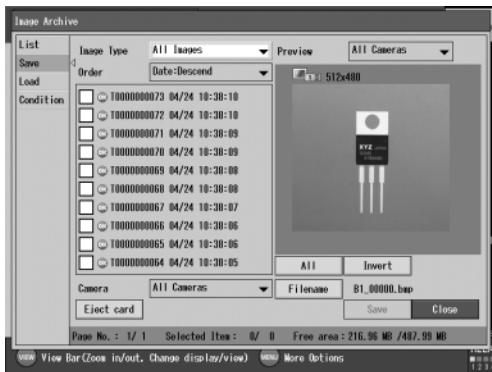
3 To specify a type of image to save, select [Image Type] .

- **[All Images]** (default): Displays images for each measurement.
- **[NG Images]**: Only displays the images when the result is evaluated as NG.
- **[OK Images]**:Only displays the images when the result is evaluated as OK.
- **[Loaded Images]**: Only displays the loaded images.

4 To change the display order of the image files, select [Order].

5 To save images from a specific camera, select [Camera] and select the desired camera.

6 Place a check next to the images that you want to save.

Reference

- Selecting [All] places checks next to all of the folders and files displayed in the list.
- Selecting [Invert] reverses the checked and unchecked states.

7 To save the images, select [Save].

8 After saving is complete, select [Close].

► Note

- Saving can take anywhere from half a minute to several minutes.
- The CV cannot be operated while saving.

Specifying a File Name or Save Locations when Saving Images

The format for file names while saving is "specified header + sequence number". The save location can also be selected on this screen.

Reference

Sequence numbers are assigned in order from the top image to the bottom image depending on the display order.

1 **Select [Filename].**

The [Select filename] menu appears.
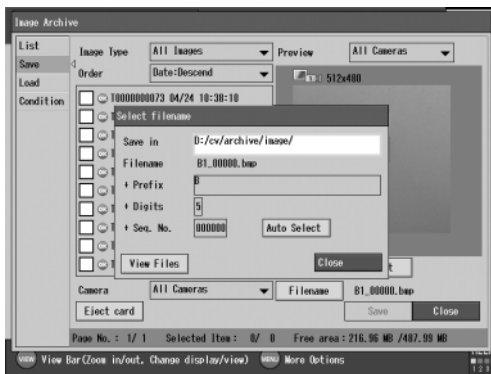
2 **Select [Save in] to select the save location for the files.**

3 **Select [Prefix] and set a character string for the header that appears before the sequence numbers (Default: "B").**

4 **Select [Digits] and set the number of digits for the sequence number (Default: 5).**

5 **Select [Seq. No.] to set the first number for the image sequence.**
- Selecting [Auto Select] automatically sets a value for [Seq. No.] so that the files previously saved in the save location are not overwritten.
- If the set value for [Seq. No.] duplicates a file name, that file is overwritten.

6 **Select [Close].**

The system returns to the [Image Archive] menu.

Ejecting the Memory Card

To eject the memory card, press the eject button near the memory card slot on the CV.

► Note
- To prevent data or the memory card from being corrupted, make sure to perform the following steps.
- Ejecting the memory card without following the steps below or turning off the power while accessing the memory card terminates the file save and can corrupt the data or memory card.

1 **In the bottom left of the [Save] menu, select [Eject card].**

The confirmation menu appears.

2 **Select [Close].**

When the access lamp goes out, the memory card can be ejected.

3 **Press the eject button near the memory card slot on the CV to eject the memory card.**

Applying Functions for the CV ([Utility]/[Display])

Load an Image to the Image Archive from the Memory Card (Load)

► **Note**

Images cannot be loaded if no inspection windows have been created for the loaded image camera.

1 **Select [Image Archive] from [Utility] in the menu bar.**

The [Image Archive] menu appears.
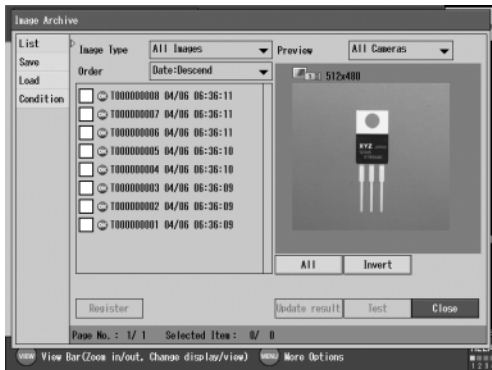
2 **Select [Load].**

The [Load] settings appear.
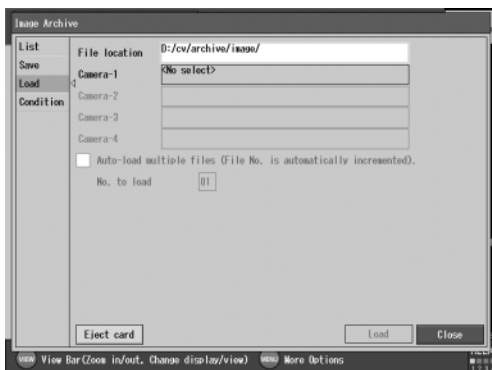
3 **Select [File location] to specify the save location for the images you want to read.**

4 **Select an image to load .**

When an image is loaded from the memory card, it will only address the camera number from which it was originally saved. (ex. Camera 1 images will reference camera 1 when loaded back into the system).

Reference

To load a group of sequentially numbered image files that follow the selected file into the image archive, place a check next to [Auto-load multiple files (File No. is automatically incremented).] and select the number of sequentially numbered images to load in [No. to load]. Sequentially numbered images are recognized only if they have file names that follow this format: "(character string)(camera number to read from)_(sequential number).bmp". The character string can be any string between 0 to 32 letters long. The camera number can be from 1 to 4, and the sequential number can be from 0 to 1000000000.
Examples: ref1_001.bmp, 3_5.bmp, image2_5000.bmp

5 **Select [Load].**

The image or images are loaded into the image archive based on the selected settings.

6 **After loading is complete, select [Close].**

Specifying the Save Conditions for Archived Images(Condition)

1 **Select [Image Archive] from [Utility] in the menu bar.**

The [Image Archive] menu appears.

2 **Select [Condition].**

The [Condition] settings and the current settings for the number of archive triggers appear.
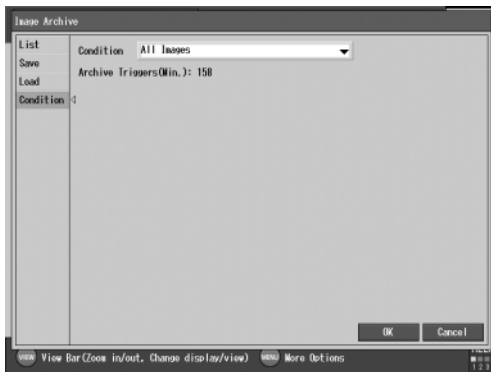
Reference

The number of Archive Triggers indicates the minimum number of images that will be stored in the Image Archive.

• The number of archive triggers changes depending on how many cameras are connected and the type of camera that is connected.

• Depending on the status of the CV, a number higher than the displayed number of archive triggers may be saved in the buffer.

3 **Select [Condition], and then select the type of image to save.**

• **[All Images]** (default): Saves images for each measurement.

• **[NG Images]**: Saves images only when the result is evaluated as NG.

• **[OK Images]**: Saves images only when the result is evaluated as OK.

Reference

• Total status (OR) is used as the judgment for condition in the image archive (Page 4-279).

• When multiple cameras are connected, if total status (OR) is judged as NG, the images are saved from all the cameras.

4 **After completing the settings, select [OK].**

► **Note**

Save (Page 4-303) after the [Condition] is set. [Condition] is saved as part of the program number.

Applying Functions for the CV ([Utility]/[Display])

Viewing Files in the Internal Memory and Memory Cards (View Files)

In the [View Files] menu, you can view files saved into the internal memory or memory cards. Verification or initialization of the internal memory or memory cards can also be performed.

1 **Select [View Files] from [Utility] in the menu bar.**
The [View Files] menu appears.
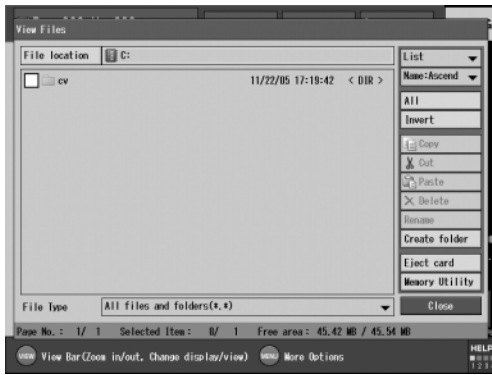
2 **After file viewing is complete, select [Close].**

Viewing Saved Files in the Internal Memory or Memory Cards

1 **From the [View Files] menu, select [File location].**
The icons appear that represent the internal memory and memory card. The internal memory is represented as the C drive, while the memory card is the D drive.
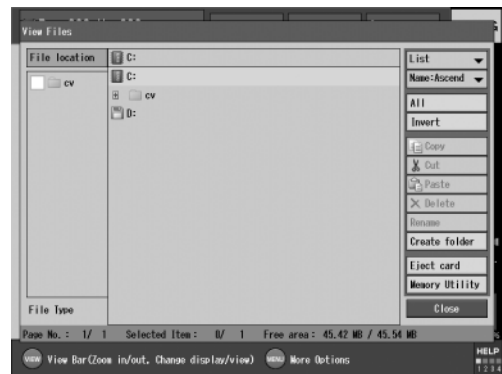
2 **Select the drive or folder containing the data you want to check and move the [ENTER] button down or right.**
The folders located in the drive or folder are expanded.
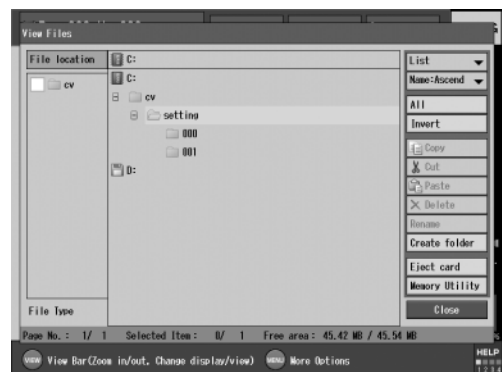
Reference
Continuing to move the [ENTER] button right opens lower level folders one after another.

3 **To view files within folders or to check a list of folders, highlight the desired folder and press the [ENTER] button.**

Files or folders within the folder are displayed as a list.
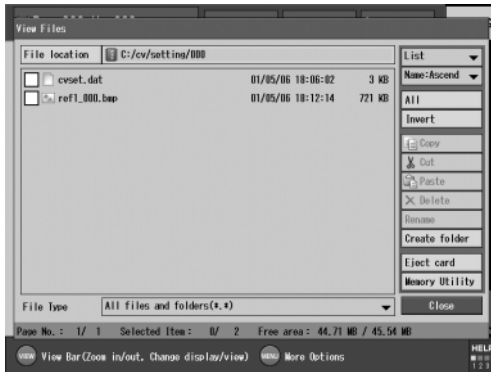
Switching between List Display Methods

The display for the list of files and folders can be switched between list and preview displays.

To switch the display method, use the display menu on the right side of the [View Files] screen.

List
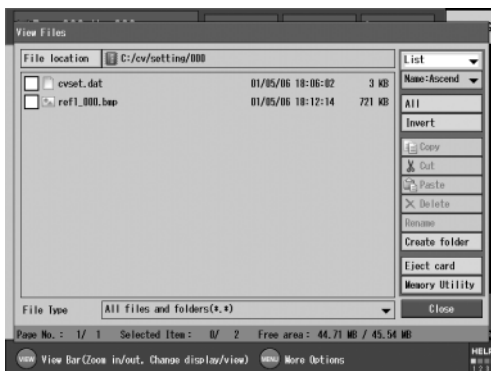
Preview

Reference

• Preview display will show any camera image that has the following attributes: 1600 x 1200, 1024 x 960, or 512 x 480 pixels, 24-bit color or 8-bit grayscale, BMP or JPEG format images.

• Screen capture images cannot be displayed.

Switching Display Order

The display order for the list of files and folders can be switched between ascending and descending order by file name, save time, or file size.

To switch the display order, use the display menu on the right side of the [View Files] screen.

Applying Functions for the CV ([Utility]/[Display])

Handling Folders and Files

The folders and files in the internal memory or the memory card can be handled just like folders and files on a computer.

► **Note**

- The CV may not be able to read saved data correctly if save folders are moved or if the names of folders or files are changed.
- After handling program data or registered image files, run [Update base values] (Page 6-30).

Duplicating Folders and Files

This procedure will save duplicated folders or files in a different location while leaving the original folders and files in their original locations.

1 Select the folders or files to duplicate on the list screen and apply check marks.
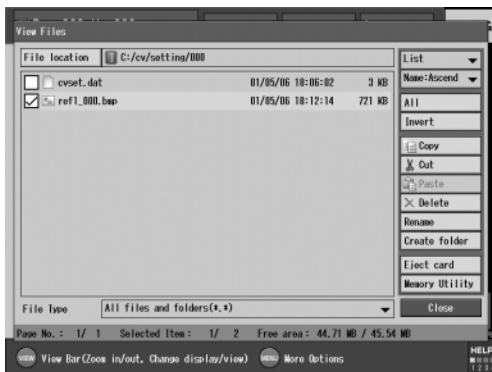
► **Reference**

- Selecting [All] places checks next to all of the folders and files displayed in the list.
- Selecting [Invert] reverses the checked and unchecked states.

2 Select [Copy].
The confirmation menu appears.

3 Select [Close].

4 In [File location], select a location to save the duplicated folders and files to.
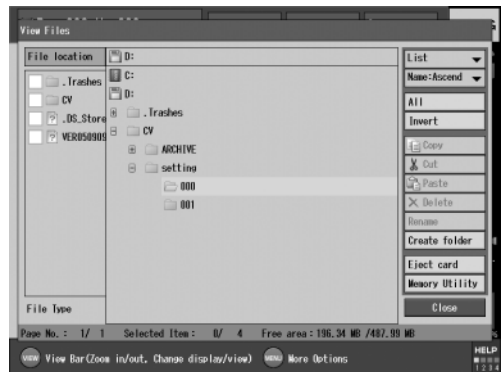
5 Press the [ENTER] button to display the save location in the list screen.

6 Select [Paste].
The confirmation menu appears.

7 Select [OK].
The duplicated folders and files selected in step 1 are saved and added to the list screen.

► **Note**

- Copying may take half a minute to several minutes, depending on the pasted data.
- The CV cannot be operated while copying.
- Do not turn off power to the CV or eject the memory card while copying. The data or memory card may be corrupted.

Moving Folders and Files

This procedure moves folders or files to a different location while deleting the original folders and files.

1 **Select the folders or files to move on the list screen and apply check marks.**

> **Reference**
> • Selecting [All] places checks next to all of the folders and files displayed in the list.
> • Selecting [Invert] reverses the checked and unchecked states.

2 **Select [Cut].**
The confirmation menu appears.

3 **Select [Close].**

4 **In [File location], select a location to save the duplicated folders and files to.**

5 **Press the [ENTER] button to display the list screen.**

6 **Select [Paste].**
The confirmation menu appears.

7 **Select [OK].**
The folders or files selected in step 1 are moved.

Deleting Folders and Files

► **Note**
Once folders or files are deleted, they cannot be restored.

1 **Select the folders or files to delete on the list screen and apply check marks.**

> **Reference**
> • Selecting [All] places checks next to all of the folders and files displayed in the list.
> • Selecting [Invert] reverses the checked and unchecked states.

2 **Select [Delete].**
The confirmation menu appears.

3 **Select [OK].**

4 **Select [Close].**

Renaming Folders and Files

1 **Select one folder or file to rename on the list screen and apply check marks.**

2 **Select [Rename].**
The [Rename] menu appears.

3 **Change the name of the folder or file and select [OK].**
See "Inputting Characters" (Page 3-7) for more details about entering characters.
The confirmation menu appears.

4 **Select [Close].**

Applying Functions for the CV ([Utility]/[Display])

Creating New Folders

1 **In [File location], select a location where you want to create a folder.**

2 **Press the [ENTER] button to display the location list.**

3 **Select [Create folder].**
The [Create folder] menu appears.

4 **Enter the name of the folder and select [OK].**
See "Inputting Characters" (Page 3-7) for more details about entering characters.
The confirmation menu appears.

5 **Select [Close].**

Ejecting a Memory Card (Eject card)

To eject the memory card, press the eject button near the memory card slot on the CV.

► **Note**
• To prevent data or the memory card from being corrupted, make sure to perform the following steps.
• Ejecting the memory card without following the steps below or turning off the power while accessing the memory card terminates the file save and can corrupt the data or memory card.

1 **In the bottom left of the [Save] menu, select [Eject card].**
The confirmation menu appears.

2 **Select [Close].**
When the access lamp goes out, the memory card can be ejected.

3 **Press the eject button near the memory card slot on the CV to eject the memory card.**

Verifying or Initializing the Internal Memory or Memory Card (Memory Utility)

Verifying the Internal Memory or Memory Card (Check)

When an error occurs in the internal memory or memory card, it may cause other problems, such as inability to load files or loss of files. If these types of problems occur, the Check function can be used to remove errors.

1 From the [View Files] menu, select [Memory Utility].

The [Memory Utility] menu appears.
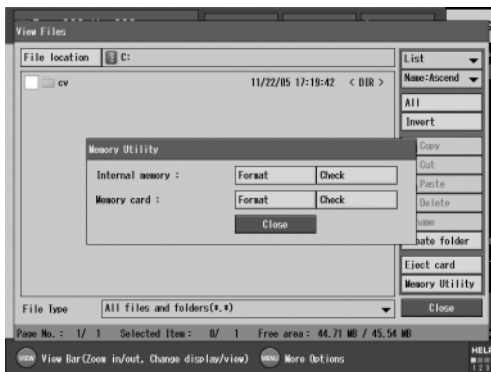
2 Select [Check] for [Internal memory] or [Memory card].

The confirmation menu appears.

3 Select [OK].

After the check is complete, the "Check is complete" verification message appears.

4 Select [Close].

Reference

See "Error Messages" (Page 13-21) when abnormal messages are displayed after Check.

Initializing the Internal Memory or Memory Card (Format)

► **Note**

Performing initialization (Format) erases all of the saved data. Deleted data cannot be recovered. Perform initialization after saving copies of data from the internal memory or memory card onto a computer.

1 From the [View Files] menu, select [Memory Utility].

The [Memory Utility] menu appears.
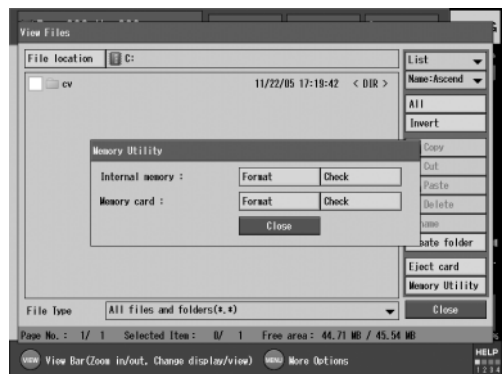
2 Select [Format] for [Internal memory] or [Memory card].

The confirmation menu appears.

3 Select [OK].

After initialization, the confirmation menu appears.

4 Select [Close].

Applying Functions for the CV (Utility/(Display))

Verifying the Connection Status of Input/Output Signals (I/O Diagnostic)

You can check the connection status of incoming and outgoing signals that pass through the I/O connector (parallel I/O interface and terminal block interface) of the CV during Run mode or Program mode. This feature comes in very handy when verifying the connection status of the CV terminals hooked up to external equipment.

► **Note**

This function does not include FLASH1 or FLASH2 outputs.

1 **Select [I/O Diagnostic] from [Utility] in the menu bar.**

The [I/O Diagnostic] menu appears.
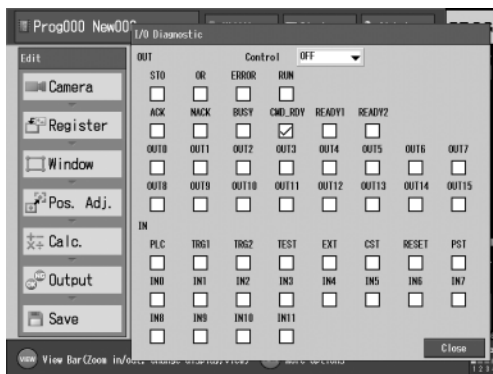
■ **Reference**

The [I/O Diagnostic] menu can also be opened from the function menu (Page 3-12) displayed by pressing the [FNC] button.

2 **Verify I/O wiring.**

Output terminals are shown in the [OUT] field at the top of the screen, while the input terminals are shown in the [IN] field at the bottom of the screen.

- The status display for each terminal is updated in real time in response to the incoming and outgoing signals, and [ON] (shorted) terminals are check-marked.
- To forcibly turn on specific output terminals, use [Control] to select [ON], and place check marks next to the terminals you want to turn on (only during Program mode).

■ **Reference**

In Program mode, data is not output on some of the terminals. To check whether data is output on the terminal, switch to Run mode or use the [Control] function.

3 **Select [Close].**

Verifying the RS-232C Communication Status (RS-232C Diagnostic)

You can check the communication status of incoming and outgoing signals that pass through the RS-232C connector of the CV during Run mode or Program mode. This feature comes in very handy when verifying the communication status of the CV's terminals hooked up to external equipment. This function can also save the most recent 10 kB of the communication log.

1 **Select [RS-232C Diagnostic] from [Utility] in the menu bar.**

The [RS-232 Diagnostic] menu appears.

■ **Reference**

The [I/O Diagnostic] menu can also be opened from the function menu (Page 3-12) displayed by pressing the [FNC] button.

2 **Verify the communication status.**

The current communication data is updated in response to the incoming and outgoing commands.

- The character "<" appears at the beginning of output data from the CV, while the character ">" appears at the beginning of input data to the CV.
- Characters other than ASCII code are displayed as "hexadecimal".

■ **Reference**

In Program mode, the only communication outputs that occur are responses to commands input from external devices. To check whether data is output on the terminal, switch to Run mode.

3 **Perform the following operations when necessary.**

- **Momentarily stop updating the displayed data on the screen:** Select [Stop].
- **Clear the communication log:** Select [Clear].
- **Save the communication log to a memory card:** Select [Save] and a file with the name "L(save time)_(save date).log" is saved in the folder "/CV".

4 **Select [Close].**

Creating Menus that Only Display Necessary Items (Activate Custom Menu)

You can create up to twenty menus that only contain items necessary for your measurement (custom menus). When used in conjunction with password and user level settings (Page 7-12), a system administrator can make the custom menu the only menu available to operators.

Example of custom menu
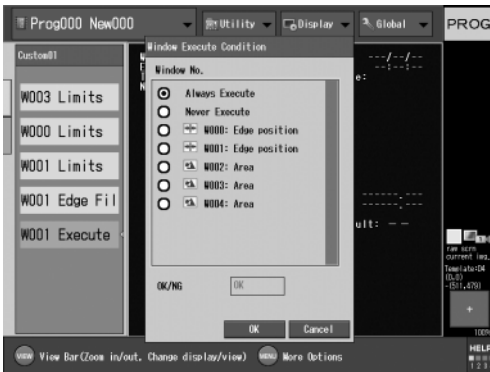
Menu Items that can be Registered in Custom Menus

- Camera (Page 4-6)
- Register (Page 4-18)
- Window (Page 4-20)
  Items for copying, adding, or deleting measurement windows cannot be registered.
- Pos. Adj. (Page 4-249)
- Calc. (Page 4-253)
  Items for copying, adding, or deleting calculation windows cannot be registered.
- Output (Page 4-278)
- Display Menu (Page 6-1)
- Global
  The following items cannot be registered: Startup mode, Run Screen update mode, Language, Password, Unlock Program No., User level settings, Operator Mode Security Level, and System Information.

The following settings cannot be registered.
- Add/Edit/Del setting for the Program No.
- Settings located under the [Utility] menu

Number of Menu Items that can be Registered in Custom Menus

Up to twenty items can be registered in one custom menu. Only seven items can be displayed in the custom menu at one time. If eight or more items are registered, scroll to display the additional menu items.

Applying Functions for the CV ([Utility]/[Display])

Registering Menu Items

1 **Display the menu item you want to register in the custom menu.**
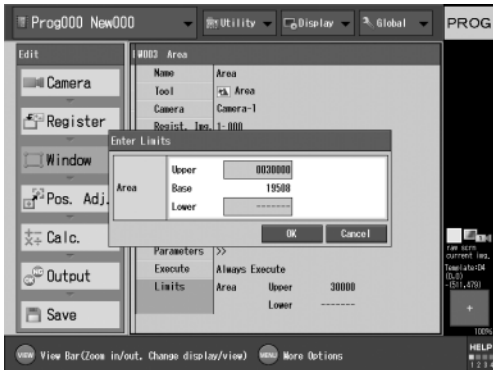
(An example showing [Limits] for W004)

2 **Press the [FNC] button.**

The [Function] menu appears.

3 **Select [Open] under [Activate Custom Menu].**

The [Activate Custom Menu] appears.
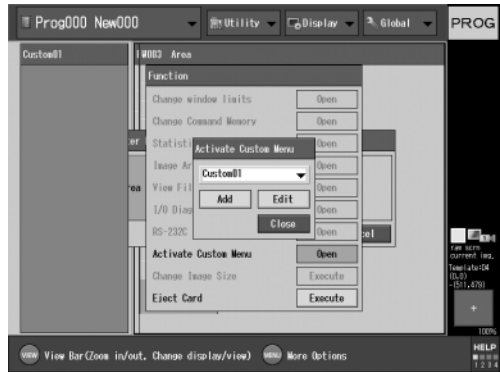
4 **Select a custom menu number to save the menu item to.**
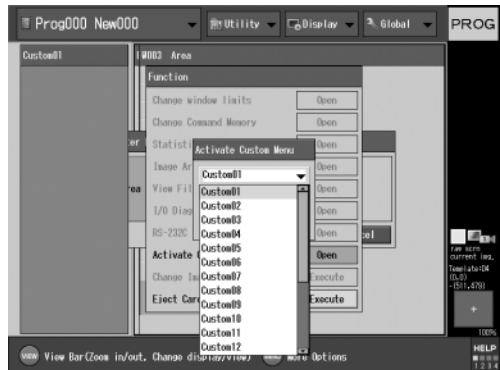
5 **Select [Add].**

The custom menu field appears in the left hand side of the screen and the [Add custom menu] menu appears.
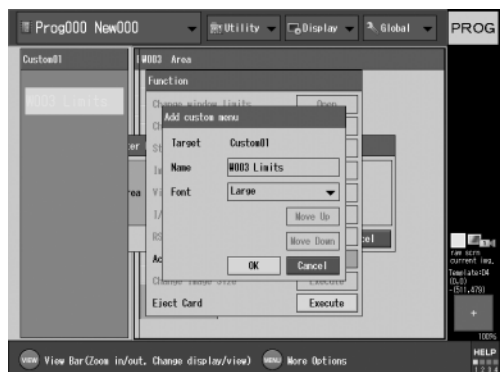
6 Change the name of the menu item as desired and then press [OK].

- **Name:** Automatically add a name based on the screen when the [FNC] button was pressed, or change to an easily recognizable name.
- **Font:** Select between [Large] and [Small] for the size of the item names displayed in the custom menu.

7 Select [Close].

The selected item is registered in the custom menu. When a custom menu is registered, the menu field appears on the left side of the screen, indicating that a custom menu has been registered.
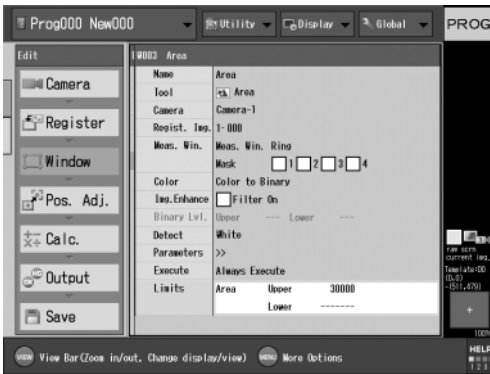
To register other items

Repeat the operations from step 1 to step 7.

Displaying a custom menu

1 Place the cursor on the Programming Menu.
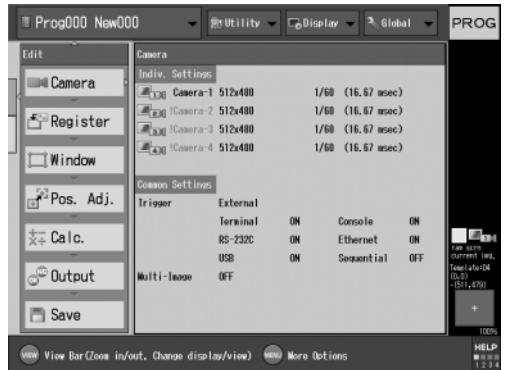
2 Move the [ENTER] button to the left.

The menu field slides to the left side of the screen and is displayed.
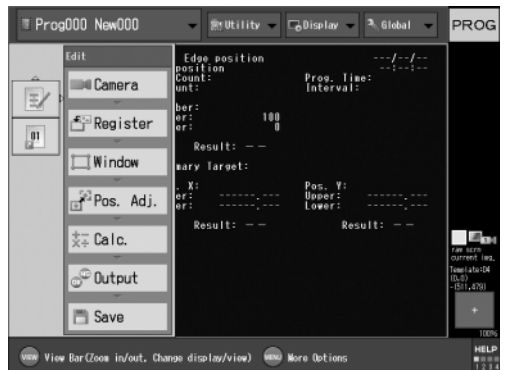
Reference

When there are no custom menus registered, this menu field does not appear.

Applying Functions for the CV ([Utility]/[Display])

3 **Select the icon for the custom menu you want to display.**

The selected custom menu slides and appears. It can then be operated just like the normal program menu.

Reference

The menu icon displayed at the very top of the menu field represents the normal program menu. The displayed icons with the menu numbers 1 through 20 are the custom menu icons.

Returning to Normal Program Menu

From the menu field, select the normal program menu icon ▤ .

Displaying Only the Custom Menu

In [Operator Mode Security Lvl] (Page 7-14), change [Programming Menu] to [Disable] to change the user mode.

Reference

When the Programming Menu is disabled, the custom menu with the smallest menu number is displayed instead.

Changing the Window Limits in Run Mode
(Run Mode Limit Change)

By default, the CV window limits are protected from being overwritten during operation. You can remove this protection and allow the tolerance (upper limit value and lower limit value) settings to be changed.

► **Note**

- Changing the tolerance value can greatly affect the evaluation of the OK/NG status. Proceed with caution if you need to change tolerance settings.
- Tolerance values that use calculation reference are not changed during Run mode.

Reference

Tolerance can be changed by using the [Statistics] menu (page 6-2) during Run mode or by using windows that permit changes to tolerance in the [Run Mode Limit Change] menu (excluding judged text in OCR measurement).

1 Select [Run Mode Limit Change] from [Utility] in the menu bar.
The [Select limits available for change in Run Mode] menu appears.

2 Select the window for which you want to allow limits to be changed in RUN mode by applying a checkmark in the corresponding checkbox.

3 Select [OK].

To change limits during operation

1 Press the [FNC] button in Run mode.
The [Function] menu appears.
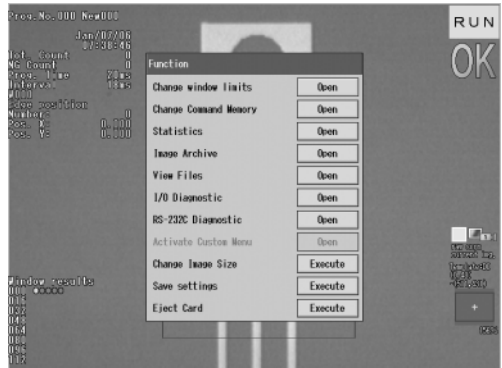
2 Select [Change window limits].
The [Change window limits] menu appears.
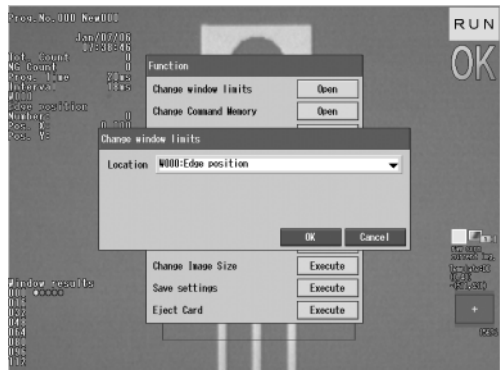
3 Select the window where you want to change the limits and press [OK].
The [Limits] menu appears.

4 After changing the limits, select [OK].
Selecting [Update] instead of [OK] performs measurement using the new limit values and updates the background results in Run mode.

5 Select [OK].
The system returns to Run mode.

Reference

The updated limit value will appear and take effect when the next trigger is input to the controller.

Applying Functions for the CV ((Utility)/(Display))

Changing Command Memory Settings
(Configure Command Memory)

With the default state, the command memory cannot be changed from the remote control console during Run mode. You can remove this protection and allow the command memory to be changed even during Run mode.

Reference

See the next page for more details about using the command memory.

1 **Select [Configure Command Memory] from [Utility] in the menu bar.**

The [Configure Command Memory] menu appears.
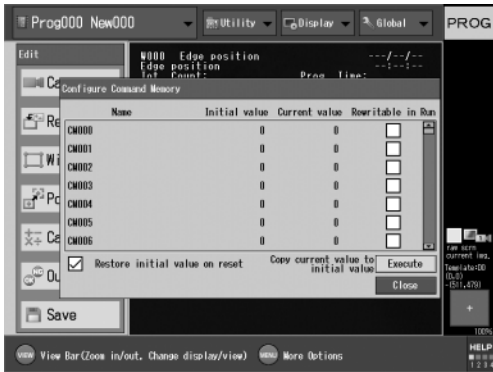
2 **Select the command memory settings that you want to change.**

The setup screen for the selected command memory is displayed.

3 **Enter the desired settings.**

- **Name:** The maximum number of characters for the name of the command memory can be set up to 16 characters. (Default: None)
- **Initial value:** Sets the current command memory value. (Range: -2147483648 to 2147483647, Default: 0)
- **Current value:** Sets the current command memory value. (Range: -2147483648 to 2147483647, Default: 0)
- **Upper limit:** Sets the upper limit for input on the [Change Command Memory] menu from the Function menu. (Range: -2147483648 to 2147483647, Default: 1000000000)
- **Lower limit:** Sets the lower limit for input on the [Change Command Memory] menu from the Function menu. (Range: -2147483648 to 2147483647, Default: -1000000000)
- **Rewritable in Run:** Place a check mark to permit changes in the [Change Command Memory] menu.

4 **Select [OK].**

5 **Select [Make current settings default] to use all of the current command memory settings as the initial values for command memory.**

This is useful when you want to adjust the command memory values and then use those values as the initial values the next time the system is started up.

► Note

- This function does not automatically save the newest command memory values as the initial values. Perform this function manually when necessary.
- To save the updated values after changing command memory, normal save operations (page 4-303) must be performed separately.

6 **Select [OK].**

The system returns to Run mode.

Reference

The updated limit value will appear and take effect when the next trigger is input to the controller.

7 **Select [OK].**

What is Command Memory?

Command memory temporarily stores values input from external device commands or from the remote control console. Up to 128 spaces, CM000 to CM127 can be used for command memory.

The value stored in command memory can be referenced in a calculation window (Page 4-253), making the value useful for the following purposes.

Directly referencing a command memory value in an equation and controlling the calculation result

This example shows how to calculate the command memory value.

Example:

Use the communication command [MW] (Page 9-27) from the computer to create a variable offset for a measurement value.

PC

Write the offset value

CM000：100

C000:CM000 + measurement value
(The offset value 100 is added to the measurement value, and the total value is output)
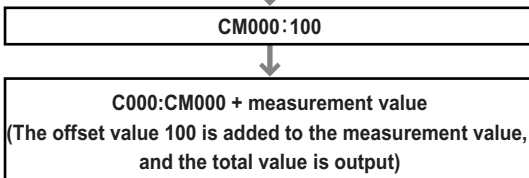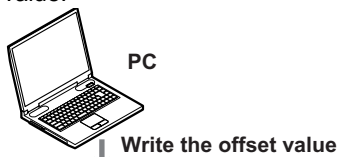
Setting a value from an external device and controlling the referenced results

Set a measurement window to reference the command memory value (through the calculation window). This allows you to control the window limits and other window parameters using an external device.

Example:

• Change the limits for multiple windows at the same time with the remote control console.

• Finely adjust the stain level settings with the remote control console during Run mode.

• Change the position and size of [Auto-Adj Rect] and [Auto-Adj Circle] with a PLC.

Remote control console

Manually change the command memory data

CM000：100

C000：CM000

| W000 Tolerance upper limit | W001 Tolerance upper limit | W002 Tolerance upper limit |

The value of CM000 (100) is substituted for the tolerance upper limit of each window.
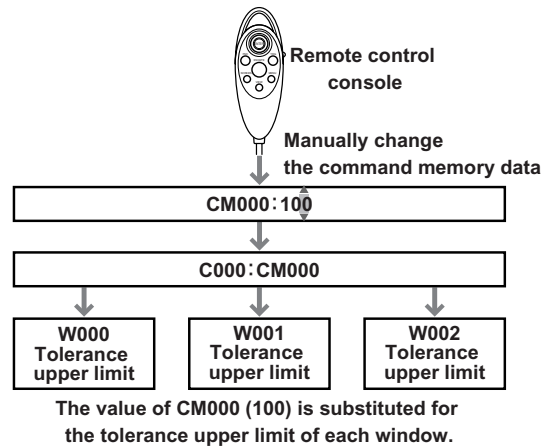
Setting a value from an external device and controlling the execute conditions

Controls each type of parameter needed for judgment from the external device. Not only that, but more complex controls become possible by combining the execute condition (Page 4-247) and a calculation referencing the command memory.

Example:

Remotely activate/deactivate different processing windows to match a given inspection target.

PLC

Write the value with a communication command

CM000：1

C000：CM000 (NG with 0)	C000：CM000 (OK with 1)	C000：CM000 (NG with 2)
✗NG	**✓OK**	**✗NG**
W000 Intensity measuremen	W001 Area	W002 Pattern search

▨ **Inspection executed**
☐ **Inspection not executed**
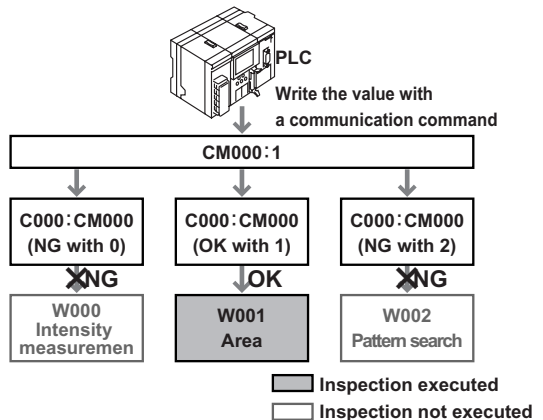
Reference

The output data can also be set to only output in the executed window.

Applying Functions for the CV ([Utility]/[Display])

Precautions when Using Command Memory

Saving Command Memory Values

- After the power is turned off, starting up again returns the values to their initial value.
- To return to the initial values when resetting or switching the program numbers, place a check mark next to [Restore initial value on reset] in the [Configure Command Memory] menu. (Page 6-28)

Entering a Value

The command memory value can be changed by the following methods.

- Change with the communication command (Page 9-27) or the I/O command (Page 11-16)
- Change with the remote control console in Run mode (only when a check mark is placed next to [Rewritable in Run] (Page 6-29))
- Change with the remote control console in Program mode (Command memory settings) (Page 6-29)

Reference

The command memory value cannot be changed from the calculation window.

Update Timing for the Command Memory Values

- The value for command memory is reflected on the internal processing when image processing starts after image transfer is complete.
- The updated command memory value will take effect after the next trigger is input to the controller.

Updating Base Values from the Registered Image (Update base values)

For calculation and position adjustment, the CV refers to results taken from the registered image as base values. When only replacing the registered image with [View Files] and not changing the set values, the base value for the replaced registered image must be updated.

By using the [Update base values] function, the base value can be recalculated and updated for the current registered image.

► Note

It may take several minutes for the updating to finish.

1 **Select [Update base values] from [Utility] in the menu bar.**
The confirmation menu appears.

2 **Select [OK] to recalculate.**
Recalculation starts.
After recalculation is complete, a verification screen is displayed.

3 **Select [Close].**

Creating Templates for Run Mode
(Configure Image Options)

Press the [SCREEN] button on the console to switch the templates in the following order.

- D0: Raw screen
- D1: Processing screen for the selected window
- D2: Processing screen for all windows
- D3: Contrast view

In addition to these templates, original templates can be created for D4 through D9. The settings can also be changed so that only specified templates are displayed when the [SCREEN] button is pressed.

Adding/Deleting Templates

Press the [SCREEN] button on the remote control console to scroll through templates. The default settings include four templates, D0 to D3. Original templates can also be created for templates D4 to D9.

The templates allow you to configure the layout of the screen images and display custom information on the screen.

▶ **Note**

The initial templates D0 through D3 cannot be changed or deleted.

Adding Templates

1 **Select [Configure Image Options] from [Display] in the menu bar.**

2 **Select [Add/Copy/Del] from the [Configure Template] menu.**
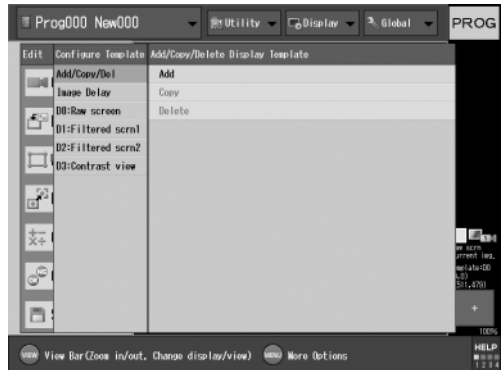
3 **Select [Add].**
The [Add Display Template] menu appears.
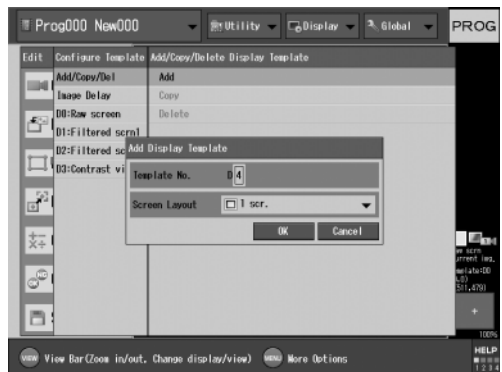
4 **Select a number from 4 to 9 in [Template No.].**

5 **Select a screen layout display in [Screen Layout] and press [OK].**
The template specified in step 4 is added.
See "Selecting the Contents of Each Screen" (Page 6-35) for details on adding settings.

Applying Functions for the CV ([Utility]/[Display])

Layouts Available for Templates

There are a total of nine types.

- ☐ 1 scr.: One image is displayed.
- ☐ 2 scr. (EQUAL): Two images of the same size are displayed side-by-side.
- ☐ 2 scr. (VERTICAL): Two images that are half of the display size in the X-direction are displayed side by side.
- ☐ 2 scr. (HORIZONTAL): Two images that are half of the display size in the Y-direction are displayed one above the other.
- ☐ 4 scr. (EQUAL): Four images of the same size are displayed in a tiled formation.
- ☐ 4 scr. (VERTICAL): One large image is displayed with three smaller images lined up to the right.
- ☐ 4 scr. (HORIZONTAL): One large image is displayed with three smaller images lined up beneath.
- ☐ 5 scr. (VERTICAL): One large image is displayed with four smaller images lined up to the right.
- ☐ 5 scr. (HORIZONTAL): One large image is displayed with four smaller images lined up beneath.

Reference

The screen layout method can be changed afterwards (Page 6-34). Note that changing the screen layout method initializes the template settings.

Copying and Using Other Templates

The configuration registered for a template can be copied to another template.

► Note

Copying the configuration overwrites the registered settings in the new template.

1 Select [Configure Image Options] from [Display] in the menu bar.

2 Select [Add/Copy/Del] from the [Configure Template] menu.

3 Select [Copy].
The [Copy Display Template] menu appears.

4 Select [Copy from:] and select the template containing the settings that you want to copy to another template.
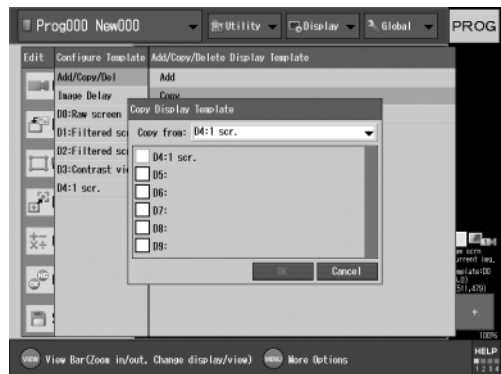
5 Select [Destination] and select the template where you want to use the copied settings.
The confirmation menu appears.

6 Select [OK].
The settings are copied.

7 Select [Close].
To stop copying, select [Close] instead of [OK] in step 6.

Deleting Templates

Registered templates can be deleted.

► **Note**
- The initial templates D0 through D3 cannot be changed or deleted.
- Deleting a template deletes all of the registered data in that template (including screen layout method or displayed information in each screen).

1 **Select [Configure Image Options] from [Display] in the menu bar.**

2 **Select [Add/Copy/Del] from the [Configure Template] menu.**

3 **Select [Delete].**
The [Delete Display Template] menu appears.

4 **Select [Delete] and place a check mark next to the template that you want to delete.**
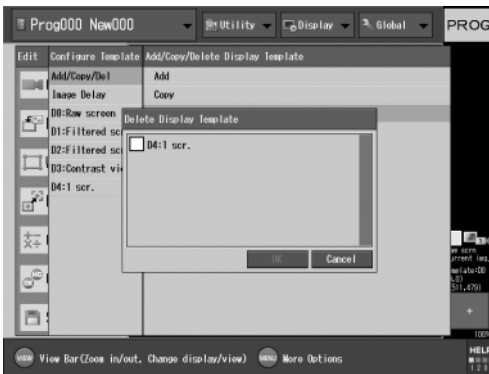
5 **Select [OK].**
The confirmation menu appears.

6 **Select [OK].**
The template selected in step 4 is deleted.

Activating/Deactivating Templates

Templates are switched each time the [SCREEN] button is pressed, but you can change the settings to not display certain templates. Take the example where there are templates registered in D0 through D7 and templates D3, D4, and D6 are deactivated. In this situation, every time the [SCREEN] button is pressed, the templates are changed in the order:
D0 D1 D2 D5 D7 D0
Deactivating unused templates and activating only those templates that apply to your application will help simplify the user interface.

1 **Select [Configure Image Options] from [Display] in the menu bar.**

2 **Select the template that you want to activate or deactivate from the [Configure Template] menu.**
The [Select Display Template] menu appears for the selected template.
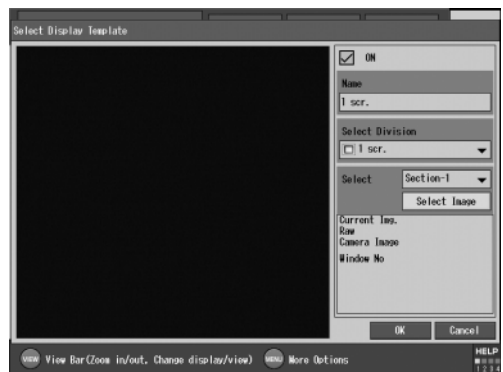
3 **To deactivate a template, uncheck the box next to [ON].**
To activate a template, place a check mark in the box next to [ON].

4 **Select [OK].**

Applying Functions for the CV ([Utility]/[Display])

Changing Screen Layout Method

► **Note**

Changing the screen layout initializes the template settings.

1 **Select [Configure Image Options] from [Display] in the menu bar.**

2 **Select the template to be changed from the [Configure Template] menu.**
The [Select Display Template] menu appears for the selected template.
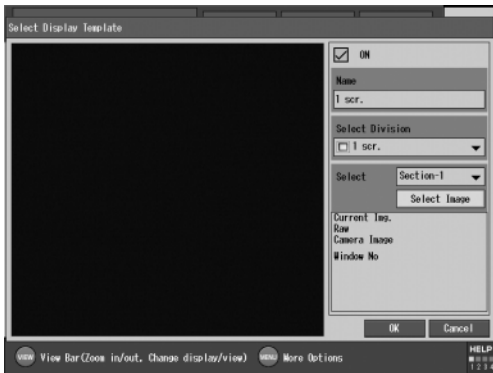
3 **Select [Select Division] and set the screen layout.**
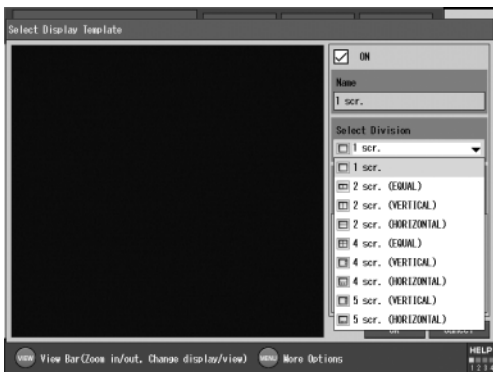
4 **Select [OK].**

Editing Template Name

1 **Select [Configure Image Options] from [Display] in the menu bar.**

2 **Select the template to be changed from the [Configure Template] menu.**
The [Select Display Template] menu appears for the selected template.
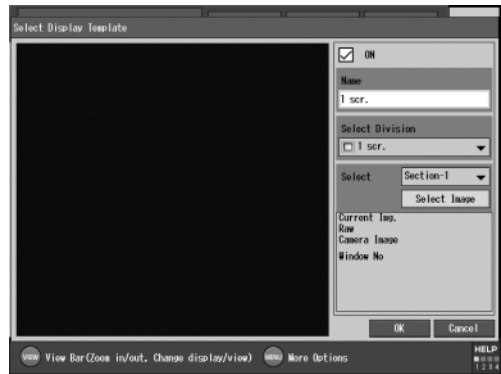
3 **Select [Name].**
The [Template Name] menu appears.

4 **Enter a name for the template and select [OK].**
See "Inputting Characters" (Page 3-7) for more details about entering characters.

5 **Select [OK].**
The template name is changed.

Selecting the Contents of Each Screen

This function sets the contents displayed in each screen inside template.

1 **Select [Configure Image Options] from [Display] in the menu bar.**

2 **Select the desired template from the [Configure Template] menu.**
The [Select Display Template] menu appears for the selected template.

3 **Select the section of the template that you would like to change.**
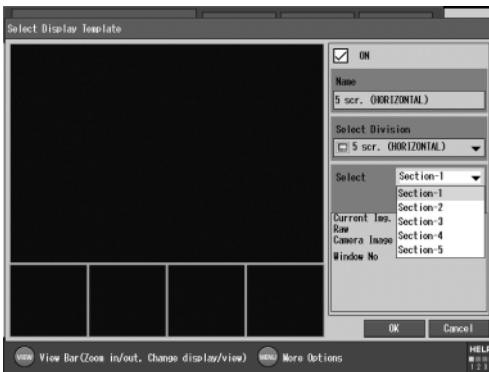
4 **Select [Select Image].**
The [Select Image] menu appears.
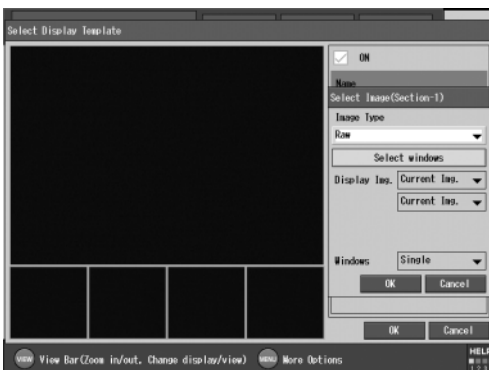
5 **With [Image Type], select the image displayed in the screen.**
- **Raw**: Displays the color/monochrome image that is input from the camera.
- **Color-extracted**: Displays the black and white image after color extraction processing in the window.
- **Filtered**: Displays an image after color extraction and preprocessing in the window.

6 **Select [Select Windows], and select the inspection window to display.**
Up to 16 windows can be selected for one screen.

7 **With [Display Img.], select the type of image displayed in the screen.**
- **Current Img.:** Displays the images from the camera in the selected window.
- **Regist. Img.:** Displays the registered images that are referenced to the inspection window.

8 **When [Current Img.] is selected in step 7, select the type of image to display in [Image Type].**
- **Current Img.**: Displays the latest captured image.
- **Trigger delay**: Displays a past captured image.

9 **When [Trigger delay] is selected in step 8, select the trigger delay to display with [Trigger delay].**
Up to three images can be selected in [1st Trg Delay]. See "Displaying Previous Images and Results (Trigger delay)" (Page 6-36) for more about trigger delay.

10 **Select the inspection windows that will appear in the template from [Windows].**
- **Single:** Displays only active windows.
- **All:** Displays all the windows selected with [Select Windows] in step 6.

When displaying all windows, processing screens are displayed in front of active windows. When multiple selected windows straddle over multiple cameras, all of the windows are displayed for only the camera selected by the active window.

11 **After completing the settings, select [OK].**

Applying Functions for the CV ((Utility)/(Display))

Displaying Previous Images and Results (Trigger delay)

This function allows the user to save past images or past results as a trigger delay and displays the information on screen during Run mode. Only NG images can be saved, so that past NG images can be displayed at the same time as the current inspection image.

Reference

• Between 0 and 3 past triggers can be saved as trigger delay, depending on the combination of connected cameras. When a value is set for trigger delay that is higher than the number of possible triggers, the message "! Camera Image" appears and the camera image appears in the frame.
• When a NG Image Delay section of the template is selected, the data that corresponds to that image will appear for each window that is selected. The CV will hold the past data for NG image for as long as the image appears in the template.However, when using a tool that has primary targets and sub targets, only the data for the primary target will be displayed.

1 Select [Configure Image Options] from [Display] in the menu bar.

2 Select [Image Delay] from the [Configure Template] menu.
The [Configure Image Delay] menu appears.

3 In [NG Img delay], set the total number of past NG images to record.
Changing the assigned triggers automatically changes the allocated images for the trigger delay.
In the default state, [NG Img. delay] is set at 0 triggers, and all of the triggers are assigned with [Standard Img. delay].

4 Select [OK].

5 Add a new template that will be used for delay.

► **Note**
Trigger delay cannot be set for templates D0 to D3.

6 Under [Select] in the new template, select the screen section on which you want to display the trigger delay image and press [Select Image].
See Page 6-35 for more details about selecting images.

7 Set the image type and windows.

8 Set [Display Image] to [Current Img.] and [Trigger delay]
If [Regist. Img.] is set for [Display Image], [Trigger delay] cannot be selected.

9 In [Select Hold], select which previously recorded NG image to display in the current section.

10 For [Windows], select the windows that will be displayed in the current section.

11 After completing the settings, select [OK].

Reference

The trigger delay is cleared under the following conditions.
• When a reset signal is input
• When the power to CV is turned off
• When the program number is switched
• When a new camera is added to the program
• When the camera specifications are altered
• When image archive, image registration, or the window settings menus are displayed
After the trigger delay display is cleared, the display appears black until the specified number of NG conditions occur.

Selecting the Contents of the Custom Display (Create Custom Screen)

Up to ten pages of custom contents can be created for each program. These pages can be displayed using [Change Result Display] on the VIEW bar. A custom display makes it easy to recognize errors and inspection details.

See "Run Mode Display Screens" (Page 5-3) for more details about each menu.

► Note

The custom screen displays a fixed position on the screen, regardless of the selected template or the zoom ratio on the screen.

Creating a [Custom display setting]

1 Select [Create Custom Screen] from [Display] in the menu bar during Program mode.

The [Create Custom Scr.] menu appears.
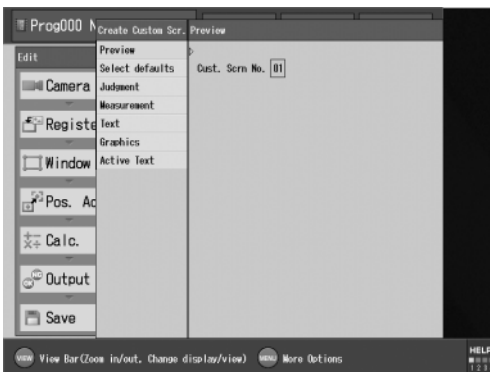
2 To end [Create Custom Scr.], press the [ESCAPE] button.

Reviewing the Contents of the Custom Screen (Preview)

1 Select [Preview] in the [Create Custom Scr.] menu.

The [Preview] menu appears.
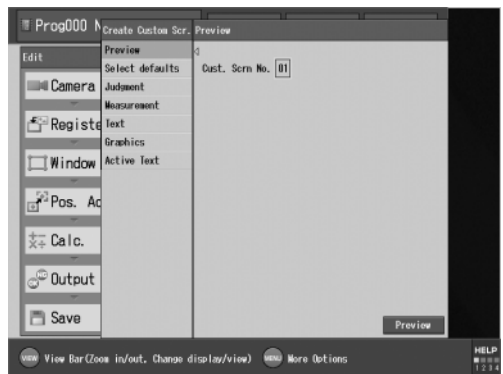
2 Select the [Cust. Scrn No.] (01 to 10) to set the page number of the custom screen you want to check.

3 Select [Preview].

The custom screen page number specified in step 2 is displayed.

Reference

- Preview uses the most recently captured image.
- The display image size is dependent on the setting for [Select Initial Run-Mode Display] (Page 6-47).

4 Press the [ESCAPE] button.

The system returns to the [Preview] menu.

Reference

The page number indicates the page that will be used to create the custom contents.

Applying Functions for the CV ((Utility)/(Display))

Selecting Standard Items Displayed on the Custom Screen (Select defaults)

Reference

[Select defaults] is the same for each page number.

Example of a display

Selecting to display only the window results, process time, and total status
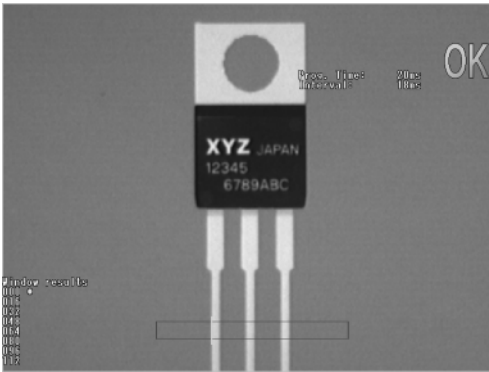
1 **Select [Select defaults] in the [Create Custom Scr.] menu.**

The [Select defaults] menu appears.
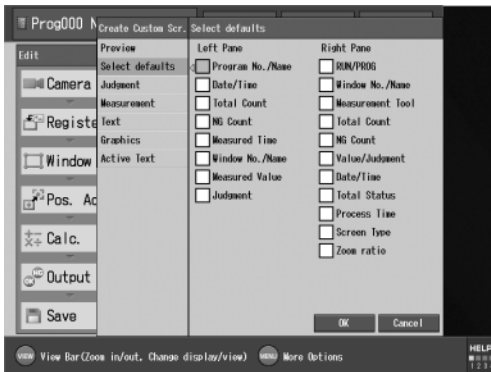
Reference

All items are unselected as the initial setting.

2 **Select one or more items you want to display as standard defaults on the custom screen by applying check marks in the corresponding checkboxes.**

You can select from the following items:

Display items on left side of screen	Display items on right side of screen
• Program No./Name	• RUN/PROG
• Date/Time	• Window No./Name
• Total Count	• Measurement Tool
• NG Count	• Total Count
• Measured Time	• NG Count
• Window No./Name	• Value/Judgment
• Measured Value	• Date/Time
• Judgment	• Total Status
	• Process Time
	• Screen Type
	• Zoom ratio

3 **After completing the settings, select [OK].**

Specifying Display Settings for Judgment Results on Custom Screen (Judgment)

You can select a judgment from a specific window to display on the custom screen. Up to 32 judgments can be displayed on one page number, showing [OK] and [NG] judgments.

► **Note**

When setting [Judgment], measurement windows must be created beforehand.

1 Select [Judgment] in the [Create Custom Scr.] menu.

The [Judgment] menu appears.
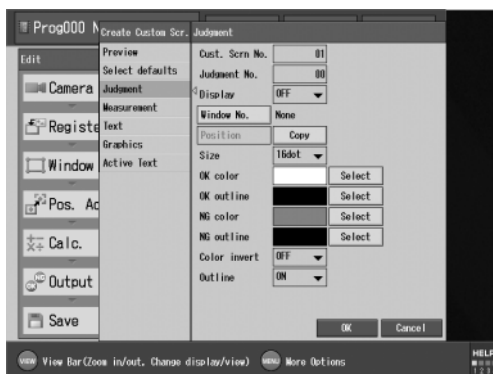
2 Specify the display details for the judgment.

[Cust. Scrn No.]

Set the custom screen page number.

[Judgment No.]

Set the judgment number (0 to 31) for which you want to specify the settings. The display method can be changed for each judgment number.

[Display]

Specify if you want to show the judgment result.

- **OFF** (default): Hides the judgment result.
- **ON**: Shows the judgment result.

[Window No.]

Select the judgment result you want to display. Select [Window No.], then select the number of the target window.

[Position]

Select the position on the custom screen where you want to show the judgment result.

When the positioning frame appears, move the [ENTER] button to select the desired position, and then press the [ESCAPE] button.

Reference

- Moving the cursor bar while holding down the [FNC] button jumps ten pixels at a time (grid movement).
- Select [Copy] to copy the current settings to a number in the same page.

[Size]

Select the size of the characters used for displaying the judgment (default: 16dot).

[OK color]

Select the color of the characters that will be shown when the judgment is OK.

[OK outline]

Select the color of the outline for the characters that will be shown when the judgment is OK.

► **Note**

This option is only effective if [Outline] is set to [ON].

[NG color]

Select the color of the characters that will be shown when the judgment is NG.

[NG outline]

Select the color of the outline for the characters that will be shown when the judgment is NG.

► **Note**

This option is only effective if [Outline] is set to [ON].

[Color invert]

Specify whether you want to invert the color of the characters used for displaying the judgment.

- **OFF** (default): Does not invert the colors.
- **ON**: Inverts the colors.

[Outline]

Specify whether you want to draw an outline around the characters used for displaying the judgment.

- **OFF**: Does not display the characters with an outline.
- **ON** (default): Displays the characters with an outline.

► **Note**

This option is always [OFF] when [Color invert] is [ON].

3 After completing the settings, select [OK].

Specifying the Display Settings for Measurement Data on the Custom Screen (Measurement)

You can select a measurement value or a calculation value from a specific window to display on the custom screen.Up to 32 measurement values can be displayed on one page number, and the color of the displayed characters can be switched according to the judgment.

► Note

When setting [Measurement], measurement windows must be created beforehand.

1 Select [Measurement] in the [Create Custom Scr.] menu.

The [Measurement] menu appears.
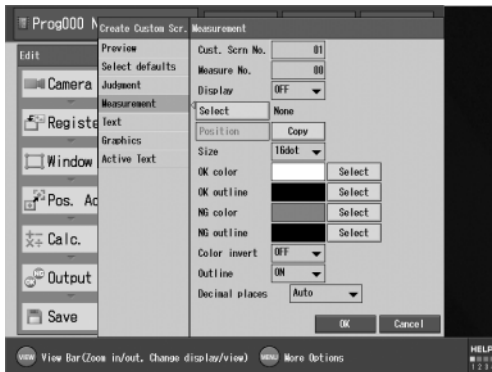
2 Specify the display details for the measurement value.

[Cust. Scrn No.]
Set the custom screen page number.

[Measure No.]
Set the measurement number (0 to 31) for which you want to specify the settings. The display method can be changed for each measurement number.

[Display]
Specify if you want to show the measurement data point.
- **OFF** (default): Hides the measurement value.
- **ON**: Shows the measurement value.

[Select]
The measurement value to display can be selected. Select [Select], and then select the name of the target window and the type of measurement value items. Select [Target No.] in the upper right corner to only output the measurement value of a specific target (for tools that have multble targets).

► Note

When the measurement value recorded in the [Target setting] field in [Output Data List] (Page 4-294) is "X", the target cannot be set.

[Position]
Select the position where you want to show the measurement value.

When the positioning frame appears, move the [ENTER] button to select the desired position, and then press the [ESCAPE] button.

Reference

- Moving the cursor bar while holding down the [FNC] button jumps ten pixels at a time (grid movement).
- Select [Copy] to copy the current settings to a number in the same page.

[Size]
Select the size of the characters used for displaying the measurement value (default: 16dot).

[OK color]
Select the color of the characters that will be shown when the judgment is OK.

Reference

The OK color always appears for measurement values that do not have a set tolerance.

[OK outline]
Select the color of the outline for the characters that will be shown when judgment is OK.

► Note

This option is only effective if [Outline] is set to [ON].

[NG color]
Select the color of the characters that will be shown when the judgment is NG.

[NG outline]
Select the color of the outline for the characters that will be shown when the judgment is NG.

► Note

This option is only effective if [Outline] is set to [ON].

[Color invert]

Specify whether you want to invert the color of the characters used for displaying the measurement.

- **OFF** (default): Does not invert the colors.
- **ON**: Inverts the colors.

[Outline]

Specify whether you want to draw an outline around the characters used for displaying the measurement.

- **OFF**: Does not display the characters with outline.
- **ON** (default): Displays the characters with outline.

► **Note**

This option is always [OFF] when [Color inverse] is [ON].

[Decimal places]

Sets the number of digits after the decimal place for the displayed value.

- **Auto** (default): Set according to the format for the measurement value.
- **0**: Only displays the integer.
- **1**: Displays up to one digit after the decimal point.
- **2**: Displays up to two digits after the decimal point.
- **3**: Displays up to three digits after the decimal point.

Reference

Numbers after the displayed digits are rounded off.

3 **After completing the settings, select [OK].**

Displaying Specified Text on the Custom Screen (Text)

You can select to display up to 32 character blocks of text per page on the custom screen, in addition to the operating information such as measurement values and judgments. This is useful when you want to label data points on the screen.

1 **Select [Text] in the [Create Custom Scr.] menu.**

The [Text] menu appears.
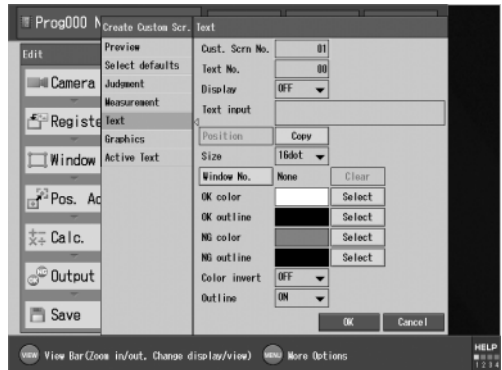
2 **Specify the text details you want to display.**

[Cust. Scrn No.]

Set the custom screen page number.

[Text No.]

Set the text number (0 to 31) for which you want to specify the settings. The display method can be changed for each text number.

[Display]

Specify if you want to show the specified text.

- **OFF** (default): Hides the specified text.
- **ON**: Shows the specified text.

[Text input]

In the character input menu that appears, type the text (up to 32 characters) you want to display. See "Inputting Characters" (Page 3-7) for more details about entering characters.

Applying Functions for the CV ([Utility]/[Display])

[Position]

Select the position where you want to show the characters.

When the positioning frame appears, move the [ENTER] button to select the desired position, and then press the [ESCAPE] button.

▌Reference▐

• Moving the cursor bar while holding down the [FNC] button jumps ten pixels at a time (grid movement).
• Select [Copy] to copy the current settings to a number in the same page.

[Size]

Select the size of the specified characters (default: 16dot).

[Window No.]

Select the judgment results that will be used for switching text color.

Select [Window No.], then select the number of the target window.

► Note

When setting [Window No.], measurement windows must be created beforehand.

[OK color]

Select the color of the characters that will be shown when the judgment is OK.

[OK outline]

Select the color of the outline for the characters that will be shown when the judgment is OK.

► Note

This option is only effective if [Outline] is set to [ON].

[NG color]

Select the color of the characters that will be shown when the judgment is NG.

[NG outline]

Select the color of the outline for the characters that will be shown when the judgment is NG.

► Note

This option is only effective if [Outline] is set to [ON].

[Color invert]

Specify whether you want to invert the color of the characters.

• **OFF** (default): Does not invert the colors.
• **ON**: Inverts the colors.

[Outline]

Specify whether you want to draw an outline around the characters.

• **OFF**: Does not display the characters with an outline.
• **ON** (default): Displays the characters with an outline.

► Note

This option is always [OFF] when [Color inverse] is [ON].

3 **After completing the settings, select [OK].**

Displaying Graphics or Lines on the Custom Screen (Graphics)

You can select to display up to 32 graphics per page on the custom screen, in addition to the operating information such as measurement values and judgments. Graphics can be used to create charts and tables, making the displayed data more comprehensive.

1 Select [Graphics] in the [Create Custom Scr.] menu.

The [Graphics] menu appears.
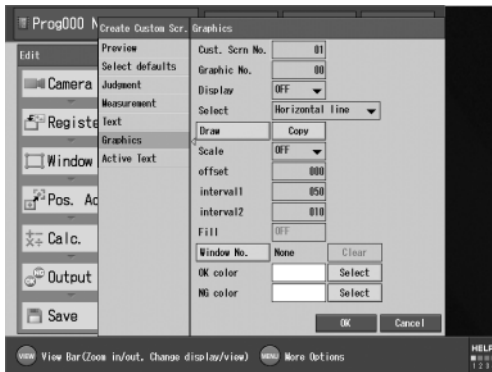
2 Specify the details of the graphics.

[Cust. Scrn No.]

Set the custom screen page number.

[Graphic No.]

Set the graphic number for which you want to specify the settings.

The display method can be changed for each graphic number.

[Display]

Specify if you want to show the graphic.

- **OFF** (default): Hides the graphic.
- **ON**: Shows the graphic.

[Select]

Select the type of graphic. You can select from the following:

- Horizontal line
- Vertical line
- Cross mark
- Circle
- Rectangle

[Draw]

Draw the graphic you want to display.

See "Drawing a Measurement Window" (Page 3-13) for more details about how to draw.

Reference

Select [Copy] to copy the current settings to a number in the same page.

[Scale]

When drawing a horizontal or vertical line, select whether to show a scale above the line.

- **OFF** (default): Hides the scale.
- **ON**: Shows the scale. Adjust the settings for [offset], [interval1], and [interval2] to display the required scale.

► Note

- This option can only be set when [Horizontal line] or [Vertical line] are selected for [Graphic].
- When the interval is set to "0", the scale will not appear even if it is turned on.

[Fill]

Select whether you want to fill the graphic.

- **OFF** (default): Only the outline of the graphic is displayed.
- **ON**: The graphic is filled with the selected color.

► Note

This option can only be set when [Circle] or [Rectangle] are selected for [Graphic].

[Window No.]

Select the judgment results that will be used for switching display color.

Select [Window No.], then select the number of the target window.

► Note

When setting [Window NO.], measurement windows must be created beforehand.

[OK color]

Select the color that will be shown when the judgment is OK.

[NG color]

Select the color that will be shown when the judgment is NG.

3 After completing the settings, select [OK].

Applying Functions for the CV ((Utility)/(Display))

Displaying Text Associated with the Measurement Results (Active Text)

In addition to the operating information such as measurement value and judgment, up to 64 characters of text (active text) relating to the measurement results can be displayed per page. Up to 32 combinations of values and text can be managed in a [Table]. This function is useful when you want to switch between multiple display messages depending on the measurement result.

1 **Select [Active Text] in the [Create Custom Screen] menu.**

The [Active Text] menu appears.
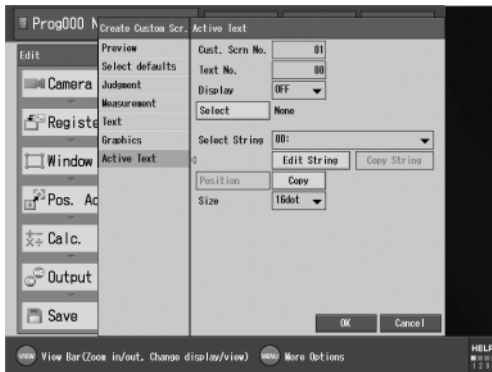
2 **Specify the basic information for active text.**

[Cust. Scrn No.]

Set the custom screen page number.

[Text No.]

Set the text number (0 to 31) for which you want to specify the settings. The display method can be changed for each text number.

[Display]

Specify if you want to show the active text.

- OFF (default): Hides the active text.
- ON: Shows the active text.

[Select]

The measurement value to display can be selected. Select [Select], and then select the name of the target window and the type of measurement value items. Select [Target No.] in the upper right corner to only output the measurement value of a specific target (for tools that have multiple targets).

▶ **Note**

When "X" is recorded in the [Target No.] field in [Output Data List] (Page 4-294) for the measurement value, the target cannot be set.

[Select String]

Select the table number (0 to 31) for which you want to set the combination of values and text.

[Position]

Select the position where you want to show the active text. When the positioning frame appears, move the [ENTER] button to select the desired position, and then press the [ESCAPE] button.

Reference

- Moving the cursor bar while holding down the [FNC] button jumps ten pixels at a time (grid movement).
- Select [Copy] to copy the current settings to a number in the same page.

[Size]

Select the size of the characters used for displaying the measurement value (default: 16dot).

3 **Select [Edit String].**

The [Edit] menu appears for the table number selected in [Select String].

4 **Select [Table name] and enter a name for the table.**

The name of the table can be up to 64 letters long (default: blank).

5 **Select [Add].**

The [Edit] menu appears.

6 **Specify the active text to display for the selected table.**

[Upper limit]

Select the upper limit for the measurement value (±9999999.999). The text will appear for values greater than the upper limit.

[Lower limit]

Select the lower limit for the measurement value (±9999999.999). The text will appear for values greater than the lower limit.

![Reference]

When a value meets two sets of conditions, the conditions displayed towards the top of the [Edit] menu for table numbers have priority over lower conditions. For example, say that there are two conditions: "Display text A between lower limit 2 and upper limit 2" and "Display text B between lower limit 1 and upper limit 10". The measurement value "2" meets both of these conditions. In this case "Display text A between lower limit 2 and upper limit 2" has priority, so "A" appears. If the measurement value were a number other than 2 but between 1 and 10, "B" would appear.

[Text input]

Enter the text (up to 64 characters) that you want to display when the conditions are met.

[Text color]

Select the color of the text.

[Outline color]

Select the color of the outline for the text.

[Color invert]

Specify whether you want to invert the color of the characters.

- **OFF** (default): Does not invert the colors.
- **ON**: Inverts the colors.

[Outline]

Specify whether you want to draw an outline around the characters.

- **OFF**: Does not display the characters with an outline.
- **ON** (default): Displays the characters with an outline.

► **Note**

This option is always [OFF] when [Color inverse] is [ON].

7 **Select [OK].**

The specified display data is added to the table number selected in [Select String] in step 2.

The added display data runs in the order that it appears in the [Edit] menu for the table number.

Changing the order for running data

Changing the order of display data shown on the [Edit] menu for the table number changes the order in which the text output runs.

Select the display data that you want to change the order for, and select [Move up] or [Move down].

Changing set display data

Select the display data that you want to change and select [Edit].

Copying set display data

Select the display data that you want to copy and select [Copy].

The copied settings appear beneath the selected display data.

Deleting display data

Part or all of the display data shown on the table menu can be deleted.

Select the display data that you want to eliminate and press [Delete].

You can select multiple display data at once.

![Reference]

- Select [Select all] to select all of the items.
- Select [Select inv.] to reverse the items that are currently selected.

8 **If there are other combinations that you want to add, repeat steps 5 to 7.**

A total of 256 combinations can be added in all of the tables for each program No. The number of items that can be added is displayed at the bottom of the [Edit] menu for the table.

9 **After completing the settings, select [OK].**

10 **Select [OK].**

Editing set tables

In the [Active Text] menu, select the table number that you want to edit in [Select String] and select [Edit String].

Copying set tables

Select [Copy String] to display the [Copy String] menu. The information in the set table can be copied to another table.

Applying Functions for the CV ([Utility]/[Display])

Changing Text Color for Values and Display Color for Windows(Configure Graphic Colors)

This function sets the display colors for each type of window and for the default measurement values and judgment values. The display colors can be switched based on the result of the window.

1 **Select [Configure Graphic Colors] from [Display] in the menu bar.**

The [Configure Graphic Colors] menu appears.

2 **Select the target for the specified display color.**

Each setting menu for the display color appears.

[Measured value]
Changes the display color for the measurement values and judgment values displayed on the screen.

[Measurement window]
Changes the display color and line thickness for the lines around the measurement windows displayed on the screen.

[Mask window]
Changes the display color and line thickness for the lines around the mask windows displayed on the screen.

[Pattern reference window]
Changes the display color and the thickness of the lines around the pattern window (pattern reference window) displayed on the screen for the pattern search tool.

[Primary Target]
Changes the display color and line thickness for the primary targets that are displayed when an inspection tool can detect more than one target on the screen.

[Sub Target]
Changes the display color and line thickness for the lines around the sub targets that are displayed when an inspection tool can detect more than one target on the screen.

3 **Select [Width] from the menu to control the line thickness of the window.**

► **Note**
When [Measured value] is selected in step 2, the [Width] setting is not displayed.

4 **Select [OK color] from the menu to change the display color for OK judgments.**

5 **Select [NG color] from the menu to change the display color for NG judgments.**

6 **After completing the settings, select [OK].**

To return the display color to default

Click [Enter] on the display setting that needs to return to default and then select [Reset].

Selecting the Information to Display at the Initial Startup of the System (Select Initial Run-Mode Display)

The CV can be configured to display desired information upon system startup.

Reference

The settings in the [Initial Run Mode Display] are only effective in the following situations:

- When the system is powered-up and is set to startup in Run Mode.
- When the system moves from Program mode to Run mode
- When the program number is switched during Run mode
- When overwriting the program via an RS-232C or Ethernet command (SW command)

► Note

The settings in the [Select Initial Run-Mode Display] menu are not updated when the CV is reset.

1 **Select [Select Initial Run-Mode Display] from [Display] in the menu bar.**

The [Select Initial Run-Mode Display] menu appears.

2 **Select the window to display in [Window No.].**

► Note

- Measurement windows must be created beforehand.
- [Select Initial Run-Mode Display] is especially effective when using templates D0 to D3. For templates D4 to D9, the template that is displayed when the program is saved is automatically displayed,regardless of the [Select Initial Run-Mode Display] settings. (Page 4-303).

3 **Select the custom page to display in [Custom Scrn Number].**

4 **Select the template in [Display Template].**

See "Switching the Display Template" (Page 5-5) and "Creating Templates for Run Mode (Configure Image Options)" (Page 6-31) for more details about templates.

5 **Select the display size for the processed image in [Display Image Size].**

- **[Full Size]** (default): Displays the processed image on the entire screen.
- **[Standard Size]**: Displays the processed image only in the normal display window.

► Note

When [Full Size] is selected, part of the actual captured image may be cut from the display.

6 **Select the method for displaying results from [Result Display].**

See "Run Mode Display Screens" (Page 5-3) for more details about the contents of result displays.

7 **After completing the settings, select [OK].**

Applying Functions for the CV ([Utility]/[Display])

Changing the Transparency of Display Images
(Select Image Transparency)

This function sets the degree of transparency for images captured by the CV camera. This setting is useful when, for example, the captured image is bright and text on the screen is hard to read.

1 **Select [Select Image Transparency] from [Display] in the menu bar.**

The [Select Image Transparency] menu appears.
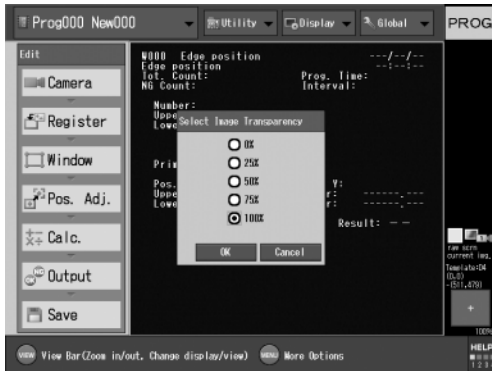
2 **Select the desired transparency.**

Select any transparency of from 0% to 100% (default). Selecting 0% allows no image transmission, while selecting 100% displays the image with complete transmission. Other values allow transmission on a scale between 0% and 100%.

3 **After completing the settings, select [OK].**

Chapter

7

Changing the Settings of the CV (Global)

Overview of the Global Menu

What is the [Global] Menu?

By selecting [Global] in the startup menu, it becomes possible to change settings other than the measurement conditions. The settings specified in the [Global] menu apply to all program numbers.

You can change the settings for the following 18 items:

- Terminal I/O (Page 7-2)
- RS-232C/PLC link (Page 7-3)
- Ethernet (Page 7-6)
- USB (Page 7-7)
- Captured Images (Page 7-7)
- Startup mode (Page 7-8)
- Screen update mode (Page 7-9)
- Change language (Page 7-9)
- Password setup (Page 7-10)
- White balance setting (Page 7-11)
- Date/time (Page 7-12)
- Program No. lock (Page 7-12)
- Operation mode change (Page 7-13)
- User mode level setup (Page 7-14)
- Registered image standard save format (Page 7-16)
- Memory card ERROR output (Page 7-16)
- System information (Page 7-16) (display only)

To display the [Global] menu:

Select [Global] from the menu bar and select the item that you want to change.
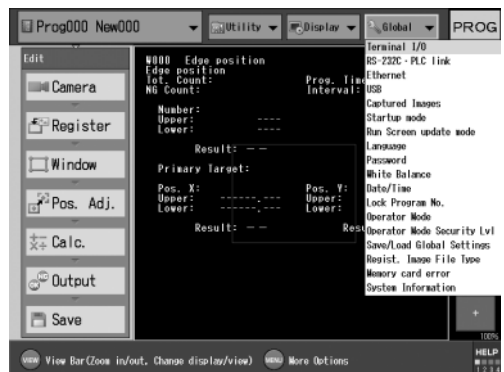
The configuration menu (or the setting menu) of the selected item appears.

Reference

The settings within the [Global] menu are saved when [OK] is selected on each configuration screen.

Changing the Terminal Output Settings
(Terminal I/O)

You can change the settings for data that is input/ output on the CV is I/O terminal (via the parallel I/O connector and the terminal block). For signal input/ output from/to external equipment, also see "Chapter 11 Controlling the System or Transmitting Data Via the I/O Terminal" (Page 11-1).

1 Select [Global] from the menu bar and select [Terminal I/O].

The [Terminal I/O] menu appears.

2 Change the settings as required.
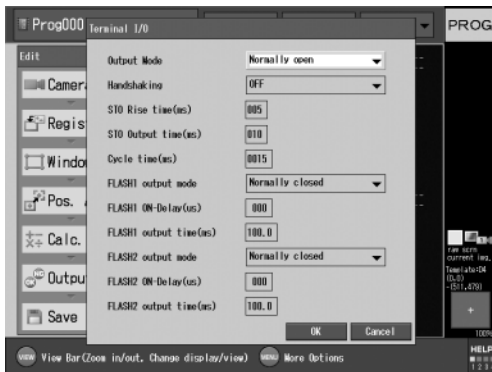
Output Mode

Select the format for the terminal output.

- **[Normally open]** (default): The standard output mode.
- **[Normally closed]**: Inverses all of the output terminals from the normally open state.
- **[Normally closed 2]**: Inverses only the ERROR, OR and OUT0 to OUT15 from the normally open state.

> **Reference**
> This setting applies to all the output terminals except for FLASH1 and FLASH2.

Handshaking

Select [OFF] (default) or [ON] for the terminal I/O protocol.

STO Rise time

Set the length of time from completion of the process time to the leading edge of STO within the range of 1 to 999 (ms). (Default: 5 ms)

STO Output time

Set the time from the leading edge of STO to the trailing edge of STO within the range of 1 to 999 (ms). (Default: 10 ms)

Cycle time

Only valid when there is more than one output cycle. When valid, the output cycle activates at the end of the process time and turns off after the set time of 2 to 1000 (ms). (Default: 15 ms)

FLASH1 output mode

Select [Normally open] or [Normally closed] (default) for the FLASH1 signal output system.

FLASH1 ON-Delay

Specify the starting point of the FLASH1 signal output within the range from - 500 to 500 (μs), where 0 is the trigger output. (Default: 0μs, the time of the trigger output.)If a negative value is specified, output starts before trigger output. If a positive value is specified, output starts after trigger output.

FLASH1 output time

Set the FLASH1 signal output time within the range from 1 to 999.9 (ms). (Default: 100.0 ms)

FLASH2 output mode

Select [Normally open] or [Normally closed] (default) for the FLASH2 signal output system.

FLASH2 ON-Delay

Specify the starting point of the FLASH2 signal output within the range from - 500 to 500 (μs), where 0 is the trigger output. (Default: 0μs, the time of the trigger output.)If a negative value is specified, output starts before trigger output. If a positive value is specified, output starts after trigger output.

FLASH2 output time

Set the FLASH2 signal output time within the range from 1 to 999.9 (ms). (Default: 100.0 ms)

3 After completing the settings, select [OK].

Changing the Communication Settings for the RS-232C/PLC Link (RS-232C/PLC Link)

You can change the details for inputting/outputting data via the RS-232C or PLC link for the system. For information about signal input/output from/to external equipment, see "Chapter 9 Transmitting Data via the Communication Ports" (Page 9-1) and "Chapter 10 Controlling the System or Outputting Data Via PLC Link" (Page 10-1).

▶ **Note**

• After changing the communication mode or PLC link mode, the system must be restarted for the changes to take effect.
• If you change the communication mode to [PLC link], a message "Initializing PLC link * th" appears at the lower right of the screen and disappears after the connection is established.
• If you change to the run mode after establishing the [PLC link] communication mode, the CV repeats initialization operation until a connection to the PLC is established. If no response is obtained from the connected PLC, the warning message "PLC communication has failed" appears. If this warning message repeatedly appears, check the communication settings for the connected PLC.

Communicating with RS-232C No Protocol Mode

Use the following procedure when communicating with an external device with RS-232C no protocol mode or when using the PLC link via RS-232C.

1 **Select [RS-232C/PLC link] from [Global] in the menu bar.**
The [RS-232C/PLC Link] menu appears.

2 **Change the settings as required.**
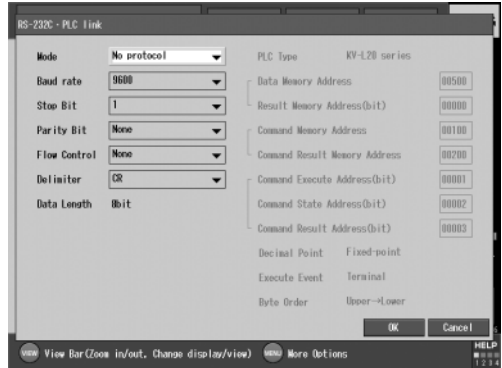
Communication mode
Select [No protocol (RS-232C)] (default).

Baud rate
Select 9600 (default), 19200, 38400, 57600, or 115200 (bps) for the baud rate.

Stop Bit
Select [1] (default) or [2] for the stop bit.

Parity Bit
Select [None] (default), [Odd] or [Even] for the parity bit.

Flow Control
Select [None] (default), or [CTS/RTS] for the flow control.

Delimiter
Select [CR] (default) or [CR + LF] for the delimiter of the RS-232C communication.

3 **After completing the settings, select [OK].**

Changing the Settings of the CV (Global)

Using the PLC Link via RS-232C

Use the following procedure when using a PLC link via RS-232C between the system and the PLC connected to the RS-232C link unit. See "Chapter 10: Controlling the System or Outputting Data Via PLC Link" (Page 10-1) for more details about data addresses and other information.

1 **Select [RS-232C/PLC link] from [Global] in the menu bar.**

The [RS-232C/PLC link] menu appears.

2 **Select [PLC link] in [Mode].**

3 **Select the connected RS-232C link unit in [PLC Type].**

The settings for the selected PLC type appear. See "Chapter 10: Controlling the System or Outputting Data Via PLC Link" (Page 10-1) for more details.

4 **Change the settings as required.**

Baud rate

Select 9600 (default), 19200, 38400, 57600, or 115200 (bps) for the baud rate.

► Note

If you selected [SYSMAC C Series] in [PLC type], only "19200" or "9600" can be selected.

Stop bit

Select [1] (default) or [2] for the stop bit.

► Note

If you selected [KV-L20 series] in [PLC type], the stop bit is fixed to [1].

Parity bit

Select [None] (default), [Odd], or [Even] for the parity bit.

► Note

If you selected [KV-L20 Series] in [PLC type], the parity bit is fixed to [None].

Flow control

Select [None] (default) or [CTS/RTS] for the flow control.

► Note

If you selected [AnN Series] or [Q Series] in [PLC type], the flow control is fixed to [CTS/RTS]. If you selected [KV-L20 Series], [SYSMAC C Series], or [SYSMAC CJ/CS1 Series], the flow control is fixed to [None].

Delimiter

Select [CR] (default) or [CR + LF] for the delimiter of the RS-232C communication.

5 **After completing the settings, select [OK].**

Using the PLC Link via Ethernet

Use the following procedure when using a PLC link via Ethernet between the system and the PLC connected to the Ethernet link unit. See "Chapter 10: Controlling the System or Outputting Data Via PLC Link" (Page 10-1) for more details about data addresses and other information.

1 **Select [RS-232C/PLC link] from [Global] in the menu bar.**

The [RS-232C/PLC link] menu appears.

2 **Select [PLC link] in [Mode].**

3 **Select the connected Ethernet link unit in [PLC Type].**

The settings for the selected PLC type appear. See "Chapter 10: Controlling the System or Outputting Data Via PLC Link" (Page 10-1) for more details.

4 **Change the settings as required.**

IP address

Enter the IP address for the unit that the system is communicating with (default: 192.168.000.020).

Port

Enter the port number for the port using the PLC link (default: 8502 (KV-LE20), 5000 (MELSECQ), 9600 (SYSMAC CJ/CS1)).

► Note

Changing the [PLC Type] returns the values to the initial values.

Resend time

Enter the resend time (ms) to use if a communication error occurs (default 10000 ms).

5 **After completing the settings, select [OK].**
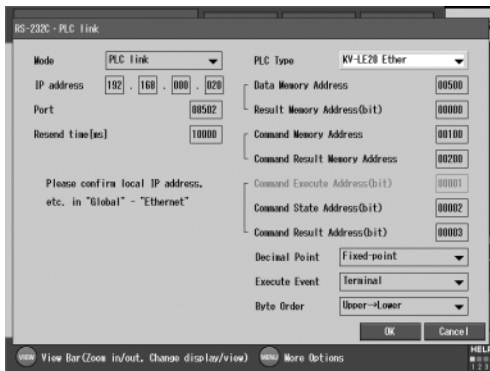
Changing the Settings of the CV (Global)

Changing Network Settings (Ethernet)

You can change the Ethernet port on the CV. For signal input/output from/to external equipment, also see "Chapter 9 Transmitting Data via the Communication Ports" (Page 9-1).

1 **Select [Global] from the menu bar and select [Ethernet].**
The [Ethernet] menu appears.

2 **Change the settings as required.**
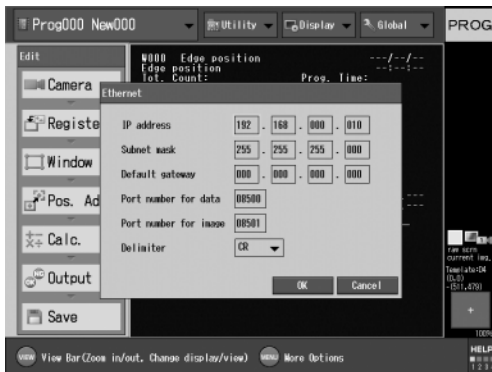
► **Note**

If any setting is made incorrectly, not only the CV but also other equipment on the network may not work properly. Consult your system administrator or network administrator about setting values.

IP address
Enter the CV IP address. (Default value: 192.168.0.10)

Subnet mask
Enter a subnet mask. (Default value: 255.255.255.0)

Default gateway
Enter a default gateway IP address. (Default value: 0.0.0.0)

Port number for data
Enter the port number used for data I/O on the CV. (Default: 8500)

Port number for image
Enter the port number used for image data I/O on the CV. (Default: 8501)

► **Note**

The same number cannot be specified for both "Port number for data" and "Port number for image".

Delimiter
Select [CR] (default) or [CR + LF] for the delimiter of the Ethernet communication.

3 **After completing the settings, select [OK].**

Changing the USB Communication Settings (USB)

You can change settings for data input/output on the USB port of the CV. For signal input/output from/to external equipment, also see "Chapter 9 Transmitting Data via the Communication Ports" (Page 9-1).

1 Select [Global] from the menu bar and select [USB].

The [USB] menu appears.

2 Change the settings as required.

Speed

Select the transmission mode to communicate via the USB port.

- **Auto** (default): The transmission mode is automatically switched between USB 2.0 and USB 1.1.
- **Low-speed**: Communication is performed in USB 1.1 communication mode. Select this option when the USB terminal of your PC supports only USB 1.1 and communication will be unstable if "Automatic" is selected.

Delimiter

Select [CR] (default) or [CR + LF] for the delimiter of the USB communication.

3 After completing the settings, select [OK].

Changing the Screen Capture Settings (Captured Images)

Pressing the [VIEW] button while holding down the [FNC] button on the remote control console saves the current screen of the CV that is displayed on the external monitor (screen capture). The naming rule of the image file that is saved by the screen capture feature can be changed.

Reference

- The image file is saved in bitmap format (.bmp) of 800 x 600 pixels.
- Images are saved in the "CV" directory in the D drive (memory card).

1 Select [Global] from the menu bar and select [Captured Images].

The [Captured Images] menu appears.

2 Change the settings as required.
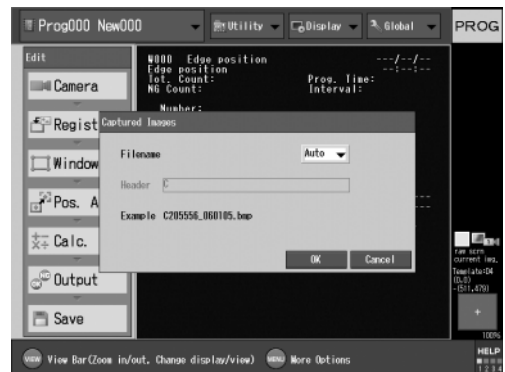
Filename

Select the file naming rule for the files that are saved when the screen capture is performed.

- **Auto** (default): The file name will be "header + time (hhmmss) of the screen capture_date (yymmdd).bmp".
- **Seq.**: The file name will be "specified header + sequential number". A sequential number from 0000 to 9999 is allocated to the file. The file after the one with "9999" will be reset to 0000. (If the file with the same name exists, the old file will be overwritten by the new file.) This sequential number continues counting until the power of the CV is turned off.
- **Fixed**: The file name will be specified. If this option is selected and screen capture is repeatedly performed, the file is always overwritten by the latest screen.

Header

Specify the header in a character string (up to 32 characters) that will be referenced when "Seq." or "Fixed" is selected for "Screen Filename".

3 **After completing the settings, select [OK].**

Select the Startup Operating Mode (Startup mode)

You can select which operating mode the CV enters immediately after system turns on: Program mode or Run mode.

1 **Select [Global] from the menu bar and select [Startup mode].**

The startup mode menu appears.

2 **Change the settings as required.**

- **Run mode**: Upon powering up, the CV starts up in the Run mode.
- **Program mode** (default): Upon powering up, the CV starts up in the Program mode.

Reference

Even if the [Run] mode is selected for the Startup mode, the CV can start up forcibly in the Program mode by entering the FNC + ENTER buttons on the console while powering on the system.

Setting the Screen Update Timing (Run screen update mode)

This controls when the display screen is updated while the system is in Run mode.

1 **Select [Global] from the menu bar and select [Run screen update mode].**

The Run screen update mode menu appears.
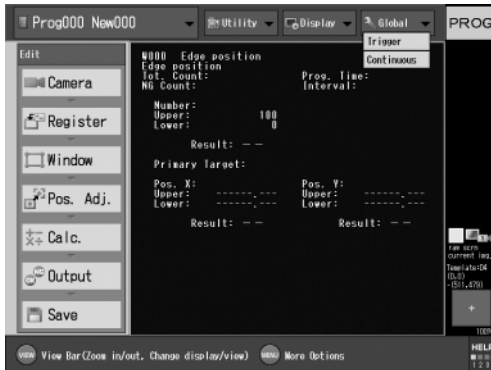
2 **Change the settings as required.**

- **Trigger** (default): Updates the screen only at the time of trigger input.
- **Continuous**: Always displays the latest information on the screen.

► **Note**

- If [Cont. capture] (Page 4-17) is set to [ON], only [Trigger] can be selected for [Screen update mode].
- When [Continuous] is selected, although the screen is always updated, measurement will not be performed unless a trigger is input.
- When [Continuous] is selected, there is a maximum time lag of "shutter speed + image capture time" between a trigger input and the actual image capture.
- When [Continuous] is selected, Trigger 2 of [Trigger] (Page 4-8) cannot be used. In this case, image capturing starts by the Trigger 1 input regardless of the [Trigger] setting.

Switching the User Interface Language (Language)

You can switch the user-interface language between English, Japanese, and German.

1 **Select [Global] from the menu bar and select [Language].**

The Language menu appears on the screen.
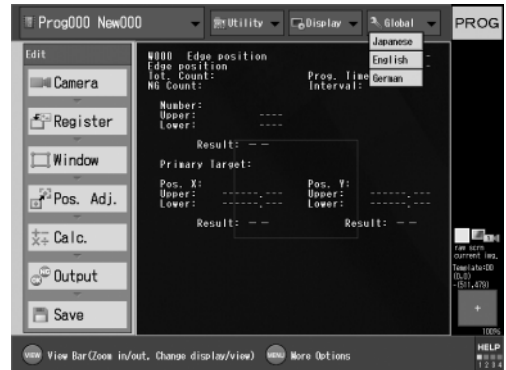
2 **Change the settings as required.**

- **Japanese**: Displays in Japanese.
- **English** (default): Displays in English.
- **German**: Displays in German.

► **Note**

To make the language change effective, the CV must be restarted after the change is made.

Password Protecting the Settings (Password)

A password can be entered to limit access to certain menus in the CV user interface.This can be a useful tool when trying to prevent unauthorized users from tampering with sensitive programs.

Reference

You can also use this password with a communication command to disable operations of the remote control console or from a particular external input (Page 9-31).

1 **Select [Global] from the menu bar and select [Password].**

The [Password] menu appears.

2 **Select [Password] and then enter a password.**

A password may be up to 4 digits long, consisting of numeric characters from 0 to 9.

The default password is [0000].

3 **Select [OK].**

The [Password Access] menu appears.

4 **In [Run→Prog. Mode], specify whether to require a password when changing from run mode to program mode.**

- **ON**: Prompts the user to enter a password when changing to Program mode.
- **OFF** (default): Does not prompt the user to enter a password when changing to Program mode.

5 **In [Oper.→Admin. Mode], specify whether to require password when changing to the administratorís mode.**

- **ON**: Prompts the user to enter a password when changing to the administratorís mode.
- **OFF** (default): Does not prompt the user to enter a password when changing to the administratorís mode.

6 **After completing the settings, select [OK].**

If you forget the password:

Turn on the CV while pressing and holding down the remote control consoleís [FNC] and [ESCAPE] buttons. This causes the CV to come on with the password setting reset to the default value [0000].

Adjusting the White Balance (White Balance)

When a color camera is used, you can adjust the
color balance to exactly reproduce the white color
of captured images to match the lighting
environment of the inspection site. Perform this
adjustment when installing a new unit or when
changing cameras or lighting equipment.

► Note

The color extraction measurement result may change due to
change of the white balance setting. Be sure to verify the
measurement results of the CV after changing the white
balance setting.

1 **Select [Global] from the menu bar and
select [White Balance].**

The [White Balance] menu appears.
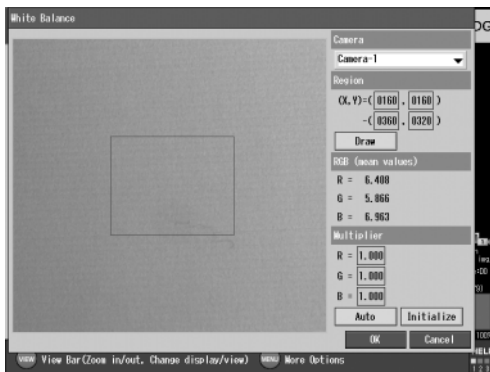
2 **Select the camera that will be adjusted.**

► Note

A monochrome camera cannot be selected.

3 **Specify the reference area for adjusting the
white balance.**

Enter a numerical value or select [Draw] to specify
the area.

4 **Place a white piece of paper (or other white
target) in the area specified in step 3, and
then press the [TRG] button.**

The average color values (R, G, B values) are
displayed in the [RGB (mean values)] field.

► Note

An external trigger input cannot be used during white
balance adjustment.

5 **Adjust the brightness of the screen so that
each value of the average RGB values will
fall within the range of 100 to 200.**

If you hold down the [TRG] button, images are
captured continuously, causing the R, G, B values to
change continuously as well.

6 **Select [Auto].**

The multipliers are automatically calculated so that
the color within the reference area will be white (R, G,
B values are all the same).

Reference

You can also specify the RGB multipliers directly.

7 **After completing the settings, select [OK].**

To initialize the multipliers:

If you select [Initialize], all the multipliers are reset
to [1.000].

Changing the Settings of the CV (Global)

Selecting the Internal Clock (Date/Time)

Using the following procedure, you can set the CV built-in clock. The clock's date and time information is used for time stamping purposes, such as when data is transmitted from the CV.

1 **Select [Global] from the menu bar and select [Date/Time].**

The [Date/Time] menu appears.

2 **Specify [Month], [Day], and [Year], respectively.**

3 **Specify [Hour], [Minute], and [Second], respectively.**

4 **After completing the settings, select [OK].**

Disabling the Ability to Change Program Nos. (Lock Program No.)

You can disable to change the program No. in the Run mode (Lock Program No.). Even if the program No. is locked, the program No. can be changed with a communication command sent through RS-232C or Ethernet.

If the user mode (Page 7-13) is set while the program No. is locked, the program No. lock status can be protected.

1 **Select [Global] from the menu bar and select [Lock Program No.].**

The confirmation screen is displayed.

2 **Select [OK].**

The ability to change programs in Run mode is disabled.

To cancel the program No. lock:

1 **Select [Global] from the menu bar and select [Unlock Lock Program No.].**

The confirmation screen is displayed.

2 **Select [OK].**

The program No. change lock is cancelled.

Limiting Access to Specified Menus on the User Interface (Operator Mode)

The CV normally operates in "Administrator mode", which enables the user to use all the features of the CV. By setting this mode to "Operator mode", you can limit access to specified areas of the user interface.

> **Reference**
>
> You can also force the user to enter a password when changing from operator mode to administrator mode by using the password function. (Page 7-10)

Features available in operator mode

Following features can be used in operator mode.

- Switching between Run mode and Program mode (If the password is set, the password must be entered to change the mode.)
- Program settings made accessible by a Custom Menu when using [Activate Custom Menu] function (Page 6-23)(Page 7-14).
- Changing the program No. (If the program No. lock is set in the administrator mode, the program No. cannot be changed.)
- Images in the Image Archive menu (change the conditions for image collection is restricted)
- All operations using the VIEW bar
- Switching between the operation modes (If a password is set for changing to the administrator mode, the password must be entered.)

1 Select [Global] from the menu bar and select [Operator Mode].

The confirmation screen is displayed.

2 Select [OK].

The operation mode is changed to the operator mode, which limits operations that can be used.

To cancel the operator mode:

1 Select [Global] from the menu bar and select [Administrator Mode].

The confirmation screen is displayed.

2 Select [OK].

The CV operates in normal mode (administrator mode), which allows the user to change any settings.

> **Reference**
>
> If a password is set for changing to the administrator mode, the password must be entered.

Changing the Settings of the CV (Global)

Limiting Access in the Operator Mode
(Operator Mode Security Lvl)

You can limit the operations that the users are allowed to perform in operator mode (Page 7-13). By combining this limitation with the [Activate Custom Menu] feature (Page 6-23), you can give operators access to only the custom menus specified by the system administrator. this can be helpful when restricting access for unauthorized users or simplifying programming options.

1 **Select [Global] from the menu bar and select [Operator Mode Security Lvl].**

The [Operator Mode Security Lvl] menu appears.

2 **Select the [Programming Menu], then specify whether to display the standard programming menu in the operator mode.**

- **Enable:** Displays the standard programming menu in the operator mode.
- **Disable** (default)**:** Does not display the standard programming menu in the operator mode. Only the menus that have been previously specified by the administrator in [Activate Custom Menu] (Page 6-23) are displayed.

3 **Select [Modify Settings], then specify whether to enable the user to modify items from the Utility, Display, or Global settings.**

- **Enable** (default value)**:** Enables the user to change settings.
- **Disable**: Disables the user from changing settings.

Reference

Even if [Enable] is selected, any modifications that have been made to the program settings will be erased once power is cycled to the system. This is because [Save settings] is still disabled, meaning that the operator does not have the ability to permanently make changes. To give the operator the ability to save changes, enable the [Save settings] option.

4 **Select [Save settings], then specify whether to enable the user to save program settings in the flash memory or the memory card in operator mode.**

- **Enable:** Enables the user to save program settings.
- **Disable** (default)**:** Disables the user from program settings.

Reference

If you want to allow the user to change, add, or delete the program settings in operator mode, both [Programming menu] and [Save settings] must be set to [Enable].

5 **After completing the settings, select [OK].**

Saving and Loading Global Settings
(Save/Load Global Settings)

You can save the settings specified in the [Global] from the menu bar into the memory card.

► Note

- Do not turn off the power of the system while you are saving the settings. It can cause an internal data error.
- The global settings are forward compatible, so data created on previous versions can be used on the second edition III. However, data that has been loaded once into the system is converted and can no longer be used by previous versions.

Reference

You can save all of the current programs in the internal memory as well as the global settings to one file using the [Save] function under Add/Edit/Del setting in the Program No.menu. This operation is useful when trying to create a complete backup file for the CV controller (Page 8-5).

Saving the Global Data

You can save the global data of the CV to the memory card.

► Note

Following operations cannot be performed if the memory card is not inserted.

1 Select [Global] from the menu bar and select [Save/Load].

The [Save/Load Global Settings] menu appears.

2 Select [Save].

3 Select [Save to] and specify where to save the global data.

Specify a folder since all the program files are managed by folder names in the CV.

4 Select [Folder] and specify where to save the global data.

5 Select [Execute].

Saving operation of the global data is executed. When saving operation is completed, a confirmation screen appears.

6 Select [Close].

Reference

If you select [View Files], the [View Files] screen (Page 6-16) appears.

Changing the Settings of the CV (Global)

Loading the Global Data

You can load the global data of the CV from the memory card.

► **Note**

- The following operations cannot be performed if the memory card is not inserted.
- If the global data is loaded from the memory card, all of the existing data is overwritten. Save the current global data in the memory card and then perform following operations.
- Global settings data created with the second edition III of the system cannot be used with previous editions. On the other hand, setting data created with previous versions can be used with the second edition III.

1 **Select [Global] from the menu bar and select [Save/Load].**

The [Save/Load Global Settings] menu appears.
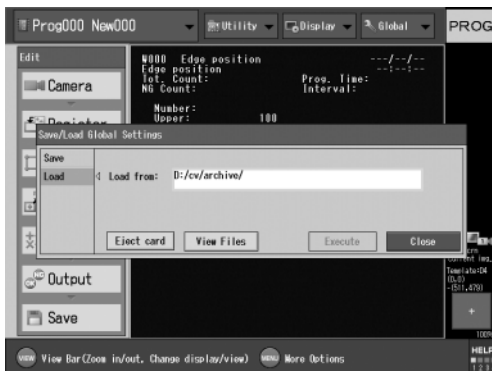
2 **Select [Load].**

3 **Select [Load from] and specify the location where the desired global data is saved.**

Specify a folder since all the program files are managed by folder names in the CV.

4 **Select [Execute].**

The loading operation of the global data is executed. When the loading operation is completed, a confirmation screen appears.

5 **Select [Close].**

► **Reference**

If you select [View Files], the [View Files] screen (Page 6-16) appears.

Selecting the Standard Save Format for Registered Images
(Registered image standard save format)

You can set the initial settings for save format for the registered image. Registered images are saved with the format specified here when they are saved with a command from an external device.

► **Note**

Saving the registered images in JPEG format leads to the following advantages and disadvantages. Select the appropriate save format for the intended use of the system.

- **Advantage**:

The images are compressed, so the smaller file size means that more registered images and program Nos. can be saved in the internal memory or memory card.

- **Disadvantages**:

– The captured image is compressed, so the measurement results for the compressed image may be different than the results when BMP format (uncompressed) registered images are used as the standard.

– When switching program Nos., the system must spend time expanding the compressed images, so it takes more time to switch program Nos. when using JPEG format than when using BMP format registered images.

– The compression rate varies depending on the image, so the image file size or number of images that can be saved may vary.

1 **Select [Registered image standard save format] from [Global] in the menu bar.**

The [Save format selection] menu appears.

2 **Change the settings as required.**

- BMP (default): Saves the images in bitmap format.
- JPEG: Saves the images in JPEG format.

ERROR Output for Memory Cards
(Memory Card ERROR Output)

You can decide whether or not to send an output to the ERROR terminal when error messages related to the memory card are displayed. This is useful when you are using the error output signal to stop measurements due to other system errors, but do not want to halt measurements due to memory card errors.

1 **Select [Memory Card ERROR] from [Global] in the menu bar.**
The [Memory Card ERROR Selection] menu appears.
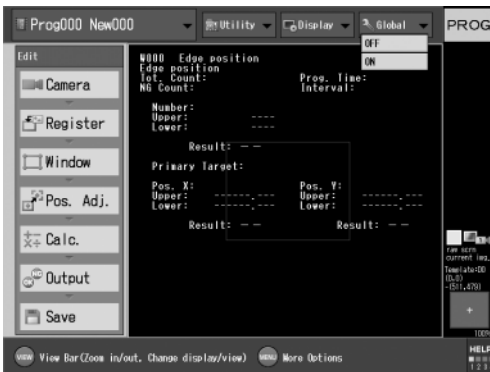
2 **Change the settings as required.**
- **ON (Default):** The ERROR output terminal will be activated when a memory card error occurs.
- **OFF:** The ERROR output terminal will not be activated when a memory card error occurs.

> **Reference**
> The error messages that relate to memory card are shown below.
> - Insert the memory card
> - Cannot access memory card
> - Insufficient memory on the memory card
> For more details about each of these messages, see "Error Messages" (page 13-21).

Changing the Settings of the CV (Global)

Checking the Memory Status of the CV (System Information)

You can check the available free space of the
internal memory of the CV.

1 **Select [Global] from the menu bar and
select [System Information].**

The [System Information] menu appears.

2 **Check the information.**

- **Window memory:** The current inspection
  window memory used for image processing is
  displayed as %, where 100% is the full memory
  size.
- **Free area:** The available memory size of each
  memory bank is displayed in the form of "available
  memory / full size".

■ **Reference**

If the memory card is not inserted, "0 KB / 0 KB" is
displayed.

3 **Select [Close].**

Overview of the [Save/Load] Menu

You can save the program settings (such as measurement conditions registered in the program No.) or global data by writing them onto a compact flash memory card. You can also load data saved on the memory card into the CV.

Types of Save/Load Operation

You can save/load data to and from the memory card from the following three menus.

1. [New/Edit/Del settings] menu (Page 8-4)

Select [New/Edit/Del settings] from the Program Edit menu to use the [New/Edit/Del settings] screen.

Types of data that can be saved or loaded
- Program settings (measurement conditions registered to the program No.)
- Global data (only when saving/loading all data)
- Registered images
- Library data

2. [Save/Load Global Settings] menu (only for global data) (Page 8-8)

Select [Save/Load Global Settings] from [Global] on the menu bar to use the [Save/Load Global Settings] screen.

Types of data that can be saved or loaded
- Global data

3. [Image Archive] menu (only for image data)

Select [Image Archive] from the [Utility] on the menu bar to use the [Image Archive] menu. See "Page 6-10" for more details about this function.

Types of data that can be saved or loaded
- Saved images

Other Information Related to Saving or Loading Data

- A function (the file management utility) is available on the CV to manage files in the internal memory and the memory card. It enables the user not only to manage files but also to initialize the memory card. See "Viewing Files in the Internal Memory and Memory Cards (View Files)" (Page 6-16) for more details about this function.
- For file format/contents that can be handled in the CV, see "Types of Files that can be Saved in the Memory Card" (Page 8-9).
- Data saved to the system can be saved to a PC (Page 8-10).
- For more details about compatibility with files created in a previous version, see "Compatibility of program data for the previous edition and second edition III" (Page 9).

Inserting or Removing a Memory Card

You can save the program settings or captured images in the memory card.

Supported models of memory card

The optional NR-M32 (32 MB, optional), GR-M256 (256 MB, optional), and CV-M1G (1 GB, optional) from KEYENCE are supported on the CV.

► **Note**
- FAT32 and VFAT formats are supported on the CV.
- Do not use commercial compact flash memory, as it may not operate normally.

Inserting a Memory Card

Insert a memory card in the compact flash memory card slot of the CV so that the upper side of the card has a triangle inscription on it.

Insert a memory card.
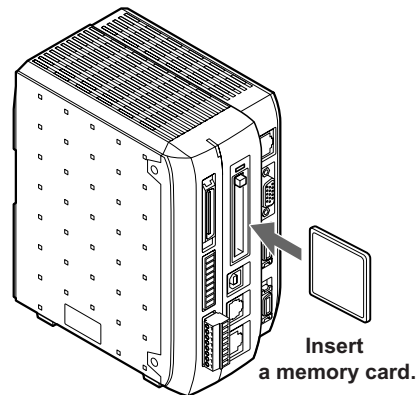
► **Note**
- Verify the orientation of the card when you insert it. Inserting the card in the wrong orientation can damage the memory card and the data stored on it.
- An access lamp lights while the compact flash memory card is inserted.
  - Green: A memory card is inserted and accessible.
  - Red: Data in the memory card is being accessed.
  - Not lit: A memory card is not accessible. (The memory card can be removed from the slot.)

Removing a Memory Card

After performing the [Eject Card], press the eject button in the compact flash memory card slot of the CV to remove the memory card.

► Note

- Be sure to use the following procedure to prevent data and the memory card from being damaged.
- If you remove the memory card using a procedure other than that specified, or if the power supply stops while the card is being accessed, the file saving task stops resulting in possible loss of data or damage to the memory card.

1 Select [Eject card] from [Utility] on the menu bar.

The confirmation screen is displayed.

Reference

[Eject card] can also be used from the function menu (Page 3-12).

2 Select [Close].

The access lamp goes off, indicating that the memory card can now be removed.

3 Press the eject button located on the compact flash memory card slot of the CV to remove the inserted memory card.

a Check that the access lamp is off.
b Press the eject button.
c Take out the memory card.

Saving and Loading the CV Data to/from the Memory Card
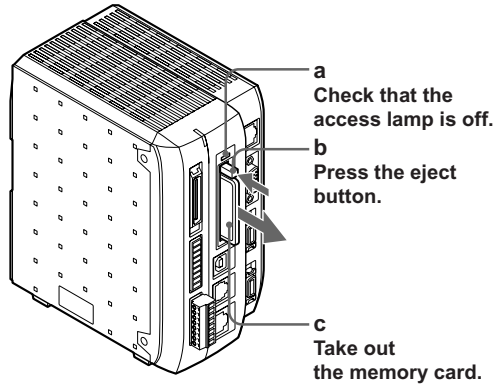
Saving the Program Settings

Saving the Specified Program Settings

Saves the program settings and screen data included in the specified program No. into the memory card.

► **Note**

Following operations cannot be performed if the memory card is not inserted.

1 Select the Prog. No. field in the upper left corner of the CV screen.

The Prog. No. menu is displayed.

2 Select [New/Edit/Del settings].
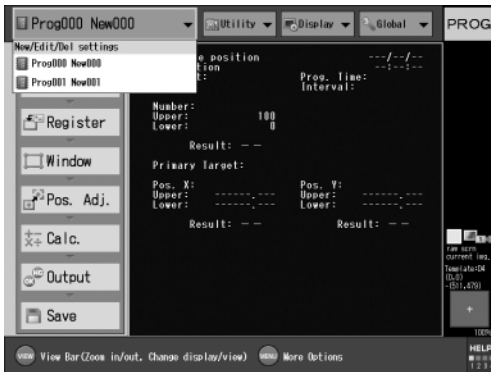
The [New/Edit/Del settings] screen appears.

3 Select [Save].
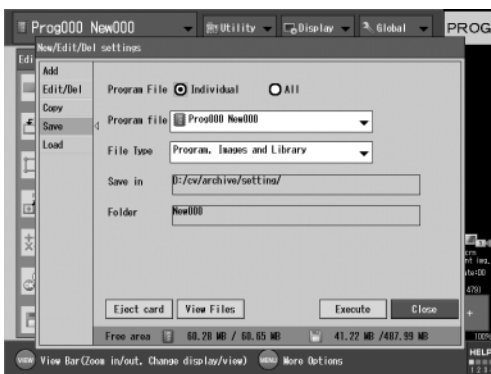
4 Select [Individual] for the [Program File].

5 Select [Program file] and select the program No. whose data you want to save to the memory card.

6 Select [File Type] and select the contents of the program settings to be saved.

- **Program only**: Saves only the program settings included in the selected program No.
- **Images only**: Saves only the image data included in the selected program No.
- **Library only**: Saves only the library data included in the selected program No.
- **Program + Images**: Saves the program settings and the image data included in the selected program No.
- **Program + Library**: Saves the program settings and the library data included in the selected program No.
- **Program + Images + Library**: Saves the program settings, the image data, and the library data included in the selected program No.

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

Specify the folder since all the program files are managed by folder names in the CV.

► **Note**

A folder in the "D:/CV/setting" folder cannot be set as the [Save in] location.

8 Select [Folder] and specify the folder to which the data will be saved.

9 Select [Execute].

Saving operation of the selected program settings is executed. When saving operation is completed, a confirmation screen appears.

Reference

When switching form Program mode to Run mode after modifying a program, a menu will appear asking you to save the changes made to the program.Choose [OK] to save or [Cancel] to continue without saving.

10 Select [Close].

Reference

The available free space on the internal memory and the compact flash memory card is displayed at the bottom of the [New/Edit/Del setting] screen in this order from the left : "available free space in the internal memory/total size, available free space on the compact flash memory card/total size".

Saving All the Program Settings and Global Settings

Saves the program settings and image data included in all program Nos. to the memory card.

► Note

Following operations cannot be performed if the memory card is not inserted.

1 **Select the Prog. No. field in the upper left corner of the CV screen.**
The Prog. No. menu is displayed.

2 **Select [New/Edit/Del settings].**

The [New/Edit/Del settings] screen appears.

3 **Select [Save].**
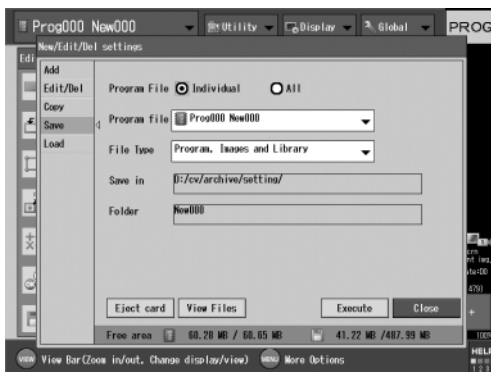
4 **Select [All] for the [Program File].**

5 **Select [Program file] and select the program settings you want to save to the memory card.**
- **All the settings memory currently in the internal memory**: Saves all the program settings currently in the internal memory.
- **All the settings within the memory card**: Saves all the program settings currently in the memory card.

6 **Select [File Type] and select the contents of the program settings to be saved.**
- **Program only**: Saves only the program settings from the location specified in [Save].
- **Images only**: Saves only the image data from the location specified in [Save].
- **Library only**: Saves only the library data from the location specified in [Save].
- **Program + Images**: Saves all of the program settings and image data from the location specified in [Save].
- **Program + Library**: Saves all of the program settings and library data from the location specified in [Save].
- **Program + Images + Library**: Saves all of the program settings, image data, and library data from the location specified in [Save].
- **Program + Images + Library + Global**: Saves all of the program settings, image data, library data, and global data (page 7-1) from the location specified in [Save].

7 **Select [Save in] and specify where to save the data.**
Specify the folder since all the program files are managed by folder names in the CV.

► Note

A folder in the "D:/CV/setting" folder cannot be set as the [Save in] location.

8 **Select [Folder] and specify the folder to which the data will be saved.**

9 **Select [Execute].**
When saving operation is completed, a confirmation screen appears.

10 **Select [Close].**

Reference

The available free space on the internal memory and the compact flash memory card is displayed at the bottom of the [New/Edit/Del setting] screen in this order from the left : "available free space in the internal memory/total size, available free space on the compact flash memory card/total size".

Saving and Loading the CV Data to/from the Memory Card

Loading the Program Settings

Loading the Specified Program Settings

You can load the program settings and image data that are saved in a folder on the memory card into the specified program No.

► Note

• Following operations cannot be performed if the memory card is not inserted.
• If you want to use the program settings of CV-3501 in the CV-3001, certain conditions must be satisfied. See "Cautions about using program data created by the CV-3501 with the CV-3001" (Page 6) for more details.
• Setting data that is created, edited, or saved with the second edition III of the CV cannot be used with previous editions. On the other hand, setting data created with previous versions can be used with the second edition III.

1 **Select the Prog. No. field in the upper left corner of the CV screen.**
The Prog. No. menu is displayed.

2 **Select [New/Edit/Del settings].**
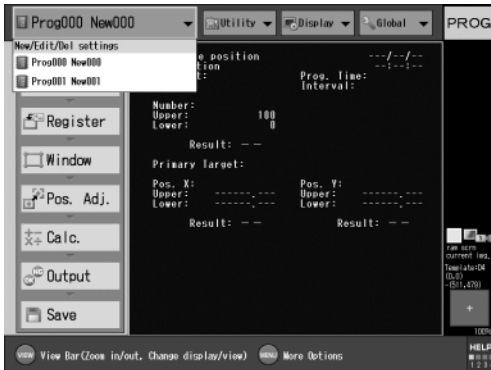
The [New/Edit/Del settings] screen appears.
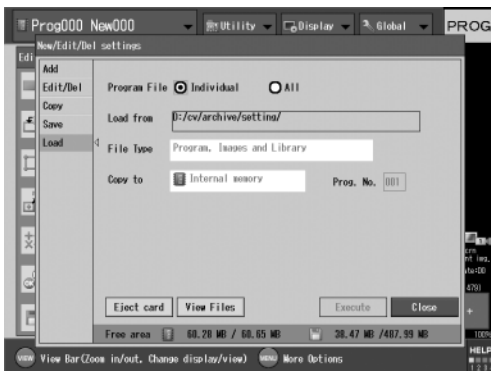
3 **Select [Load].**

4 **Select [Individual] in the [Program File].**

5 **Select [Load from] and specify the location of the desired program settings.**
Specify the folder since all the program files are managed by folder names in the CV.

► Note
A folder in the "D:/CV/setting" folder cannot be set as the [Load from] location.

6 **Select [File Type] and select the contents of the program settings to be loaded.**
• **Program only**: Loads only the program settings.
• **Images only**: Loads only the image data.
• **Library only**: Loads only the library data.
• **Program + Images**: Loads the program settings and the image data.
• **Program + Library**: Loads the program settings and the library data.
• **Program + Images + Library**: Loads the program settings, image data, and library data.

7 **Select [Copy to] and specify where to load the data.**
• **Internal memory**: Load the data to the internal flash memory.
• **Memory card**: Load the data to the memory card.

8 **After selecting [Prog No.], specify the program number where you would like the selected data to be loaded.**

9 **Select [Execute].**
Loading operation of the selected program settings is executed.
When loading operation is completed, a confirmation screen appears.

10 **Select [Close].**

Reference

The available free space on the internal memory and the compact flash memory card is displayed at the bottom of the [New/Edit/Del setting] screen in this order from the left : "available free space in the internal memory/total size, available free space on the compact flash memory card/total size".

Loading All the Program Settings and Global Settings

You can load the program settings, image data, and global data included in all the program numbers from the memory card.

► **Note**

• Following operations cannot be performed if the memory card is not inserted.

• If all the program settings and global data are loaded from the memory card, the existing program numbers are overwritten. Save the current program settings and global data in the memory card as required and then perform the following operations.

• If you want to use the setup data of CV-3501 in the CV-3001, certain conditions must be satisfied. See "Cautions about using program data created by the CV-3501 with the CV-3001" (Page 6) for more details.

• Setting data that is created, edited, or saved with the second edition III of the CV cannot be used with previous editions. On the other hand, setting data created with previous versions can be used with the second edition III.

1 **Select the Prog. No. field in the upper left corner of the CV screen.**
The [Prog. No.] menu is displayed.

2 **Select [New/Edit/Del settings].**
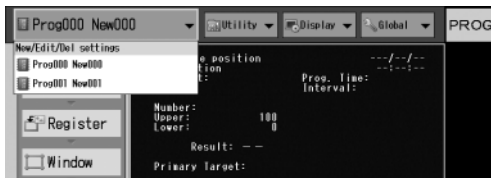
The [New/Edit/Del settings] screen appears.
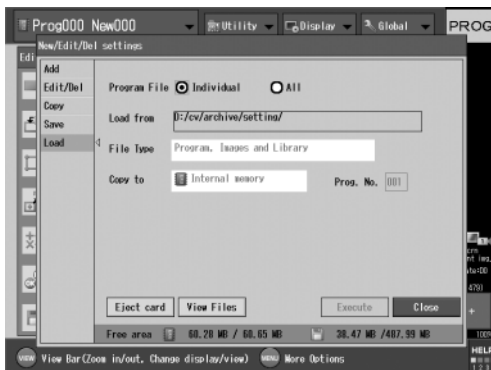
3 **Select [Load].**

4 **Select [All] in the [Program File].**

5 **Select [Load from] and specify the location of the desired program settings.**
Specify the folder since all the program files are managed by folder names in the CV.

► **Note**
A folder in the "D:/CV/setting" folder cannot be set as the [Load from] location.

6 **Select [File Type] and select the contents of the program settings to be loaded.**

• **Program only**: Loads only the program settings.

• **Images only**: Loads only the image data.

• **Library only**: Loads only the library data.

• **Program + Images**: Loads all the program settings and the image data.

• **Program + Library**: Loads all the program settings and the library data.

• **Program + Images + Library**: Loads all the program settings, image data, and library data.

• **Program + Images + Library + Global**: Loads all the program settings, image data, library data, and global data (page 7-1).

7 **Select [Load to] and specify where to load the data.**

• **Internal memory**: Load the data to the internal memory.

• **Memory card**: Load the data to memory card.

8 **Select [Execute].**
Loading operation of the selected program settings is executed. When the loading operation is completed, a confirmation screen appears.

9 **Select [Close].**

Reference

The available free space on the internal memory and the compact flash memory card is displayed at the bottom of the [New/Edit/Del setting] screen in this order from the left : "available free space in the internal memory/total size, available free space on the compact flash memory card/total size".

Saving and Loading the CV Data to/from the Memory Card

Saving or Loading the Global Settings of the CV

Saving the Global Settings

► **Note**

Following operations cannot be performed if the memory card is not inserted.

1 Select [Global] from the menu bar and select [Save/Load].

The [Save/Load Global Settings] menu appears.
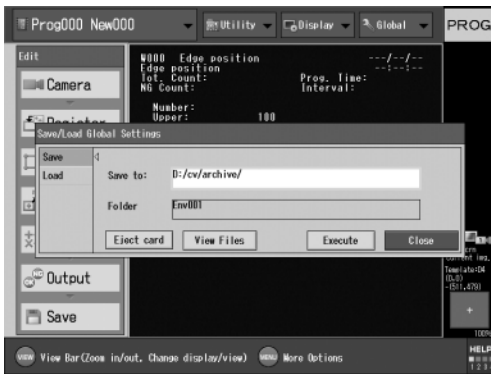
2 Select [Save].

3 Select [Save to] and specify where to save the Global settings.

Specify the folder since all the program files are managed by folder names in the CV.

4 Select [Folder] and specify the folder to which to global data will be saved.

5 Select [Execute].

The saving operation of the global data is executed. When the saving operation is complete, a confirmation screen appears.

6 Select [Close].

Loading the Global Settings

► **Note**

- Following operations cannot be performed if the memory card is not inserted.
- If the global data is loaded from the memory card, all the existing global data will be overwritten. Save the current global data in the memory and then perform following operations.
- Global settings data created with the second edition III of the system cannot be used with previous editions. On the other hand, setting data created with previous versions can be used with the second edition III.

1 Select [Global] from the menu bar and select [Save/Load Global Settings].

The [Save/Load Global Settings] menu appears.
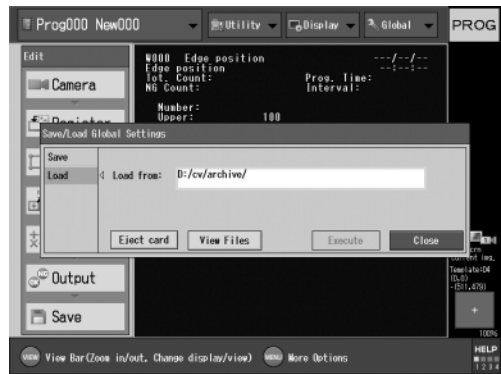
2 Select [Load].

3 Select [Load from] and specify the location of the desired global data.

Specify the folder since all the program files are managed by folder names in the CV.

4 Select [Execute].

The loading operation of the global data is executed. When the loading operation is completed, a confirmation screen appears.

5 Select [Close].

Types of Files that can be Saved in the Memory Card

The following table lists the types of files that are saved to the memory when you perform the procedures described in this chapter, and the data contained in those files.

Reference

- In the CV, all the program files are managed by folder names. Therefore, you must specify the folder name that contains the data when you save or load that data.
- If you change the name of the program file on the memory card, that file will not able to be used in the CV.
- The "number of measurement" value that is used in the file name will be reset to the default value when the power is turned on, when the RESET operation is executed, and when the program number is switched.
- The images that have been compressed cannot be loaded again in the CV. If you want to load stored images into the CV, select "1/1 (No Compression)" in the Image output setting (Page 4-289).

	File name	Data contained
Output file	• hhmmss_yymmdd_camera number_capture count.bmp • Header_hhmmss_yymmdd_camera number_capture count.bmp • Header_camera number.bmp	• The captured images that are saved by image output (Page 4-289) Data (1600 x 1200 or 1024 x 980, 512 x 480 dot, 24-bit color or 8-bit grayscale bitmap format) • If the captured image is not compressed, the data can be loaded again to the CV. • Three naming rules of the file name are available, which can be selected in the [Image Output] setting (Page 4-289).
	• Chhmmss_yymmdd.bmp • Sequential number of the header.bmp • Header.bmp	• The displayed screen data (800 x 600 dot, 24-bit color bitmap format) that is saved by screen capture (Page 1-4). • Three naming rules of the file name are available, which can be selected in the "Screen capture setting" (Page 7-7).
	Rhhmmss_yymmdd.csv	• Output data log of the measurement result (comma-delimited text data) • The contents that have been set in the memory card output setting (Page 4-287) are recorded and the file name is automatically assigned based on the time of file creation such as "hhmmss_yymmdd". • The file name is reset when the power to the CV is cycled, when the RESET operation is executed, and when the program number is switched. And another file is created when the data is saved for the first time after reset.
	Shhmmss_yymmdd_idx.csv	The index data (comma-delimited text data) of the measurement data that is saved for Statistics (Page 6-2).
	Shhmmss_yymmdd_dat.csv	The measurement data (comma-delimited text data) that is saved for Statistics (Page 6-2).
	Lhhmmss_yymmdd.log	The communication log data (text data) that is saved for RS-232C monitor (Page 6-22)
Program file (Do not change the file name.)	cvenv.dat	Global data of the CV (the binary data in a specialized format)
	cvset.dat	Data of the individual program number for the CV (the binary data in a specialized format)
	• ref camera number_registered image number.bmp • ref camera number_registered image number.jpg	Registered screen data in the CV (1600 x 1200, 1024 x 980, or 512 x 480 pixel, 24-bit color or 8-bit grayscale bitmat format or JPEG format)
Library file (Do not change the file name)	• cvdic library number.dat (When saved from the [Library Settings] menu, the name is "cvdic.dat".) Library data for OCR on the CV (exclusive format with binary data)	

Saving and Loading the CV Data to/from the Memory Card

Saving the Program Settings in your Computer

You can load data saved on the compact flash memory onto your computer and then save it to other media including hard disks and CD-Rs.

1 Slide the compact flash memory card in the PCMCIA adapter XV-A1 (optional), then insert the adapter in the PC card slot of your computer.

PCMCIA adaptor XV-A1
(sold separately)
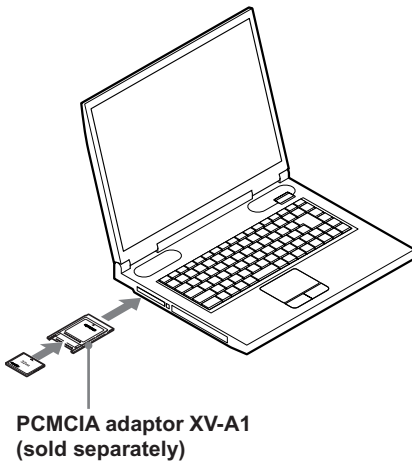
Reference
See the instruction manual of your computer for more information.

2 Open "My Computer" on the desktop and double-click the drive icon for the compact flash memory card.
The data stored on the memory card is displayed.
If the drive icon for the memory card does not appear in "My Computer", see "When the memory card is not recognized."

3 To save the data from the compact flash memory to another medium, copy the desired data by dragging-and-dropping them onto the icon of the destination medium.

When the memory card is not recognized

When using the memory card for the first time, you must specify its driver settings as follows. Complete the operation by following the steps below.

► Note
The actual screen displayed may slightly vary depending on the version of Windows you are using and the model of your computer.

1 Slide the memory card in the PCMCIA adapter, then insert the adapter in the PC card slot of your computer. When the following screen appears, click [Next].

Reference
The driver file for the memory card is included with Windows; it is not necessary to insert any floppy disk.

2 Click [Finish].
The driver for the memory card is now configured.

To open a saved file on your computer

- You can open files with the extension of ".bmp" using an image processing program such as "Paint" included with Windows.
- The file with the extension of ".csv" is comma-delimited text data. This type of file can be opened using a spreadsheet software.

► Note
- Because a specialized format is used for the program files in the CV, they cannot be opened with commercial software.
- Do not change the file name of the program files on the memory card. Otherwise, the program file cannot be loaded into the CV.

Overview of the Communication Ports

The following three types of communication ports are available on the system.
- RS-232C interface (Page 9-2)
- Ethernet interface (Page 9-3)
- USB interface (Page 9-8)

More than one communication port can be used at the same time.

With the RS-232C interface or the Ethernet interface, both the no protocol mode and the PLC link mode can be used for transmitting data. See "Chapter 10: Controlling the System or Outputting Data Via PLC Link" (Page 10-1) for more details about the PLC link.

Example of using the communication ports

Data such as the measurement results and NG screens are output to the PC via Ethernet while the Program number is controlled from the PLC via RS-232C.
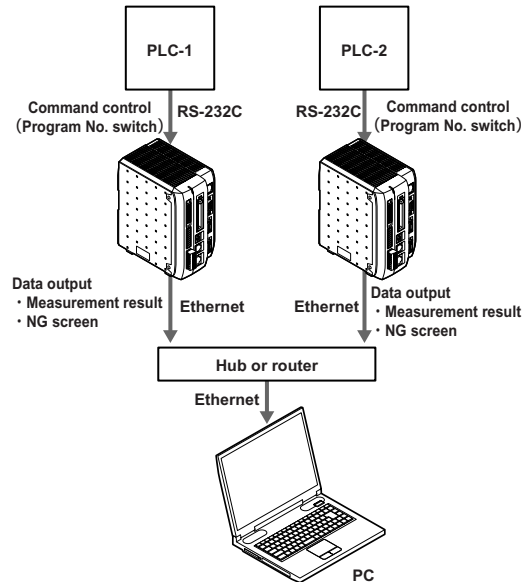
RS-232C Interface

The no protocol mode (Page 9-10) and the PLC link mode (Page 10-1) are used to communicate with external equipment via the RS-232C interface. The transmitted data is different depending on the communication mode. Change the mode depending on the environment. For more details about switching the communication mode, see "Changing the Communication Settings for the RS-232C/PLC Link (RS-232C/PLC Link)"(Page 7-3).

► **Note**

The signal GND and power GND are common to both communication modes. Be sure not to generate voltage potential difference with external equipment that are connected to the CV.

Connector Specifications of the RS-232C Port on the System

Basic specifications

• Connector: RJ-11
• Standard: The modem must comply with EIA (Electronic Industries Association) RS-232C standard.

Item	Specification
Communication system	Full-duplex
Synchronous system	Asynchronous
Transmission code	ASCII (binary code in parts)
Data bit length	8-bit
Stop bit length	1-bit/2-bit
Parity check	None/odd/even
Baud rate	9,600/19,200/38,400/57,600/ 115,200 bps
Data delimiter	CR/CR + LF
Flow control	None, CTS/RTS
Maximum cable length	15 m

Connector specifications

The specifications of the RS-232C port are as follows:
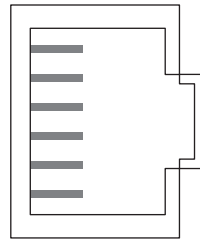
No.	Signal	Description of signal	Direction of signal
1	CS (CTS)	Data transmission permission	Output
2	Not used	—	—
3	SD (TXD)	Data transmission	Input
4	SG (GND)	GND	—
5	RD (RXD)	Data reception	Output
6	RS (RTS)	Data transmission request	Input

Reference

Since the system complies with the modem definition, SD is assigned to input and RD is assigned to output.

Ethernet Interface

Connecting to a Computer

The system can be connected to your computer using a dedicated cable (optional).

When the PC has a D-sub 9-pin connector

OP-26487（2.5m）

OP-26486

CV-3501/3001　　　　　**PC**
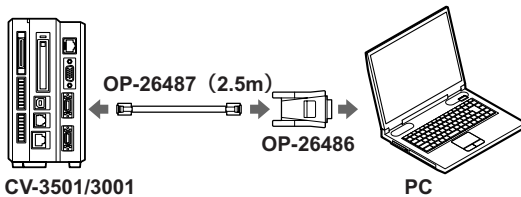
When the PC has a D-sub 25-pin connector

OP-26487（2.5m）

OP-26485

CV-3501/3001　　　　　**PC**
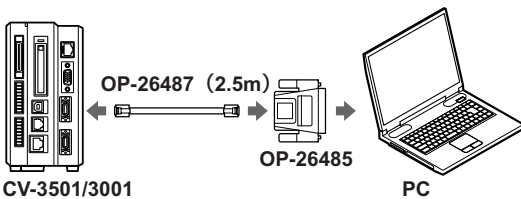
► **Note**

In the connection examples shown above, hard flow control is impossible. If hard flow control is needed, connect by the method shown on Page 10-6.

There are two types of communication modes when using the Ethernet port on the system to communicate with external devices: PLC link mode (Page 10-1) and no protocol mode (Page 9-10), which uses the same command codes as those used when communicating via RS-232C. Settings such as the IP Address, subnet mask, default gateway, and port number need to be specified under [Ethernet] in the Global menu. See "Changing Network Settings （Ethernet)" (Page 7-6) for more details on how to configure the Ethernet settings in the Global menu. When communicating in PLC link mode, use the settings described in "Changing the Communication Settings for the RS-232C/PLC Link (RS-232C/PLC Link)" (Page 7-3).

► **Note**

The connector shield and power GND are common to both communication modes. Be sure not to generate voltage potential difference with external equipment that are connected to the CV.

Communication Specifications of the Ethernet Port on the System

Basic specifications

- Connector: RJ-45
- Medium: 10 BASE-T/100 BASE-TX
- Communication protocol: TCP/IP (no protocol), UDP (PLC link)

Connector specifications

The specifications of the Ethernet port are as follows:
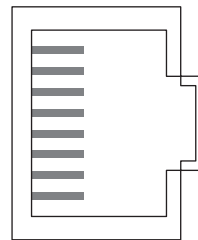
No.	Signal	Description of signal	Direction of signal
1	TX +	Differential data transmission	Output
2	TX -	Differential data transmission	Output
3	RX +	Differential data reception	Input
4	Not used	—	—
5	Not used	—	—
6	RX -	Differential data reception	Input
7	Not used	—	—
8	Not used	—	—

Preparation for Transmission via Ethernet

The system can be controlled via Ethernet by connecting it to a PC using an Ethernet cable.

► **Note**
- Consult your system administrator or network administrator when you want to connect to the existing LAN. If any setting is made incorrectly, not only the system but also other equipment on the network may not work properly.
- The system cannot be controlled concurrently from multiple PCs on the network.
- Depending on the network conditions, the output data from the system may be skipped. (The system does not resend the data for packet loss)
- A delay may occur in the data transmission between the network and the system, depending on the network conditions. If a response is required, such as a trigger input, it is recommended to communicate via the I/O interface.
- The firewall function on the connected PC must be disabled, as it may cause a problem with the communication.
- Use equipment for the network (such as HUB and LAN cables) that is intended for use in an FA environment. Using commercial equipment meant for office applications may cause unstable operations.

Communication specifications

The communication specifications via Ethernet are as follows:
- Communication protocol: TCP/IP (no protocol), UDP (PLC link)
- Topology: Peer to Peer

When the system is used in one-to-one connection with PC

This section describes how to prepare and communicate when the system is controlled in a one-to-one connection with a PC, not via LAN. To connect to your PC, an optional cross cable (3 m) OP-66843 should be used.

Cross cable（3m）
（**OP-66843**）
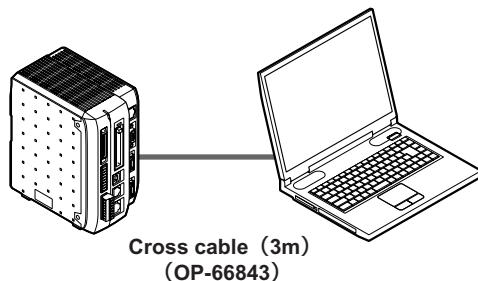
Connecting the CV to a PC

1 Change the TCP-IP settings

See "Changing Network Settings (Ethernet)" (Page 7-6) for more details.
It is not required to change the default values when you directly connect the system to a PC using a cross cable.

2 Change the TCP-IP settings on a PC.

When the system is directly connected to a PC with a cross cable, set the IP address between 192.168.0.1 to 192.168.0.255
excluding 192-168-0-10 (when the subnet mask of the system and PC are 255.255.255.0).
- **For Windows 95/98/Me**: Change the settings in the [Network] within the Control Panel.
- **For Windows 2000**: Change the settings in the [Network and Dial-up connections] within the Control Panel.
- **For Windows XP**: Change the settings in the [Network and Internet Connections] within the Control Panel.

See the instruction manual of your computer or LAN card for more information.

3 **Turn off the power of the CV and your PC and connect the Ethernet connector on the PC to the CV Ethernet port using a cross cable.**

4 **Turn on the power of the system and the PC.**

5 **Start [Command Prompt] on the PC.**
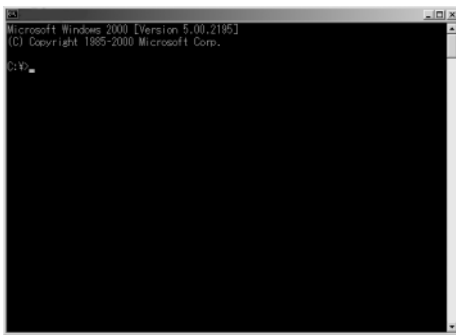
> **Reference**
> To start the command prompt, click the [Start] menu and then click [All Programs] - [Accessory] - [Command Prompt] in this order (for Windows XP).

6 **Enter [ping] followed by the IP address of the CV in alphanumeric characters and press the Enter key.**

When the IP address of the system is [192.168.0.10]
Enter [ping 192.168.0.10].
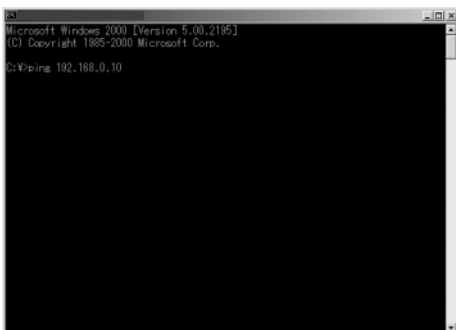
If the system and the PC are properly configured, a message [Reply from (the IP address of the system) ~] will appear.
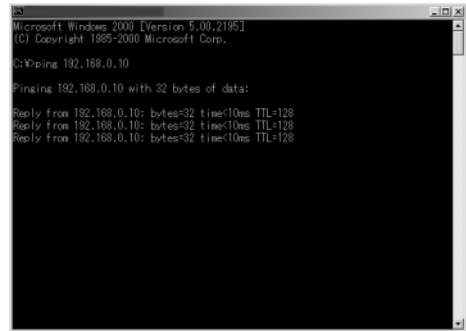
When [Request timed out] appears
If a message [Request timed out] appears and the correct IP address of the system has been specified in the ping command, the setting and configuration of the system and the PC are not successfully complete.
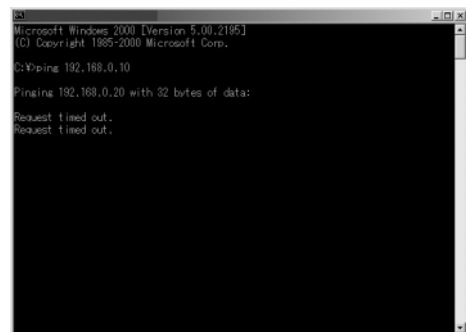
Check that the steps from 1 to 3 described on the previous page are properly performed.

Transmitting Data via the Communication Ports

Example of communicating with the system using Telnet software

You can use Telnet software to communicate with the system. In this example, operation using Tera Term (free software) is described.

Reference

See the following URL for details on Tera Term (as of April 2005).
http://www.vector.co.jp/soft/win95/net/se067018.html

1 Prepare Telnet software.

Obtain Telnet software such as Tera Term (freeware).

2 Start Telnet software on your PC and configure settings for the host.

• Host: Enter the CV's IP address. (Default value: 192.168.0.10)
• TCP port#: Enter the specified communication port. (Default value: 8500)

Example of host connection settings using Tera Term
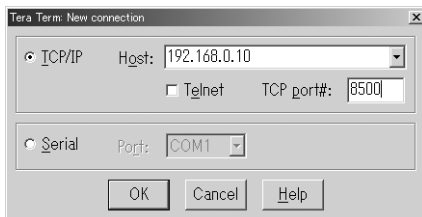
3 Connect the host.

If Tera Term is used, click [OK] after configuring the host computer connections.
The command system used in communication is the same as that of the no protocol mode in RS-232C. See Page 9-10 for more details.

Setup example of the Tera Term terminal
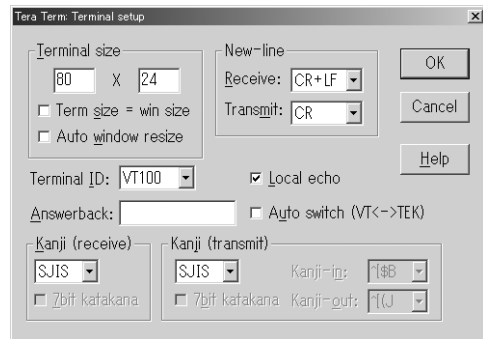
When the system is used in one-to-n connection with PCs

This section describes how to prepare and communicate when more than one CV-3501/3001 is controlled by one PC via LAN.

HUB
（router）
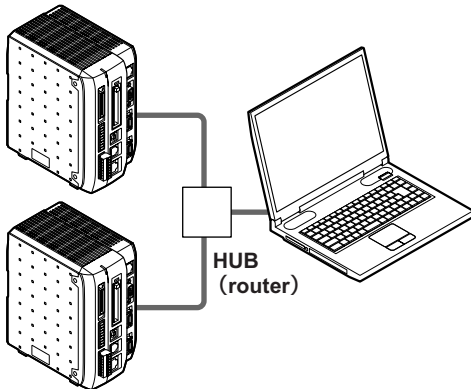
Difference between one-to-one connection and one-to-n connection

Preparation and control methods for one-to-n connection are basically the same as those for one-to-one connection. However, the following points differ.

- To connect multiple CV-3501/3001 units, a hub or router that supports 100BASE-TX or 10BASE-T is required.
- To connect a CV-3501/3001 unit to a hub (or router), use a commercial straight cable. Keyence recommends using an STP straight cable, category 5e or greater.
- The IP addresses of the CV-3501/3001 on the network and that of PC must be configured not to be overlapped each other.

  ### Example of using two CV-3501/3001 units (the subnet mask of the CV-3501/3001 are 255.255.255.0)

  – IP address of the first CV-3501/3001: 192.168.0.10 (default)
  – IP address of the second CV-3501/3001: 192.168.0.11 (changed because the default value overlaps the IP address of the first unit)
  – The IP address of the PC: 192.168.0.12 (Set it to a value that does not overlap the addresses of the CV-

3501/3001 units and other equipment on the network.)

- If a router is used, the Ethernet settings of the CV-3501/3001 units must be changed according to the settings of the router. For details, see the instruction manual of the router or consult your system administrator or network administrator.

Note on one-to-n connection

- A single CV-3501/3001 cannot be concurrently controlled by multiple PCs on the network. In addition, a single CV-3501/3001 cannot output data to multiple PCs on the network at the same time.
- Multiple CV-3501/3001 units cannot exchange data with each other or control each other.
- Consult your system administrator or network administrator when you want to connect to the existing LAN. If any setting is made incorrectly, not only the system but also other equipment on the network may not work properly.
- The baud rate or stability may vary depending on the combination of connected devices or the network status. Make sure to check the operations before starting actual operations on the system.

Transmitting Data via the Communication Ports

USB Interface

The command codes used in communication via the USB port are the same as those used for No Protocol mode via RS-232C. See Page 9-10 for more details.

See "Changing the USB Communication Settings (USB)" (Page 7-7) for more details on how to setup the USB in the Global menu.

► Note

The connector shield, signal GND, and power GND are common. Be sure not to generate voltage potential difference with external equipment connected to the CV.

Communication Specifications of the USB Port on the System

Basic specifications

- Connector: Female B connector
- Standard: Comply with USB Ver. 2.0 (USB Ver. 1.1 forward compatible), High-speed supported

Connector specifications

The specifications of the USB port on the system are as follows:
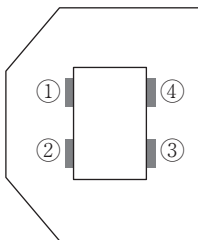
No.	Signal	Description of signal	Direction of signal
1	VBUS	VBUS	—
2	D-	Differential signal -	I/O
3	D+	Differential signal+	I/O
4	GND	GND	—

Connecting to the Computer

You can connect the CV to the PC via the USB port. To connect the CV to the PC, use a USB cable (2 m) OP-66844 (optional).

► Note

- Only a single PC can be connected to one system.
- If a cable other than OP66844 or the extension cable is used, the system may not fully operate.
- The USB port on the system is dedicated for communication. Typical USB devices such as a USB mouse or card reader cannot be connected to this port.
- Be sure to connect or disconnect the USB cable while the communication software is not running. If you disconnect the USB cable during transmission, exit the terminal software and then connect the cable again.
- With Windows 2000, connect the USB cable and start the communication software before starting transmission.
- Communication may be interrupted due to surrounding noise signals. If communication is interrupted, exit the terminal software, then disconnect and connect the USB cable, and restart the terminal software.
- If communication interruption frequently occurs, check whether there are noise sources (inverter, solenoid valve, etc.) around the CV or PC.

System requirements

To connect the system to a PC via the USB port, a system that satisfies following requirements is needed.

- Operating system: Microsoft Windows XP Professional Edition/Home Edition SP2 or later, or Windows 2000 Professional SP4 or later (Other Windows operating systems are not supported)
- USB port that supports USB2.0 (Although the system also operates with USB1.1, it may not fully operate).
- CD-ROM drive

Installing a driver

You must install a driver before connecting the system to a PC. After the driver is installed, the system can be used via the COM port.

► Note

To install a driver, the user must have administrator privileges.

This section describes how to install a driver, using Windows XP as an example.

1 **Turn on the power of the system and the PC.**

2 **When the PC starts, insert the supplied CD-ROM in the CD-ROM drive.**

3 **Connect the USB port of the CV and that of the PC using a cable OP-66844 (optional).**
   [New Hardware Search Wizard] appears on the screen of the PC.

4 **Select [Install from the list or specified location] and specify the folder that contains the USB driver.**
   Installation of the USB driver starts.

Reference
   • The USB driver is held in the \driver\USB directory in the downloaded CV-H3N files.
   • When you install a driver in the Windows XP environment, a warning message may appear. When a warning message appears, click [Continue] to continue installation.

5 **When copying the USB driver is completed, click [Finish].**
   The system is now connected to the PC via the USB port.
   After installing a driver, the USB port is recognized as a COM port, enabling the commercial terminal software to control the system. The protocol settings of the serial port such as communication speed, are automatically configured by the driver, so that it is not required to set them on the terminal software.

Transmitting Data via the Communication Ports

List of Communication Commands

Overview of Communication Commands for Control

The system can be controlled by commands from a PC or PLC. These commands are common to all communication ports (RS-232C, Ethernet, USB). (When the PLC link is used, some of the commands are not supported.)

Precautions Relating to Command Input/Output

Command input during operation

Most of the commands are accepted even during Run mode. But some commands temporarily stop the CV from receiving captured images. Be aware of the command timing and system status when inputting commands on a high speed production line.

There is a command (LK) that will enable/disable input communication to a specified communication port on the CV. Be aware of that status of each communication port. (Page 9-31)

• When a normal input command is issued to a communication port that has been disabled by the LK command, it will receive an [ER, (input command), 81] reply.
• The device input enabling command [LK] (Page 9-31) is accepted even if the specified communication port has been disabled.

Binary file checksum

The checksum CS that is added to the binary file does not normally need to be calculated, but it is required for operations such as using communication to load image data that was taken with a digital still camera. Use the following method to calculate the checksum.
Calculation method
The checksum is the calculated from taking the XOR (exclusive OR) from the beginning to the end (directly before the checksum) of the binary data in 1 byte units and inversing the bits for the requested value.

If an error occurs when a command is received

An error message [ER, ○○, nn CR] will be sent to the communication device if an error occurred while receiving the command.
The contents of errors are as follows.
• ○○: Received command that caused the error
• Example: If Program No. 1005 is specified in the program number change command, [ER, PW, 22, CR] (ER, program number change, data range error, CR) is sent.
• nn: ASCII 2-digit error codes
  – 00: Command error (the corresponding command does not exist)
  – 01: Command action disabled (the received command cannot be performed)
  – 02: Work memory error (unable to perform measurement due to insufficient work memory)
  – 22: Error in either the number of parameters or parameter range. There are more than 250 characters (CR counts as one character) in the entered command text.
  – 80: Password error (the specified password does not match)
  – 81: Password command error (the command is sent to a communication port that has been disabled)
  – 90: Checksum error
  – 91: Time limit exceeded error (three seconds have elapsed since the last data is sent from the PC)

Operation Modes and Input Enabling Commands of this Unit

○ = Input enabled

	Command	Run mode	Program mode	PLC supported	Note	Reference page
Trigger 1	T1	○		○	Does not send back the ASCII data of the results when the system is set for PLC Link.	Page 9-13
Trigger 2	T2	○		○		Page 9-13
Changing to RUN	R0		○			Page 9-14
Changing to Program mode	S0	○				Page 9-14
Repeat output measurement results	M0	○		○		Page 9-14
Writing the program number	PW	○		○		Page 9-15
Reading the program number	PR	○		○		Page 9-15
Writing the window number	UW	○		○		Page 9-16
Reading the window number	UR	○		○		Page 9-16
Display switching	DS	○		○		Page 9-16
Screen capture	BC	○	○	○/-	The screen is not output via the communication ports when the system is set for PLC Link.	Page 9-17
Image registration	BS	○		○		Page 9-18
Retrieving a list of registered images	BL	○		○		Page 9-18
Reading the image data	BR	○		○/-	The screen is not output via the communication ports when the system is set for PLC Link.	Page 9-19
Reading all screen data	BT	○		○		Page 9-20
Writing the program data	SW	○				Page 9-20
Reading the program data	SR	○				Page 9-22
Writing the Global settings data	SB	○				Page 9-24
Reading the Global settings data	SA	○				Page 9-24
Retrieving a list of library numbers	DL	○		○		Page 9-24
Writing the binary data	JW	○		○		Page 9-25
Reading the binary data	JR	○		○		Page 9-25

Transmitting Data via the Communication Ports

	Command	Run mode	Program mode	PLC supported	Note	Reference page
Writing the limit settings	DW	○		○		Page 9-25
Reading the limit settings	DR	○		○		Page 9-26
Writing the command memory	MW	○		○		Page 9-27
Reading the command memory	MR	○		○		Page 9-27
Setting initial values for command memory	MI	○		○		Page 9-27
Writing the camera settings	CW	○		○		Page 9-28
Writing the date and time settings	TW	○		○		Page 9-29
Reading date and time settings	TR	○		○		Page 9-29
Recalculating a base value	RR	○		○		Page 9-29
Saving the setup values	SS	○		○		Page 9-30
Resetting	RS	○		○		Page 9-30
Trigger input enabling	TE	○		○		Page 9-30
Communication enabling	LK	○		○		Page 9-31
Password	PS	○	○	○		Page 9-32
Remote control console pseudo input	KY	○	○	○		Page 9-32
Echoing	EC	○	○	○		Page 9-33
Reading statistics data	ST	○		○		Page 9-33

Details of Communication Commands

Trigger

Inputting a trigger

Performs a trigger.

Send	**T1** CR
Receive	**T1, result data** CR

► Note

When entering a trigger with communication commands, the image capture and command reply may be delayed. For applications that require precise image capture timing, such as then capturing images of moving objects, use TRG input on the terminal block.

Reference

- If there is no result data only T1 is output.
- See "Output Data List" (Page 4-294) for numerical data.
- If [T2] is specified instead of [T1], Trigger 2 is input in a similar way. [T1] is also output in this case.
- If the command is input from the remote control console or Trigger 1 or 2 is input, [T1] is output.
- Even when the [T2] command produces an error, ER, T1, and the error code CR are returned.

Error code

- 01: The command has been input at a time (e.g. Ready is not turned ON) that the trigger cannot be accep. Or the command has been input in Program mode.
- 22: An incorrect parameter has been used.

When automatic image output is set

The following responses are sent, timed to match the image output timing.

Receive	**T1 , c , t , nnnnnnnnnn , ddddddd , image data** CS

- c (camera number): 1 to 4
- t: Total status
  0: OK, 1: NG
- nnnnnnnnnn: Measurement count (0~1000000000)
- ddddddd: Data length of image data (including checksum)
- Image data: Binary (when using a color camera: 24-bit color bitmap format, when using a monochrome camera: 8-bit grayscale bitmap format)
- CS: Checksum

Reference

When outputting image data using multiple cameras, T1 and subsequent data are repeatedly output for each Camera.

When setting an individual trigger for each camera

The following response is sent after receiving the second trigger command.

Receive	**T1** CR **T2** CR
Receive	**T1, result data** CR

Reference

- The command can be received correctly, no matter whether T1 or T2 is sent first.
- [T1] is always returned.
- When [Continuous] is selected for the screen update mode, all of the images are captured after only T1 is received.

Transmitting Data via the Communication Ports

Change Mode

Changing to RUN mode

Enables the system to enter to the RUN mode.

Send   **R0** CR

Receive **R0** CR

> **Reference**
> This command is performed after the current measurement is completed.

Error code

22: An incorrect parameter has been used.

Changing to Program mode

Enables the system to enter to the Program mode.

Send   **S0** CR

Receive **S0** CR

> **Reference**
> During measurement, the command is performed after measurement is completed. During measurement result output, the command is performed after one measurement is output. During all other output, the command is performed after the output is canceled.

Error code

22: An incorrect parameter has been used.

Outputting the Latest Process Result Again

Reads the latest measurement result again. When automatic image output is set, the image data is also output.

Send   **M0** CR

Receive **M0 , Result data** CR

> **Reference**
> • This command is performed after the current measurement is completed.
> • See also "Output Data List" (Page 4-294).

Error code

• 01: The latest result data does not exist.
• 22: An incorrect parameter has been used.

Program No.

Switching the program number

Closes all the displayed program screens and switches to the specified program No.

Send	**PW , IN , nnn** CR
	Or
	PW , CF , nnn CR
Receive	**PW** CR

- IN: When switching to a Program No. that is saved in the internal memory
- CF: When switching to a Program No. that is saved in the memory card
- nnn: Program to be set (0 to 999)

Reference

- All volatile memory data (i.e, statistical data, image archive, etc) is erased when the Program No. is switched. (The reset operation is performed when switching the Program No.)
- During measurement, the command is performed after measurement is completed. During measurement result output, the command is performed after one measurement is output. During all other output, the command is performed after the output is canceled.

Error code

- 01: The Program No. that has been specified does not exist. Or the memory card is not available (cannot be accessed).
- 22: An incorrect parameter has been used.

Reading the program number

Returns the current Program No.

Send	**PR** CR
Receive	**PR , IN , nnn** CR
	Or
	PR , CF , nnn CR

- IN: When a Program No. that is saved in the internal memory is used
- CF: When a Program No. that is saved in the memory card is used
- nnn: Current Program No. (0 to 999)

Reference

This command does not affect the measurement process time.

Transmitting Data via the Communication Ports

Window No.

Switching the window number

Switches to the specified window No. and refreshes the screen.

> **Send** UW , nnn CR
>
> **Receive** UW CR
>
> • nnn: Window No. (0 to 127)

> **Reference**
>
> This command does not affect the measurement process time.

Error code

- 01: The command has been input at a time that the window No. cannot be switched. Or the window No. that has been specified does not exist.
- 22: Either the number, number of digits, or range of parameters is incorrect.

Reading the window number

Returns the current window No.

> **Send** UR CR
>
> **Receive** UR , nnn CR
>
> • nnn: Window No. (0 to 127)
> If no window is set, [0] is returned.

> **Reference**
>
> This command does not affect the measurement process time.

Display Setting

Switching the display template

> **Send** DS , PT , n CR
>
> **Receive** DS CR
>
> • n: Display template No. (0 to 9)
> 0: Raw screen
> 1: Filtered screen 1
> 2: Filtered screen 2
> 3: Contrast view
> 4-9: User defined templates

> **Reference**
>
> This command does not affect the measurement process time.

Error code

- 01: The display template that has been specified does not exist. Or it is disabled.
- 22: Either the number, number of digits, or range of parameters is incorrect.

Switching the result display

> **Send** DS , RS , n CR
>
> **Receive** DS CR
>
> • n: Result display No.
> 0: None
> 1: Default 1
> 2: Default 2
> 3: Calculation Results
> 4: Custom display

> **Reference**
>
> This command does not affect the measurement process time.

Error code

- 01: The result display that has been specified does not exist.
- 22: Either the number, number of digits, or range of parameters is incorrect.

Switching the page

Displays the specified page.

Send   **DS , PG , nnnn** CR
        Or
        DS , PG , P CR
        Or
        DS , PG , N CR
Receive DS CR

- nnnn: Specify page (0 to 9999)
- P: Move to the previous page
- N: Move to the next page

► **Note**
The value of [0] for [specify page] represents the first page.

Reference
This command does not affect the measurement process time.

Error code
- 01: Cannot move to other pages. Or the page that has been specified does not exist.
- 22: Either the number, number of digits, or range of parameters is incorrect.

Switching the screen

Switches to the specified screen when multiple screens are displayed.

Send   **DS , FC , n** CR
Receive DS CR

- n: Screen number (1 to 5)

Reference
This command does not affect the measurement process time.

Error code
- 01: Cannot switch the screen. Or the screen that has been specified does not exist.
- 22: Either the number, number of digits, or range of parameters is incorrect.

Image Data

Saving the current image (screen capture)

When saving to the memory card
Captures the screen and saves it to the memory card.

Send   **BC , CF** CR
Receive BC CR

Reference
- The file name of the saved image will be the one that has been specified in [Captured Images] of the [Global] menu. (Page 7-7) However, the destination folder is fixed to [D:CV]
- This command does not affect the measurement process time.

Error code
- 01: The memory card does not exist. Or, the memory card is not available.
- 22: Either the number or content of parameters is incorrect.

When outputting via the communication ports
Captures the screen and outputs it via a communication port.

Send   **BC , CM** CR
Receive **BC , ddddddd , image data** CS

- ddddddd: Data length of image data (including checksum)
- Image data: Binary (24-bit color bitmap format)
- CS: Checksum

Reference
This command does not affect the measurement process time.

Error code
22: Either the number or content of the parameters is incorrect.

Registering an image

Registers the latest captured image specified by camera No..

Send　**BS , c , nnn** CR

Receive **BS** CR

- c: camera number (1 to 4)
- nnn: Registered image No.(0 to 999)

Reference
- This command is performed after the current measurement is completed.
- The latest captured image means the image that has been captured after a trigger was input in RUN mode.

Error code
- 01: The memory card is not available (cannot be accessed) when attempting to access memory card. Cannot register the image due to insufficient free space. Or the specified camera is not connected.
- 02: Work memory error
- 22: Either the number or content of the parameters is incorrect.

Image formats and sizes handled on the system
The following table shows the relationship between pixel mode, file size, and the camera used by the system.

Camera	When using a color camera	When using a monochrome camera
	24-bit color bitmap format	8-bit grayscale bitmap format
Standard mode	737,334 bytes	246,838 bytes
1 megapixel mode	2,949,174 bytes	984,118 bytes
2 megapixel mode	5,760,054 bytes	1,921,078 bytes
Screen capture	1,440,054 bytes (24-bit color bitmap)	

- The display size does not include the checksum (1 byte) used during communication.
- When using a compressed registered image, the image is saved in JPEG format and the file size changes depending on the image.

Retrieving a list of registered images

Retrieves a list of registered images that have been previously saved (example: BL, 000, 002, 008).

Send　**BL , IN , nnn , c** CR

　　　　Or

　　　　BL , CF , nnn , c CR

　　　　Or

　　　　BL , CP , c CR

Receive **BL , (returns the registered screen numbers (3 digit, 000 to 999) that have been set in the specified program in comma delimited format)** CR

- IN: When a list of registered images that is saved in the internal memory is retrieved
- CF: When a list of registered images that is saved in the memory card is retrieved
- CP: When a list of current registered images in the current program is retrieved
- nnn: The Program No. of the registered image to be retrieved (0 to 999)
- c: camera No. (1 to 4)

Reference
- This command does not affect the measurement process time.
- If there are no registered images in the specified program, only BL is returned.

Error code
- 01: The memory card is not available (cannot be accessed) when attempting to access memory card.
- 22: Either the number or content of the parameters is incorrect.

Reading the image data

When retrieving it via the communication ports

The current image that is stored in the image buffer is output to a communication device in binary format.

Send   **BR , CM , c , m , nnnnnnnnnn** CR

              Or

              BR , CM , c , m , NW CR

              Or

              BR , CM , c , m , NG CR

              Or

              BR , CM , c , m , OK CR

Receive   **BR , c , t , nnnnnnnnnn , ddddddd**

              , image data CS

- c: camera number (1 to 4)
- t: Total status
  0: OK, 1: NG
- m: Compression ratio
  0: No compression, 1: 1/2, 2: 1/4, 3: 1/8
- nnnnnnnnnn: Measurement count
  (0~1000000000)
- ddddddd: Data length of image data
  (including checksum)
- NW: When specifying the latest image
- NG: When specifying the latest NG image
- OK: When specifying the latest OK image
- Image data: Binary (when using a color camera: 24-bit color bitmap format, when using a monochrome camera: 8-bit grayscale bitmap format)
- CS: Checksum

Reference
- This command does not affect the measurement process time.
- When [Output Image] in the [Output] menu is ON, a new image will not be output while this command is being processed.

Error code
- 01: The specified image does not exist in the buffer at the instant of interpreting the command. Or the specified camera is not connected.
- 22: Either the number or content of the parameters is incorrect.

When saving to the memory card

The current image data that is stored in the image buffer is written to the memory card in bitmap format.

Send   **BR , CF , c , m , nnnnnnnnnn , File name** CR

           Or

           BR , CF , c , m , NW , File name CR

           Or

           BR , CF , c , m , NG , File name CR

           Or

           BR , CF , c , m , OK , File name CR

Receive   **BR , c , t , nnnnnnnnnn** CR

- c: camera number (1 to 4)
- t: Total status
  0: OK, 1: NG
- m: Compression ratio
  0: No compression, 1: 1/2, 2: 1/4, 3: 1/8
- nnnnnnnnnn: Measurement count
  (0~1000000000)
- NW: When specifying the latest image
- NG: When specifying the latest NG image
- OK: When specifying the latest OK image
- File name: The name of the bitmap file that is to be written in the memory card. (Specify the file name with a path such as "/CV/TEST.bmp".)

Reference
- This command does not affect the measurement process time.
- The format of the bitmap file will be 24-bit color for a color camera and 8-bit grayscale for a monochrome camera.

Error code
- 01: The memory card or the specified folder does not exist (cannot be accessed) when attempting to access the memory card. At the instant of interpreting the command, the specified image does not exist in the image buffer or the specified camera is not connected, or the image capture has not been performed by using the specified camera,
- 22: Either the number or content of the parameters is incorrect.

Reading all image data

All the images that are stored in the image buffer are written to the memory card in bitmap format.

Send   **BT , c , m , AL , folder name** CR

Or

BT , c , m , OK , folder name CR

Or

BT , c , m , NG , folder name CR

Receive **BT** CR

- c: camera number (1 to 4)
- m: Compression ratio
  0: No compression, 1: 1/2, 2: 1/4, 3: 1/8
- AL: When saving all the image data stored in the image buffer
- NG: When saving all the NG images stored in the image buffer
- OK: When saving all the OK images stored in the image buffer
- Folder name: The name of the folder to write to in the memory card. (For example, [/CV].)

Reference
- This command does not affect the measurement process time.
- The format of the bitmap file will be 24-bit color for a color camera and 8-bit grayscale for a monochrome camera.
- The image is saved with the file name [hhmmss_yymmdd_camera number_measurement count (10 digits).bmp].
  Example: 190501_050209_1_0000010023.bmp
- If there are no images in the image buffer, only BT is returned.
- If the specified folder does not exist, a new one is created.
- When [Output Image] (Page 4-289) in the [Output] menu is ON, a new image will not be output while this command is being processed.

Error code
- 01: The memory card is not available (cannot be accessed) when attempting to access the memory card. Or the specified camera is not connected.
- 22: Either the number or content of the parameters is incorrect.

Saving or Loading the Program Data

Writing the Program data

Loads the Program No. data from a communication device. Performing this command not only allows the loaded data to be reflected in the current Program No., but it also allows new data to be loaded into Programs saved in the internal memory or the memory card.

Send   **SW , DT , IN , nnn , ddddddd , Program data** CS

Or

SW , DT , CF , nnn , ddddddd , Program data CS

Or

SW , DT , CP , ddddddd , Program data CS

Receive **SW** CR

- IN: When writing the Program data into a Program No. that is stored in the internal memory
- CF: When writing the Program data into a Program No. that is stored in the memory card
- CP: When writing the Program data into the current Program No.
- nnn: Destination Program No. (0 to 999)
- ddddddd: Data length of the Program No. data (including checksum)
- Program data: Program data from a single Program number (binary)
- CS: Checksum

Reference
- During measurement, the command is performed after measurement is completed. During measurement result output, the command is performed after one measurement is output. During all other output, the command is performed after the output is canceled.
- Register the images separately by following the instruction of [Writing a registered image] on the following page.

Error code

- 01: An inconsistency occurred in the Program No. data. The free space of the destination device is insufficient or failed to write the data.
- 02: Work memory error
- 22: Either the number or the content of the parameters is incorrect.
- 90: Checksum error
- 91: Timeout error .

Writing a registered image

Loads the image data from a communication device and saves it as a registered image in the specified Program No.

Send **SW , BD , IN , nnn , c , mmm ,**
ddddddd , image data CS
Or
SW , BD , CF , nnn , c , mmm ,
ddddddd , image data CS
Or
SW , BD , CP , c , mmm , ddddddd
, image data CS

Receive **SW** CR

- IN: When registering the image to a Program No. that is saved in the internal memory
- CF: When registering the image to a Program No. that is saved in the memory card
- CP: When registering the image to the currently selected Program No.
- nnn: Destination Program No. (0 to 999)
- c: camera number (1 to 4)
- mmm: Registered image No.(0 to 999)
- ddddddd: Data length of the registered image data (including checksum)
- Image data: Registered image data (binary)
- CS: Checksum

Reference

This command is performed after the current measurement is completed.

Error code

- 01: An inconsistency occurred in the Program data. The free memory space of the destination CV is insufficient or failed to write the data. The specified camera is not connected.
- 02: Window memory error
- 22: Either the number or content of the parameters is incorrect.
- 90: Checksum error
- 91: Timeout error

Writing the library data

Loads the library data from a communication device and saves it as library data in the specified Program No. The registered library data is saved in the specified Program No. as a binary file named "cvdic library number.dat".

Send **SW , DC , IN , nnn , mmm , dddddd , library data** CR
Or
SW , DC , CF , nnn , mmm , dddddd , library data CR
Or
SW , DC , CP , mmm , dddddd , library data CR

Receive **SR , dddddd , setup data** CS

- IN: When registering the library data to a Program No. that is saved in the internal memory
- CF: When registering the library data to a Program No. that is saved in the memory card
- CF: When registering the library data to a Program No. that is saved in the memory card
- nnn: Destination Program No. (0 to 999)
- mmm: Library No. (0 to 999)
- Setup data: Setup data (binary)
- dddddd: Data length of the library data (including checksum)
- Library data: Library data (binary)
- CS: Checksum

Reference
- This command is performed after the current measurement is completed.
- The base values are not updated, so in order to reflect changes to the base values, the separate update base value command must be executed.

Error code
- 01: The Program No. that has been specified does not exist. The data cannot be read out from the internal memory or from the memory card. Access became disabled while accessing the memory card.
- 02: Failed to register the pattern
- 22: Error in either the number of parameters or parameter data.
- 90: Checksum error
- 91: Timeout error

Reading the program data

Loads the specified Program data and outputs it in binary format.

Send **SR , DT , IN , nnn** CR
Or
SR , DT , CF , nnn CR
Or
SR , DT , CP CR

Receive **SR , dddddd , setup data** CS

- IN: When reading data from a Program that is stored in the internal memory
- CF: When reading data from the Program that is stored in the memory card
- CP: When reading data from the currently selected Program No.
- nnn: The Program No. from which the data is read (0 to 999)
- dddddd: Data length of program data (including checksum)
- Setup data: Setup data (binary)
- CS: Checksum

Reference
- This command does not affect the measurement process time.
- Read the images separately by following the instruction of "Reading a registered image" on the next page.

Error code
- 01: The Program No. that has been specified does not exist. The data cannot be read out from the internal memory or from the memory card. Access became disabled while accessing the memory card.
- 22: Either the number or content of the parameters is incorrect.

Reading a registered image

Reads the registered image of the specified Program No. and outputs it via a communication port.

Send   **SR , BD , IN , nnn , c , mmm** CR

        Or

        SR , BD , CF , nnn , c , mmm CR

        Or

        SR , BD , CP , c , mmm CR

Receive   **SR , ddddddd , image data** CS

- IN: When reading the registered image from a Program No. that is stored in the internal memory
- CF: When reading the registered image from a Program No. that is stored in the memory card
- CP: When reading the registered image from the currently selected Program No.
- nnn: The Program No. from which the registered image is read (0 to 999)
- c: camera number (1 to 4)
- mmm: Registered image No.(0 to 999)
- ddddddd: Data length of the registered image data (including checksum)
- Image data: Registered image data (binary)
- CS: Checksum

Reference

This command does not affect the measurement process time.

Error code

- 01: The registered image that has been specified does not exist. The image data cannot be read from the internal memory or from the memory card.
- 22: Either the number or content of the parameters is incorrect.

Reading the library data

Reads the library data of the specified Program No. and outputs it in binary format.

Send   **SR , DC , IN , nnn , mmm** CR

        Or

        SR , DC , CF , nnn , mmm CR

        Or

        SR , BD , CP , mmm CR

Receive   **SR , ddddddd , library data** CS

- IN: When reading the library data to a Program No. that is saved in the internal memory
- CF: When reading the library data to a Program No. that is saved in the memory card
- CP: When reading the library data from the currently selected Program No.
- nnn: Library No. (0 to 999)
- mmm: Registered image No.(0 to 999)
- ddddddd: Data length of the library data (including checksum)
- Library data: Library data (binary)
- CS: Checksum

Reference

This command does not affect the measurement process time.

Error code

- 01: The library data that has been specified does not exist. The library data cannot be read from the internal memory or from the memory card.
- 22: Error in either the number of parameters or parameter data.

Transmitting Data via the Communication Ports

Acquiring the Library List

Acquires the list of library numbers that have set data. (Example when D000, D002, D008 have registered information: DL, 000, 002, 008)

Send **DL , IN , nnn** CR

 Or

 DL , CF , nnn CR

 Or

 DL , CP CR

Receive **DL, (the numbers for configured registered images (3 digits, 000 to 999) delimited by commas)** CR

- IN: When acquiring a list of library numbers that are saved in the internal memory
- CF: When acquiring a list of library numbers that are saved in the memory card
- CP: When acquiring a list of library numbers for the current Program No.
- nnn: Program No. for the library number to acquire (0 to 999)

> **Reference**
> - This command does not affect the measurement process time.
> - If the specified library does not exist, only DL is returned.

Error code
- 01: When attempting to access a memory card, a memory card does not exist (cannot be accessed)
- 22: Error in either the number of parameters or parameter data.

Saving or Loading the Global Settings Data

Writing the global settings data

Send **SB , ddddddd , global data** CS

Receive **SB** CR

- ddddddd: Data length of the global settings data (including checksum)
- Global data: Global settings data (binary)
- CS: Checksum

> **Reference**
> During measurement, the command is performed after measurement is completed. During measurement result output, the command is performed after one measurement is output. During all other output, the command is performed after the output is canceled.

Error code
- 01: Failed to write the data.
- 22: Either the number or content of the parameters is incorrect.

Reading the global settings data

Send **SA** CR

Receive **SA , ddddddd , global data** CS

- ddddddd: Data length of the global settings data (including checksum)
- Global settings data: Global settings data (binary)
- CS: Checksum

> **Reference**
> This command does not affect the measurement process time.

Error code
- 01: The global setting data does not exist.
- 22: Either the number or content of the parameters is incorrect.

Writing or Reading Binary Filter Data

Writing binary filter data

You can specify the upper and lower limit on the binary filter of the specified window.

Send   **JW , nnn , xxx , yyy** CR

Receive   **JW** CR

- nnn: Window No. (0 to 127)
- xxx: Upper limit of the binary data (0 to 5)
- yyy: Lower limit of the binary data (0 to 255)

Reference
- This command does not affect the measurement process time.
- To reflect the result of changing the binary data on reference values (for position adjustment or calculation), perform recalculation of the reference values (RR, Page 9-29) separately.

Error code
- 01: The binary filter is not set.
- 22: Either the number, number of digits, or range of parameters is incorrect.

Reading binary filter data

You can read the upper and lower limit of the binary filter of the specified window.

Send   **JR , nnn** CR

Receive   **JR , xxx , yyy** CR

- nnn: Window No. (0 to 127)
- xxx: Upper limit of the binary data (0 to 5)
- yyy: Lower limit of the binary data (0 to 255)

Reference
This command does not affect the measurement process time.

Error code
- 01: The binary filter is not set.
- 22: Either the number, number of digits, or range of parameters is incorrect.

Writing or Reading the Window or Calculation Limits

Writing the window or calculation limits

Sets the upper and lower limit of the specified window.

Send   **DW , W(C)nnn . aa . bb , mmmmmm** CR

Receive   **DW** CR

- nnn: Measurement window W000 to W127, or calculation window C000 to C127. For a measurement window, "W" appears before "nnn". For a calculation window, "C" appears before "nnn".
- aa: Limit type (See [Measured Value Calculation Symbol Table] (Page 4-267.) Items that have [HL] and [LL] values in the table support writing of limits.)
- bb: Specify upper/lower limit (HL: Upper limit, LL: Lower limit)
- mmmmmm: Limit values (The number of digits differ depending on the limit.)

► Note
The symbols that are inserted between nnn . aa . bb are not commas (,) but dots (.).

Reference
- This command does not affect the measurement process time.
- The result of writing the data is reflected on the image processing immediately after it is written. When the continuous capturing function (Page 4-17) is used, the result will be reflected on the next image processing immediately after completing the continuous capture.
- Calculation limits that are used in calculation reference cannot be written (01 error is returned).
- When using an OCR measurement window, judged text only applies to fixed characters (letters, numbers, symbols, and custom characters) and it is written to the same location regardless of whether HL or LL are set. If HL is set to other calculation limits, 01 error is produced.

Error code
- 01: The limit specified with aa and bb does not exist in the specified window.
- 22: Either the number, number of digits, or range of parameters is incorrect.

Transmitting Data via the Communication Ports

Example:

• When changing the upper limit of the measurement window 005 (Area tool) to 1200

> **Send**   **DW , W005 . AR . HL , 1200** CR
>
> **Receive** **DW** CR

• When changing the lower limit of the calculation window 010 to -142.214

> **Send**   **DW , C010 . MS . LL , -142.214** CR
>
> **Receive** **DW** CR

Reading a limit value

Reads the upper and lower limit of the specified window.

> **Send**   **DR , W(C)nnn . aa . bb** CR
>
> **Receive** **DR , mmmmmm** CR

- • nnn: Measurement window W000 to W127, or calculation window C000 to C127. For a measurement window, "W" appears before "nnn". For a calculation window, "C" appears before "nnn".
- • aa: Limit type (See "Measured Value Calculation Symbol Table" (Page 4-267.) Items that have [HL] and [LL] values in the table support reading of limits.
- • bb: Specify upper/lower limit (HL: Upper limit, LL: Lower limit)
- • mmmmmm: Limit values (The number of digits differ depending on the limit.)

► **Note**

The symbols that are inserted between nnn . aa . bb are not commas (,) but dots (.).

Reference

- • This command does not affect the measurement process time.
- • When using an OCR measurement window, the program status for items other than fixed characters (letters, numbers, symbols, and custom characters) for judged text is read ([Year4] is read for calendar) and the same result is read regardless of whether HL or LL are set.
  If HL is set to other calculation limits, 00 error (nonnumeric) is always produced.

Error code

- • 01: The limit type specified with aa and bb does not exist in the specified window.
- • 22: Either the number, number of digits, or range of parameters is incorrect.

Example:

When reading the lower limit of x-coordinate (256.030) in the measurement window 005 (pattern search)

> **Send**   **DR , W005 . X . LL** CR
>
> **Receive** **DR , + 00256.030** CR

Writing or Reading the Data to/ from the Command Memory

Writing the data to the command memory

Sets data into a maximum of 32 pieces of specified command memory.

Send **MW , nn1 , xx1 [, nn2 , xx2···]** CR

Receive **MW** CR

- nn1, nn2, ··· : The 1st, 2nd, Åc command memory Nos. (0 to 127)
- xx1, xx2, ··· : The data written to the 1st, 2nd, ··· command memory (-2147483648 to 2147483647, can decide whether to add "+" (plus sign) to positive number and whether to add "+" (plus sign) or "-" (negative sign) to the number "0".)

Reference
- This command does not affect the measurement process time.
- The upper and lower limits that have been programmed in the command memory setup (Page 6-28) are not applied.
- The result of writing the data is reflected on the image processing immediately after it is written. When the continuous capturing function (Page 4-17) is used, the result will be reflected on the next image processing immediately after completing the continuous capture.

Error code
Error in either the number of parameters or parameter range. There are more than 250 characters (CR counts as one character) in the entered command text.

Setting initial values for command memory

Sets all of the current command memory values as the initial values for command memory.

Send **MR , nnn** CR

Receive **MR , xxxxxxxxxx** CR

- nnn: command memory No. (0 to 127)
- xxxxxxxxxx: Data to be read out (The data rages from - 2147483648 to 2147483647 in integer from consisting of a positive sign (+) and 10-digit numerals, where the value "0" has the positive sign (+).)

Reference
This command does not affect the measurement process time.

Error code
22:Either the number, number of digits, or range of parameters is incorrect.

Setting internal values for command memory

Sets all of the current comman memory values as the initial values for command memory.

Send **MI** CR

Receive **MI** CR

Reference
- This command does not affect the measurement process time.
- You cannot set only selected current values as the initial values for command memory data.

Error code
22:Either the number, number of digits, or range of parameters is incorrect.

Transmitting Data via the Communication Ports

Changing the Camera Settings

Changing the shutter speed

Send   **CW , SH , c , nn** `CR`

Receive **CW** `CR`

- c: camera number (1 to 4)
- nn: Shutter speed
  - 0: 1/15
  - 1: 1/30
  - 2: 1/60
  - 3: 1/120
  - 4: 1/240
  - 5: 1/500
  - 6: 1/1000
  - 7: 1/2000
  - 8: 1/5000
  - 9: 1/10000
  - 10: 1/20000

Reference

- This command is performed after the current measurement is completed.
- You cannot change the shutter speed of multiple cameras during measurement. If you want to change the shutter speed of multiple cameras, stop the measurement and then change the settings of each camera.

Error code

- 01: The specified camera does not exist or is not connected or is not used by any window.
- 22: Either the number or content of the parameters is incorrect.

Specifying the camera sensitivity

Send   **CW , SE , c , nn** `CR`

Receive **CW** `CR`

- c: camera number (1 to 4)
- nn: sensitivity (10 to 90)

Reference

- This command is performed after the current measurement is completed.
- One tenth (1/10) of nn is specified as a sensitivity of the camera.
- You cannot change the sensitivity of multiple cameras during measurement. If you want to change the sensitivity of multiple cameras, stop the measurement and then change the settings of each camera.

Error code

- 01: The specified camera does not exist or is not connected or is not used by any window.
- 22: Either the number or content of the parameters is incorrect.

Writing or Reading the Date and Time

Writing the date and time

Writes the specified date and time to the system.

Send   TW , yy , mo , dd , hh , mi , ss CR

Receive TW CR

- yy: Lower two digits of the western calendar (e.g. 04 for 2004) (00 to 99)
- mo: month (01 to 12)
- dd: day (01 to 31)
- hh: hour (in 24-hours display) (00 to 23)
- mi: minute (00 to 59)
- ss: second (00 to 59)

Reference
This command does not affect the measurement process time.

Error code
22: Either the number or content of the parameters is incorrect.

Reading a date and time

Reads the date and time that are set on the system.

Send   TR CR

Receive TR , yy , mo , dd , hh , mi , ss CR

- yy: Lower two digits of the western calendar (e.g. 04 for 2004) (00 to 99)
- mo: month (01 to 12)
- dd: day (01 to 31)
- hh: hour (in 24-hours display) (00 to 23)
- mi: minute (00 to 59)
- ss: second (00 to 59)

Reference
This command does not affect the measurement process time.

Error code
22: An incorrect parameter is added. Either the number, number of digits, or range of parameters is incorrect.

Recalculating a Reference Value

Recalculates a reference value using the currently registered images.

Send   RR CR

Receive RR CR

► **Note**
If recalculation is performed when a registered image does not exist, the measurement result of the black screen becomes the reference value.

Reference
- This command is performed after the current measurement is completed.
- The result of recalculation using a RR command is not saved in the internal memory or memory card. Use the SS command (Saving the Settings) to save the result.

Error code
- 01: Window memory is insufficient to perform recalculation.
- 22: The incorrect parameter is added.

Transmitting Data via the Communication Ports

Saving the Program Settings

Saves the data of the currently selected Program No..

> **Send** SS CR
>
> **Receive** SS CR

> Reference
>
> This command does not affect the measurement process time.

Error code
- 01: Cannot write the settings to the internal memory or in the memory card. Or the memory card is not inserted.
- 22: The incorrect parameter is added.

Resetting

The following values/data are reset.
- Total Count
- NG count
- Image archive (image buffer)
- Statistical data
- Output data buffer
- OR output
- OUT 0 to 15 (normal status)
- HIST function within a calculation window
- Command memory (when a check is placed next to [Restore initial value on reset])
- Trigger queue status

> **Send** RS CR
>
> **Receive** RS CR

> Reference
>
> - During measurement, the command is performed after measurement is completed. During measurement result output, the command is performed after one measurement is output. During all other output, the command is performed after the output is canceled.
> - A new file name of the destination file for the measurement result in the memory card is created at the same time.

Error code

22: The incorrect parameter is added.

Trigger Input Enabling

Enabling trigger input

Both of external trigger /internal trigger are enabled (normal status).

> **Send** TE , ON CR
>
> **Receive** TE CR

> Reference
>
> This command does not affect the measurement process time.

Error code

22: Either the number or content of the parameters is incorrect.

Disabling trigger input

Disables both the external trigger/internal trigger inputs by always setting the READY pin to OFF.

> **Send** TE , OF CR
>
> **Receive** TE CR

> Reference
>
> - This command does not affect the measurement process time.
> - Because the trigger disabling setting is not saved in the system, the trigger input is reset to enabled once the power is turned off.

Error code

22: Either the number or content of parameters is incorrect.

Enabling Input from External Devices

Enabling a communication port

Send   LK , ON , nn , pppp CR

Receive LK CR

- nn: Specify a communication port
  RS: RS-232C no protocol
  PL: PLC
  US: USB
  ET: Ethernet
  CN: Remote control console
- pppp: Password (4-digit numerical characters)

Reference

- This command does not affect the measurement process time.
- Use the password that has been registered using the password change command (PS, Page 9-32) or in the [Input Password] (Page 7-10) menu.
- The password that is set can be checked by the RS-232C data.

Error code

- 22: Either the number or content of the parameters is incorrect.
- 80: The password is incorrect.

Disabling a communication port

Send   LK , OF , nn , pppp CR

Receive LK CR

- nn: Specify a communication port
  RS: RS-232C no protocol
  PL: PLC
  US: USB
  ET: Ethernet
  CN: Remote control console
- pppp: Password (4-digit numerical characters)

Reference

- This command does not affect the measurement process time.
- When turning on the power of the system while the FNC + ESC buttons are pressed, all the disabled settings of the communication ports are cancelled.
- The disabled settings are automatically saved. They are still valid after restarting the system.
- Use the password that has been registered using the password change command (PS, Page 9-32) or in the [Input Password] (Page 7-10) menu.
- The password that is set can be checked by the RS-232C data.

Error code

- 22: Either the number or content of the parameters is incorrect.
- 80: The password is incorrect.
- 81: A command other than the enabling command of communication ports has been input from the device on which input is disabled.

Transmitting Data via the Communication Ports

Password

Changes the password.This password is the same as that used for switching to the administrator's mode by using the remote control console (Page 7-13).

Send   **PS , mmmm , nnnn** CR

Receive **PS** CR

- mmmm: Old password (4-digit numerical characters)
- nnnn: New password (4-digit numerical characters)

Reference

- This command does not affect the measurement process time.
- When turning on the power of the system while the FNC + ESC buttons are pressed, the password is reset to [0000].
- The password is automatically saved. It is still valid after restarting the system.

Error code

- 22: Either the number or content of the parameters is incorrect.
- 80: The password is incorrect.

Remote Control Console Pseudo Input

Pseudo input commands mimic the functionality of the remote control console. This gives the user the ability to access and modify the system's program from a remote location using a PC or PLC. These commands can be used in Run Mode, Trial Run, or Program Mode.

Send   **KY , mm** CR

Receive **KY** CR

- mm: Remote control console input code
  FN: FNC button
  ES: ESCAPE button
  TG: TRG button
  SC: SCREEN button
  VI: VIEW button
  MN: MENU button
  EN: ENTER button
  UP: ENTER button upward direction
  DN: ENTER button downward direction
  LT: ENTER button leftward direction
  RT: Enter button rightward direction
  LU: ENTER button upward and leftward direction
  LD: ENTER button downward and leftward direction
  RU: Enter button upward and rightward direction
  RD: Enter button downward and rightward direction
  FU: FNC + Enter button upward direction
  FD: FNC + Enter button downward direction
  FL: FNC + Enter button leftward direction
  FR: FNC + Enter button rightward direction
  FLU: FNC + ENTER button upward and leftward direction
  FLD: FNC + ENTER button downward and leftward direction
  FRU: FNC + ENTER button upward and rightward direction
  FRD: FNC + ENTER button downward and rightward direction
  RS: Switching RUN/Program mode
  FV: FNC + VIEW
  FT: FNC + TRG
  FM: FNC + MENU
  FE: FNC + ENTER
  FS: FNC + ESCAPE
  SL: SCREEN + ENTER button leftward direction
  SR: SCREEN + ENTER button rightward direction

> **■ Reference ▱**
> This command does not affect the measurement process time. The response to this command is sent not when the command execution is completed but when the command is stored in the key buffer within the system. Therefore the operation of the system by the command may be delayed the point of the response to when the command is issued.

Error code

22: Either the number or content of the parameters is incorrect.

Echoing

Returns a text string that has been sent from the external equipment. This command is used for checking the communication conditions.

Send   **EC , Text string of variable length (up to 128 characters)** CR

Receive   **EC , Text string of variable length (up to 128 characters)** CR

> **■ Reference ▱**
> This command does not affect the measurement process time.

Error code

22: The variable length of the text string exceeds 128 characters.

Saving the Statistical Data

Writes all the statistics data that have been saved in the Statistics menu (Page 6-2) to the memory card in the comma-delimited text format.

Send   **ST , Folder name** CR

Receive   **ST** CR

                Folder name: The destination directory of the memory card (e.g. \cv\stat)

> **■ Reference ▱**
> • This command does not affect the measurement process time.
> • If the destination directory does not exist, a new one is automatically created.

Error code

• 01: The command has been performed in modes other than RUN mode, the memory card does not exist, insufficient free space in the memory card to save the data.
• 22: Either the number or the content of parameters is incorrect.

Transmitting Data via the Communication Ports

Controlling the System or Outputting Data Via PLC Link

Overview of the System's PLC Link

Using the PLC link with the RS-232C interface or the Ethernet interface enables the following functions.

- Outputting data with PLC link: The measurement data from the system can be directly output to the DM (data memory) in the PLC.
- Controlling the system with PLC link: Commands in the DM (data memory) of the PLC can be loaded and used to control the system.

▶ **Note**

- Even when using another brand of PLC, only connection through the link unit can be used. See [Types of Compatible PLC Link Connections] (Page10-3) for more details about using the PLC link in combination with this system.
- See "RS-232C Interface" (page 9-2) and "Ethernet Interface" (page 9-3) for more details about the connector specifications and the standard specifications for the RS-232C interface and the Ethernet interface.

Reference

DM (data memory) is referred to as data register (D) for the Mitsubishi Electric PLC, and as data memory (D) for the Omron PLC.

Example of Using PLC Link

Use #1: Data output

Outputting measurement results 1 to 3 to a KV-1000 series

System	PLC
Measurement result 1 1111.111 Measurement result 2 2222.222 Measurement result 3 3333.333	DM0000-DM0001 (32bit) 1111111 DM0002-DM0003 (32bit) 2222222 DM0004-DM0005 (32bit) 3333333

Write data →

(When decimal point is fixed)
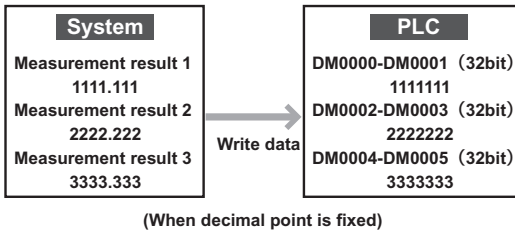
- Every time the trigger is input, the measurement results for the system are written to the DM of the specified PLC.
- Each measurement result uses two DM (32 bits).

Use #2: Command control

Switching to program number 10 saved in internal memory (Command PW, IN, 10 [CR])

System	PLC

Switch to program No.10 saved in the internal memory	DM100
	  5057 (PW)
	DM101
	  2C49 (,I)
	DM102
	  4E2C (N,)
	DM103
	  3130 (10)
	DM104
	  0000 (NULL)

Read command ↔ Execute command
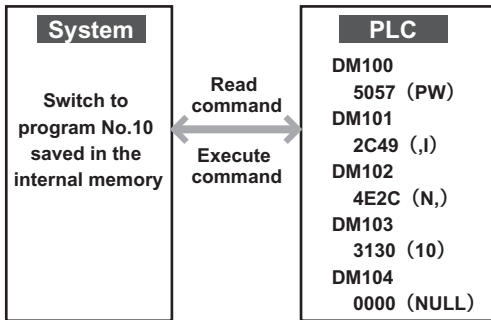
(When character string is upper byte → lower byte)

- The system uses terminal inputs or polling to read command codes previously written into the DM for the PLC and execute the commands.
- The command codes enter communication commands for control into DM in hexadecimal ASCII code (some communication commands are excluded).
- [NULL] (0000) can be used instead of [CR].

Types of Compatible PLC Link Connections

The following PLCs are compatible with the PLC link connection to the system.

► **Note**

Even when using another brand of PLC, only the connection
through the link unit can be used.

Through RS-232C Interface

Keyence PLC

Series name	Target system	Link unit	PLC operation mode	PLC type
KV	KV-700 KV-1000	KV-L20 KV-L20R	KV-Builder mode	KV-L20 series

Mitsubishi Electric PLC

Series name	Target system	Link unit	PLC operation mode	PLC type
MELSEC-AnS	A1S, A1SH, A1SJ, A1SJH1, A2S, A2SH, A171S, A171SH	A1SJ71 (U) C24-R2, A1SJ71 (U) C24-PRF	Exclusive protocol format 1	MELSEC AnN series
	A1CPUC24-R2	Calculator link port	Exclusive protocol format 1	MELSEC AnN series
	A2US, A2USH	A1SJ71 (U) C24-R2, A1SJ71 (U) C24-PRF	Exclusive protocol format 1	MELSEC AnN series
MELSEC-A0J2	A0J2, A0J2H	A0J2-C214-S1	Exclusive protocol format 1	MELSEC AnN series
MELSEC-AnN	A1N, A2N, A3N	AJ71C24, AJ71C24-S3, AJ71C24-S6, AJ71C24-S8, AJ71UC24	Exclusive protocol format 1	MELSEC AnN series
MELSEC-AnA	A2A, A3A	AJ71C24-S6, AJ71C24-S8, AJ71UC24	Exclusive protocol format 1	MELSEC AnN series
MELSEC-AnU	A2U, A3U, A4U	AJ71C24-S6, AJ71C24-S8, AJ71UC24	Exclusive protocol format 1	MELSEC AnN series
MELSEC-QnA	Q2A, Q2A-S1, Q3A, Q4A	AJ71QC24 (N) AJ71QC24 (N) R2 AJ71QC24 (N) R4	Exclusive protocol format 1	MELSEC AnN series
	Q2AS, Q2AS-S1, Q2ASH, Q2ASH-S1	A1SJ71QC24 A1SJ71QC24-R2	Exclusive protocol format 1	MELSEC AnN series
MELSEC-Q	Q00CPU, Q01CPU	QJ71C24, QJ71C24 (N)-R2	MCprotocol format 5	MELSEC Q series
	Q02CPU, Q02HCPU, Q06HCPU, Q12HCPU, Q25HCPU	QJ71C24, QJ71C24 (N)-R2	MCprotocol format 5	MELSEC Q series
	Q02CPU-A, Q02HCPU-A, Q06HCPU-A	A1SJ71 (U) C24-R2 A1SJ71 (U) C24-PRF	Exclusive protocol format 1	MELSEC AnN series

Controlling the System or Outputting Data Via PLC Link

Omron PLC

Series name	Target system	Link unit	PLC operation mode	PLC type
SYSMAC SPM1	SRM1-C01 SRM1-C02	CPM1-C1F01	Upper link (SYSWAY)	SYSMAC-C series
SYSMAC CPM1 SYSMAC CPM1A	CPM1 CPM1A	CPM1-C1F01	Upper link (SYSWAY)	SYSMAC-C series
SYSMAC CPM2A	CPM2A-30CD☐☐ CPM2A-40CD☐☐ CPM2A-60CD☐☐	CPM1-C1F01	Upper link (SYSWAY)	SYSMAC-C series
SYSMAC CPM2C	CPM2C-10CD☐☐ CPM2C-20CD☐☐	CPM1-C1F01 CPM2C-C1F01	Upper link (SYSWAY)	SYSMAC-C series
SYSMAC CQM1H	CQM1H-CPU11* CQM1H-CPU21* CQM1H-CPU51/61	CPM1-C1F01 CQM1H-SCB41	Upper link (SYSWAY)	SYSMAC-C series
SYSMAC C	C120, C120F	C120-LK201-V1	Upper link (SYSWAY)	SYSMAC-C series
	C200H	C200H-LK201(-V1)	Upper link (SYSWAY)	SYSMAC-C series
	C200HS-CPU01 C200HS-CPU03 C200HS-CPU21/23 C200HS-CPU31/33	C200H-LK201(-V1)	Upper link (SYSWAY)	SYSMAC-C series
	C500, C500F, C1000H, C1000HF, C2000, C2000H	C120-LK201-V1 C500-LK201-V1 C500-LK203	Upper link (SYSWAY)	SYSMAC-C series
SYSMAC α	C200HE-CPU11 C200HE-CPU32 C200HE-CPU42	C200H-LK201(-V1)	Upper link (SYSWAY)	SYSMAC-C series
	C200HG-CPU33 C200HG-CPU43 C200HG-CPU53 C200HG-CPU63	C200H-LK201(-V1)	Upper link (SYSWAY)	SYSMAC-C series
	C200HX-CPU34 C200HX-CPU44 C200HX-CPU54 C200HX-CPU64 C200HX-CPU65-Z C200HX-CPU85-Z	C200H-LK201(-V1)	Upper link (SYSWAY)	SYSMAC-C series
SYSMAC CJ	CJ1M-CPU12, CJ1M-CPU13, CJ1M-CPU22, CJ1M-CPU23, CJ1G-CPU44, CJ1G-CPU45, CJ1G-CPU42H, CJ1G-CPU43H, CJ1G-CPU44H, CJ1G-CPU45H, CJ1H-CPU65H, CJ1H-CPU66H	CJ1W-SCU21, CJ1W-SCU41	Upper link (SYSWAY)	SYSMAC-CJ/CS1 series
SYSMAC CS1	CS1G-CPU42 (H), CS1G-CPU43 (H) CS1G-CPU44 (H), CS1G-CPU45 (H), CS1H-CPU63 (H), CS1H-CPU64 (H) CS1H-CPU65 (H), CS1H-CPU66 (H), CS1H-CPU67 (H)	CS1W-SCU21	Upper link (SYSWAY)	SYSMAC-CJ/CS1 series

* The CQM1H-SCB41 link unit cannot be used.

Through Ethernet Interface

Keyence PLC

Series name	Target system	Link unit	PLC operation mode
KV	KV-700	KV-LE20	KV-LE20 Ether
	KV-1000	KV-LE20A	

Mitsubishi Electric PLC

Series name	Target system	Link unit	PLC operation mode
MELSEC-Q	Q00CPU, Q01CPU,	QJ71E71	MELSEC Q Ether
	Q02CPU, Q02HCPU,	QJ71E71-100	
	Q06HCPU, Q12HCPU,		
	Q25HCPU		

Omron PLC

Series name	Target system	Link unit	PLC operation mode
SYSMAC CJ	CJ1M-CPU12, CJ1M-CPU13,	CJ1W-ETN11,	SYSMAC-CJ/CS1
	CJ1M-CPU22, CJ1M-CPU23,	CJ1W-ETN21	Ether
	CJ1G-CPU44, CJ1G-CPU45,		
	CJ1G-CPU42H, CJ1G-CPU43H ,		
	CJ1G-CPU44H, CJ1G-CPU45H,		
	CJ1H-CPU65H, CJ1H-CPU66H		
SYSMAC CS1	CS1G-CPU42 (H) , CS1G-CPU43 (H) ,	CS1W-ETN11,	SYSMAC-CJ/CS1
	CS1G-CPU44 (H) , CS1G-CPU45 (H) ,	CJ1W-ETN21	Ether
	CS1H-CPU63 (H) , CS1H-CPU64 (H) ,		
	CS1H-CPU65 (H) , CS1H-CPU66 (H),		
	CS1H-CPU67 (H)		

Controlling the System or Outputting Data Via PLC Link

Wiring to PLC Link and Setting Link Unit

1. Overview of Wiring

PLC is wired to the system in the following way.
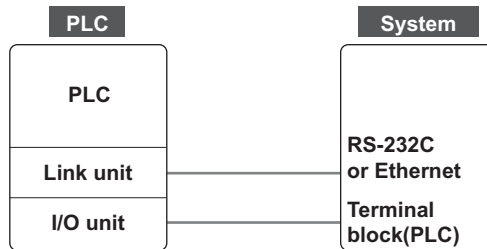
Reference

- When the system is not receiving commands from the PLC or when it is using polling, the system does not need to be connected to the terminal block (PLC).
- When connecting to a terminal definer through RS-232C to define the modem of the system, wire the system's RD to the RD connection, and wire the system's SD to the SD connection.

2. Wiring to PLC Link and Setting Link Unit (RS-232C)

Wiring to Keyence KV-L20 series

- Use OP-26486 (D-sub 9-pin female connector) and OP-26487 (2.5 m straight cable).
- Set the link unit operation mode to [KV-Builder mode].
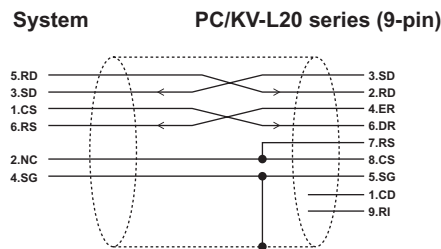
⚠ Warning

The system's SG and the 0 V power source are common. When an electrical potential difference occurs between these two terminals, it may cause damage to the system or the connected device.

When connected to SYSMAC CJ1/CS1

Reference

When connected to SYSMAC C, use the wiring referred to in "Wiring to Keyence LV-L20 series" (previous page) for the connection.

- Modify OP-26487 (2.5 m straight cable) and wire as shown in the diagram below.
- Set the link unit operation mode to "Upper link (SYSWAY)".
- Set the 1:1 or 1:N process to "1:N process".
- Set the unit number to "No. 0".
- Set the CS control to "None".
- When making the settings the CX-Programmer 6.0 or later, made sure to set the [Optional settings on/off] item to [On]. When set to [Off], the changes to other settings will not be effective.

For 9-pin

System		SYSMAC (9-pin)
5.RD		2.SD
3.SD		3.RD
1.CS		4.RS
6.RS		5.CS
		8.ER
		7.DR
4.SG		9.SG
		6.+5V

For 25-pin

System		SYSMAC (25-pin)
5.RD		2.SD
3.SD		3.RD
1.CS		4.RS
6.RS		5.CS
4.SG		7.SG
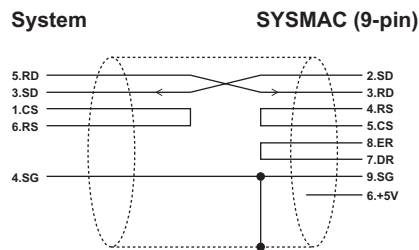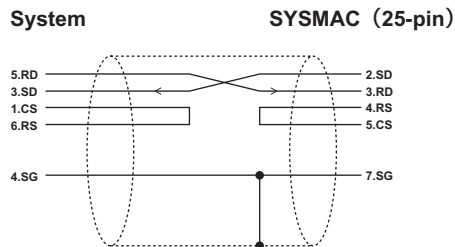
⚠ **Warning**

- When OP-26486 or OP-26487 are used without any modifications, it may cause damage to the system or the connected device. Do not use these connections.
- The system's SG and the GND power source are common. When an electrical potential difference occurs between these two terminals, it may cause damage to the system or the connected device.

Controlling the System or Outputting Data Via PLC Link

When connected to MELSEC

- Use OP-26486 (D-sub 9-pin female connector) and OP-26487 (2.5 m straight cable). However, the OP-26486 must be converted into a D-sub 9-pin male connector. Use a commercially available converter (D-sub 9-pin female D-sub 9-pin male, straight) for this purpose.
- Set the operation mode for the link unit to [MC protocol format 5] (for Q series) or "exclusive protocol format 1" (for A series). Set the checksum setting to [On].

► **Note**

When connected to the A series, "RS-232C CD terminal unchecked" must be defined in the ladder. See the manual for the Mitsubishi Electric computing link unit for more details.

Reference

When the Q series link unit QJ71C24 (N)-R2 is set to "Communication speed: 115200 bit/s, data length: 8 bits, stop bit: 1 bit, even parity", set the PC parameter switch settings to "0BEE (hexadecimal)".
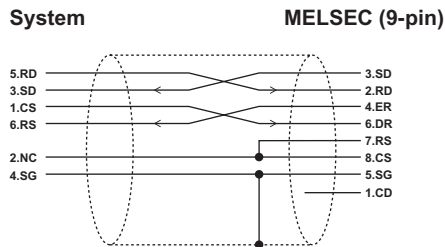
System		MELSEC (9-pin)
5.RD		3.SD
3.SD		2.RD
1.CS		4.ER
6.RS		6.DR
		7.RS
2.NC		8.CS
4.SG		5.SG
		1.CD

⚠ **Warning**

The system's SG and the GND power source are common. When an electrical potential difference occurs these two terminals, it may cause damage to the system or the connected device.

3. Wiring to PLC Link and Setting Link Unit (Ethernet)

- Make sure that the specified IP address is different than the IP addresses for other devices.
- Use the initial value for the subnet mask setting when connecting directly with Ethernet. For other connections, change the subnet mask setting depending on the network configuration. However, all of the connected equipment must have the same setting.
- Use a category 5e or greater STP cable for connection. When connecting the equipment directly, use a cross cable. When connecting through a hub, use a straight cable.

⚠ Warning

The system's connector shield and the 0 V power source are common. When an electrical potential difference occurs between these two terminals, it may cause damage to the system or the connected device.

Wiring to Keyence KV-L20 series

Make the settings using KV BUILDER Ver. 3.52 or later.
- IP address: In the PLC link settings on the system, set the specified IP address in [Communication address].
- Port number (VT): In the PLC link settings on the system, set the specified port number in [Communication port].

When connected to SYSMAC

Make the settings using CX-Programmer.

Reference
- Before making the settings, set the NODE No. in the PLC link settings on the system. Normally, the setting is [1].
- The NODE No. settings appear when the PLC type for the system is set to [SYSMAC CJ/CS1 Ether].

- **IP address**: In the PLC link settings on the system, set the specified IP address in [Communication address].
- **FINS UDP port**: Select [Define user], and in the PLC link settings on the system, set the specified port number in [Communication port].
- **IP address table**: In the [Ethernet] menu (Page7-6) for the Global settings on the system, set the specified IP address or note address. The note address is normally [1].
- **IP router table**: Only set this item when using a router. In router address, set the IP address for the router. In IP address, set the IP address specified in the [Ethernet] menu (Page7-6) for the Global settings on the system.

► Note

Make the settings so that the NODE No. for the link unit does not repeat the NODE No. specified in the PLC link settings on the system.

Reference

Set the IP address setting SW on the back of the system as the IP address for CS1W-ETN11.

Controlling the System or Outputting Data Via PLC Link

When connected to MELSEC

Make the settings for the network parameters of GX-Developer.

[MELSECNET/Ethernet]
- Network type: Select [Ethernet].
- Mode: Select [Online].

[Operation settings]
- Communication data code setting: Select [Binary code communication].
- Initial timing setting: Select [Always OPEN]
- IP address setting: In the PLC link settings on the system, set the specified IP address in [Communication address].
- Send frame setting: Select [Ethernet (V2.0)].
- Authorize writing during RUN: Select [Authorize].

Outputting Measurement Data with PLC Link

Procedure for Data Output (Data Output Flowchart)

The system outputs data through the PLC link using the following procedure.

System	PLC
Starts measurement	**Outputs a measurement trigger signal.**
Performs a series of measurement processes with a trigger input.	
Writes measurement data in the data memory continued from the data output address.	**Measurement data is written in the data output address.**
After confirming that the data of one measurement has been written, writes "1" in the "output result address" data memory.	**When the output result address value changes to 1, the PLC confirms that the measurement data of one trigger has been written, and refers to the measurement data.**
	Returns the "output result address" value to 0.
Performs next measurement.	**Outputs the trigger signal for the next measurement.**

See the explanation starting on the next page for more information about required settings.

Controlling the System or Outputting Data Via PLC Link

Changing the System's Settings

Change the settings on the system to output data with the PLC link. The operations are different when using the PLC link via RS-232C and when using the PLC link via Ethernet.

> ► Note

After changing to [PLC link] communication mode, restart the system and confirm that it is using PLC link communication mode. Switch to Run mode and repeat initialization until a connection to the PLC is established. If there is still no response from the connected PLC, the warning "PLC communication has failed" is displayed every time initialization is performed. If the warning continues to appear, check if the PLC is connected correctly.

When using the PLC link via RS-232C

Use the following procedure to change the settings.

1 **Select [RS-232C/PLC link] from [Global] in the menu bar.**
The [RS-232C/PLC link] menu appears.

2 **Select [PLC link] in [Mode].**

3 **Select the connected model in [PLC Type].**
Select the connected model to display the settings for the selected PLC type.
See "Types of Compatible PLC Link Connections" (Page10-3) for more details about each model of connected PLC that can be selected in [PLC Type].

> ► Note

A PLC not listed in "Types of Compatible PLC Link Connections" cannot be used as a PLC link. Try using the PLC in No protocol mode.

4 **Change the settings as required.**

Baud rate
Select 9600 (default), 19200, 38400, 57600, or 115200 (bps) for the baud rate.

> ► Note

If you selected [SYSMAC C Series] in [PLC type], only "19200" or "9600" can be selected.

Stop bit
Select [1] (default) or [2] for the stop bit.

> ► Note

If you selected [KV-L20 Series] in [PLC type], the stop bit is fixed to [1].

Parity bit
Select [None] (default), [Odd], or [Even] for the parity bit.

> ► Note

If you selected [KV-L20 Series] in [PLC type], the parity bit is fixed to [None].

Flow control
Select [None] (default) or [CTS/RTS] for the flow control.

> ► Note

If you selected [AnN Series] or [Q Series] in [PLC type], the flow control is fixed to [CTS/RTS]. If you selected [KV-L20 Series], [SYSMAC C Series], or [SYSMAC CJ/CS1 Series], the flow control is fixed to [None].

Delimiter
Select [CR] (default) or [CR + LF] for the delimiter of the RS-232C communication.

5 **In [Data Memory Address], set the initial address for the data memory of the system that outputs data to the PLC.**
All of the system's measurement data is output in 32-bits, so the word device for each piece of data becomes two words. The range of data memory address that can be used for data output changes depending on the contents set in [Output] (Page4-279).

Only the initial part of the address is set, and multiple addresses cannot be set at the same time.

Reference

The system can use the following range of data memory to write to the PLC.

- KV-L20: 00000 to 39999
- MELSEC-AnA: 0000 to 8191
- MELSEC Q: 00000 to 32767
- SYSMAC C: 0000 to 9999
- SYSMAC CJ/CSI: 00000 to 32767

Entering a value outside of the data memory range causes a communication break error message to appear. Even if a value within the range is entered, the system may not be able to write to the data memory depending on the PLC specifications and settings.

6 **In [Result Memory Address(bit)], set the address for the data memory that outputs the data output results (1 bit/data) to the data memory area.**

When data has successfully finished outputting to the PLC, the system writes [1] in the address.

When there is a data handshake between the system and the PLC

The timing for converting the value for the address from 0 to 1 is used. Set the PLC to output to the system on the trigger after the address value returns to 0 when the value conversion is verified on the PLC.

7 **In [Decimal Point], select the method for representing the data.**

- **Fixed-point** (default): Multiplies the calculated result by 1000 and writes the data into data memory as 32 bits of fixed-point data (address m: lower 16 bits, address m+1: upper 16 bits).
  When the integer portion of the calculated results contain seven digits, the value ±999999.999 is written into the data memory (the value can be positive or negative).
- **Floating-point**: Writes the measured result into the data memory as single-precision floating point data (32 bits).

Reference

The settings for [Decimal Point] only affect the measured value. Fixed-point is always displayed for output items other than measurement items such as count.

8 **After completing the settings, select [OK].**

If you have made any changes, a confirmation message appears for the system to be restarted.

9 **Restart the system.**

► Note

The changed contents are not effective until the system is restarted.

Controlling the System or Outputting Data Via PLC Link

When using the PLC link via Ethernet

Use the following procedure to change the settings.

1 **Select [RS-232C/PLC link] from [Global] in the menu bar.**
The [RS-232C/PLC link] menu appears.

2 **Select [PLC link] in [Mode].**

3 **Select the connected model in [PLC Type].**
Select the connected model to display the settings for the selected PLC type.
See "Types of Compatible PLC Link Connections" (Page10-3) for more details about each model of connected PLC that can be selected in [PLC Type].

► **Note**
A PLC not listed in "Types of Compatible PLC Link Connections" cannot be used as a PLC link. Try using the PLC in No protocol mode.

4 **Change the settings as required.**

IP address
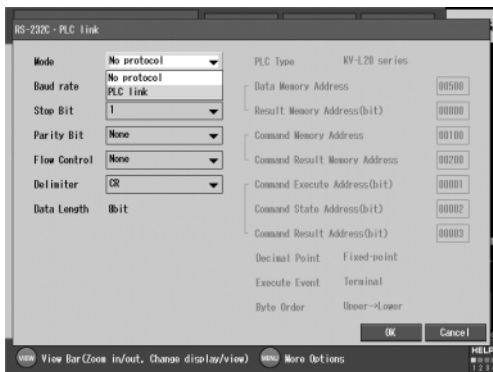Enter the IP address for the unit that the system is communicating with (default: 192.168.000.020).

Port
Enter the port number for the port using the PLC link (default: 8502 (KV-LE20), 5000 (MELSECQ), 9600 (SYSMAC CJ/CS1)).

► **Note**
Changing the [PLC Type] returns the values to the initial values.

Resend time
Enter the resend time (ms) to use if a communication error occurs (default 10000 ms).

5 **[Data Memory Address], set the initial address for the data memory of the system that outputs data to the PLC.**
All of the system's measurement data is output in 32-bits, so the word device for each piece of data becomes two words. The range of data memory address that can be used for data output changes depending on the contents set in [Output] (Page4-279).

► **Note**
Only the initial part of the address is set, and multiple addresses cannot be set at the same time.

Reference
The system can use the following range of data memory to write to the PLC.
• KV-L20: 00000 to 39999
• MELSEC-AnA: 0000 to 8191
• MELSEC Q: 00000 to 32767
• SYSMAC C: 0000 to 9999
• SYSMAC CJ/CSI: 00000 to 32767
Entering a value outside of the data memory range causes a communication break error message to appear. Even if a value within the range is entered, the system may not be able to write to the data memory depending on the PLC specifications and settings.

6 **In [Result Memory Address(bit)], set the address for the data memory that outputs the data output results (1 bit/data) to the data memory area.**
When data has successfully finished outputting to the PLC, the system writes [1] in the address.

When there is a data handshake between the system and the PLC
The timing for converting the value for the address from 0 to 1 is used. Set the PLC to output to the system on the trigger after the address value returns to 0 when the value conversion is verified on the PLC.

7 **In [Decimal Point], select the method for representing the data.**

- **Fixed-point** (default): Multiplies the calculated result by 1000 and writes the data into data memory as 32 bits of fixed-point data (address m: lower 16 bits, address m+1: upper 16 bits). When the integer portion of the calculated results contain seven digits, the value ±999999.999 is written into the data memory (the value can be positive or negative).
- **Floating-point**: Writes the measured result into the data memory as single-precision floating point data (32 bits).

Reference

The settings for [Decimal Point] only affect the measured value.

8 **After completing the settings, select [OK].**

If you have made any changes, a confirmation message appears for the system to be restarted.

9 **Restart the system.**

► Note

The changed contents are not effective until the system is restarted.

Data Output Settings

- The data contents and output order to the PLC link are all set in the [RS-232C] menu (Page4-279) from [Output].
- Functions such as output data format can be used in the same way as when using another communication setting, but all data is handled in 32 bit units (2 words) with the PLC link, regardless of the type of data.
- Every time a trigger is input, the measurement results set in [Output] are written to the set data output address.
- After the measurement results for one trigger are written, [1] is written into the [Result Memory Address(bit)].

► Note

- Data is output for PLC link mode only during Run mode. Data is not output during Program mode.
- Images and other binary data cannot be output with PLC link.
- When [Skip unexecuted window] is turned on in [Output] (), and all of the windows are set to not execute in [Execute Condition] (Page4-222), no data is output. In this case, nothing is written to the result memory address (bit).

Controlling the System or Outputting Data Via PLC Link

Controlling the System with PLC Link (Polling Method)

The system maintains constant surveillance (polling) on the bit conversion for [Command Execute Address(bit)] and uses this to read and execute the command.

Command Execute Procedure with Polling (Command Process Flowchart)

The commands are executed between the system and the PLC in the following manner.

► **Note**

See the data output flowchart (Page10-11) when referencing data output with trigger commands [T1] and [T2].

System	PLC
	Writes a command code and parameters in the command address.
Confirms that the command execution address (bit) value has changed to 1, and reads a command and parameters from the command address.	Writes 1 in the command execution address (bit) when the command is executed.
Executes the command.	
After executing the command, writes return data of the command execution in the data memory continued from the command result address.	The return data is written in the command result address.
After writing the return data, writes the command execution result (1: success, 0: failure) in the command result address (bit).	The command execution result is written in the command result address (bit).
After writing the command execution result, writes 1 in the command complete address (bit).	When the command complete address (bit) value changes to 1, the PLC confirms that the command execution is complete, and refers to the return data and the command execution result.
Detects that the command execution address (bit) value has changed to 0, and returns the command complete address value to 0.	Returns the command execution address (bit) value and the command result address (bit) value to 0.
	After confirming that the command complete address (bit) value has returned to 0, proceeds to the next command action.

See the explanation starting on the next page for more information about required settings.

Changing the System's Settings

Change the settings on the system to control the system with the PLC link (polling method). The operations are different when using the PLC link via RS-232C and when using the PLC link via Ethernet.

► **Note**
- After changing to [PLC link] communication mode, restart the system and confirm that it is using PLC link communication mode. Switch to Run mode and repeat initialization until a connection to the PLC is established. If there is still no response from the connected PLC, the warning "PLC communication has failed" is displayed every time initialization is performed. If the warning continues to appear, check if the PLC is connected correctly.
- When the polling method is selected, the overall response from the PLC link may be slower than control with the PLC terminal.

When using the PLC link via RS-232C

Use the following procedure to change the settings.

1 **Select [RS-232C/PLC link] from [Global] in the menu bar.**
The [RS-232C/PLC link] menu appears.

2 **Select [PLC link] in [Mode].**

3 **Select the connected model in [PLC Type].**
Select the connected model to display the settings for the selected PLC type.
See "Types of Compatible PLC Link Connections" (Page10-3) for more details about each model of connected PLC that can be selected in [PLC Type].

► **Note**
A PLC not listed in "Types of Compatible PLC Link Connections" cannot be used as a PLC link. Try using the PLC in No protocol mode.

4 **Change the settings as required.**

Baud rate
Select 9600 (default), 19200, 38400, 57600, or 115200 (bps) for the baud rate.

► **Note**
If you selected [SYSMAC C Series] in [PLC type], only "19200" or "9600" can be selected.

Stop bit
Select [1] (default) or [2] for the stop bit.

► **Note**
If you selected [KV-L20 Series] in [PLC type], the stop bit is fixed to [1].

Parity bit
Select [None] (default), [Odd], or [Even] for the parity bit.

► **Note**
If you selected [KV-L20 Series] in [PLC type], the parity bit is fixed to [None].

Flow control
Select [None] (default) or [CTS/RTS] for the flow control.

► **Note**
If you selected [AnN Series] or [Q Series] in [PLC type], the flow control is fixed to [CTS/RTS]. If you selected [KV-L20 Series], [SYSMAC C Series], or [SYSMAC CJ/CS1 Series], the flow control is fixed to [None].

Delimiter
Select [CR] (default) or [CR + LF] for the delimiter of the RS-232C communication.

5 **In [Command Memory Address], set the initial address for the data memory that contains the parameter or command code for the system.**

- The command code and parameter are each set in 16 bit hexadecimal. Only the initial part of the address is set, and multiple addresses cannot be set at the same time.

- The commands that can be used are almost the same as the communication commands and parameters for the system (excluding some of the commands that are handled as binary data). See Page9-10 for more details.

► **Note**

The range of data memory addresses changes depending on the command code contents and parameters.

6 **In [Command Result Memory Address], set the initial address for the data memory that contains the data character string that will be sent back from the PLC as the result of command execution.**

- The character string is sent back as a 16 bit hexadecimal. Only the initial part of the address is set, and multiple addresses cannot be set at the same time.

- The sent character strings are the same as the system communication commands (excluding T1 and T2). See Page9-10 for more details.

► **Note**

The range of data memory addresses changes depending on the type of command and execution result.

Reference

The only reply to trigger commands T1 and T2 is a command echo. The measurement result data is not written into the command result address.

7 **In [Command Execute Address(bit)], read the command code or parameter from the command address specified in the system and set the address for the data memory to execute.**

When controlling with the polling method, setting this bit device to [1] starts reading from the system.

► **Note**

[Command Execute Address(bit)] must maintain the state until the [Command State Address(bit)] changes to [1]. Execution of the command cannot be guaranteed if the value returns to [0] partway through.

8 **In [Command State Address(bit)], the system provides notification when writing to [Command Result Memory Address] or [Command Result Address(bit)] is finished after executing the command and sets the data memory address.**

Refer to the written result when [Command State Address(bit)] becomes [1].

► **Note**

The next command will not be executed until the system returns [Command State Address(bit)] to [0]. To execute the next command, briefly return the value for [Command Execute Address(bit)] to [0] and check that the system returns the [Command State Address(bit)] value to [0].

9 **In [Command Result Address(bit)], the system provides notification of the results for the executed command and sets the data memory address.**

- When the command finishes normally, the value changes to [1]. When the command finishes with errors, the value changes to [0].

- When it finishes with errors, refer to the error message text for the command result memory address returned from the system for the contents of the error. See Page9-10 for more details about error messages for communication commands.

10 **Select [Poling] in [Command Execute Type].**

11 **Change the settings for [Byte Order] to match the settings for the connected PLC.**

This sets how to handle the data character string in the data memory.

Reference

The default settings are different depending on the setting selected for [PLC Type] in step 3.
- For KV-L20 series: Upper → Lower
- For other models: Lower → Upper

12 **After completing the settings, select [OK].**

If you have made any changes, a confirmation message appears for the system to be restarted.

13 **Restart the system.**

► **Note**

The changed contents are not effective until the system is restarted.
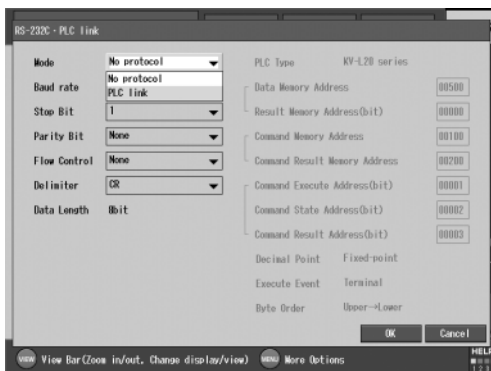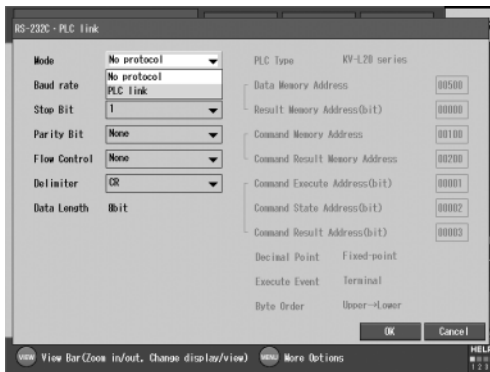
When using the PLC link via Ethernet

Use the following procedure to change the settings.

1 **Select [RS-232C/PLC link] from [Global] in the menu bar.**
The [RS-232C/PLC link] menu appears.

2 **Select [PLC link] in [Mode].**

3 **Select the connected model in [PLC Type].**
Select the connected model to display the settings for the selected PLC type.
See "Types of Compatible PLC Link Connections" (Page10-3) for more details about each model of connected PLC that can be selected in [PLC Type].

> ► **Note**
> A PLC not listed in "Types of Compatible PLC Link Connections" cannot be used as a PLC link. Try using the PLC in No protocol mode.

4 **Change the settings as required.**

IP address
Enter the IP address for the unit that the system is communicating with (default: 192.168.000.020).

Port
Enter the port number for the port using the PLC link (default: 8502 (KV-LE20), 5000 (MELSECQ), 9600 (SYSMAC CJ/CS1)).

> ► **Note**
> Changing the [PLC Type] returns the values to the initial values.

Resend time
Enter the resend time (ms) to use if a communication error occurs (default 10000 ms)

5 **In [Command Memory Address], set the initial address for the data memory that contains the parameter or command code for the system.**
• The command code and parameter are each set in 16 bit hexadecimal. Only the initial part of the address is set, and multiple addresses cannot be set at the same time.
• The commands that can be used are almost the same as the communication commands and parameters for the system (excluding some of the commands that are handled as binary data). See Page9-10 for more details.

> ► **Note**
> The range of data memory addresses changes depending on the command code contents and parameters.

6 **In [Command Result Memory Address], set the initial address for the data memory that contains the data character string that will be sent back from the PLC as the result of command execution.**
• The character string is sent back as a 16 bit hexadecimal. Only the initial part of the address is set, and multiple addresses cannot be set at the same time.
• The sent character strings are the same as the system communication commands (excluding T1 and T2). See Page9-10 for more details.

> ► **Note**
> The range of data memory addresses changes depending on the type of command and execution result.

> ■ **Reference**
> The only reply to trigger commands T1 and T2 is a command echo. The measurement result data is not written into the command result address.

7 **In [Command Execute Address(bit)], read the command code or parameter from the command address specified in the system and set the address for the data memory to execute.**
When controlling with the polling method, setting this bit device to [1] starts reading from the system.

> ► **Note**
> [Command Execute Address(bit)] must maintain the state until the [Command State Address(bit)] changes to [1]. Execution of the command cannot be guaranteed if the value returns to [0] partway through.

Controlling the System or Outputting Data Via PLC Link

8 **In [Command State Address(bit)], the system provides notification when writing to [Command Result Memory Address] or [Command Result Address(bit)] is finished after executing the command and sets the data memory address.**

Refer to the written result when [Command State Address(bit)] becomes [1].

► Note

The next command will not be executed until the system returns [Command State Address(bit)] to [0]. To execute the next command, briefly return the value for [Command Execute Address(bit)] to [0] and check that the system returns the [Command State Address(bit)] value to [0].

9 **In [Command Result Address(bit)], the system provides notification of the results for the executed command and sets the data memory address.**

- When the command finishes normally, the value changes to [1]. When the command finishes with errors, the value changes to [0].

- When it finishes with errors, refer to the error message text for the command result memory address returned from the system for the contents of the error. See Page9-10 for more details about error messages for communication commands.

10 **Select [Poling] in [Command Execute Type].**

11 **Change the settings for [Byte Order] to match the settings for the connected PLC.**

This sets how to handle the data character string in the data memory.

■ Reference

The default settings are different depending on the setting selected for [PLC Type] in step 3.
- For KV-L20 series: Upper → Lower
- For other models: Lower → Upper

12 **After completing the settings, select [OK].**

If you have made any changes, a confirmation message appears for the system to be restarted.

13 **Restart the system.**

► Note

The changed contents are not effective until the system is restarted.

Controlling the System with PLC Link (PLC Terminal)

Activates the PLC input terminal and reads or executes commands in the same way as [Command Execute Address(bit)]. Wiring to the PLC input terminal must be performed separately (Page11-7).

Command Execute Procedure through the PLC Terminal (Command Process Flowchart)

The commands are executed between the system and the PLC in the following manner.

System	PLC
	Writes a command code and parameters in the command address.
When the PLC terminal is activated, the system reads a command and parameters from the command address.	Set terminal input "PLC" to ON.
Executes the command.	
After executing the command, writes return data of the command execution in the data memory continued from the command result address.	The return data is written in the command result address.
After writing the return data, writes the command execution result (1: success, 0: failure) in the command result address (bit).	The command execution result is written in the command result address (bit).
After writing the command execution result, writes 1 in the command complete address (bit).	When the command complete address (bit) value changes to 1, the PLC confirms that the command execution is complete, and refers to the return data and the command execution result.
	Releases the PLC terminal on the system, and returns the command result address (bit) value to 0.
When the PLC terminal is released, the system returns the command complete address (bit) value to 0.	After confirming that the command complete address (bit) value has returned to 0, proceeds to the next command action.

See the explanation starting on the next page for more information about required settings.

Controlling the System or Outputting Data Via PLC Link

Changing the System's Settings

Change the settings on the system to control the system with the PLC link (PLC terminal). The operations are different when using the PLC link via RS-232C and when using the PLC link via Ethernet.

► Note

After changing to [PLC link] communication mode, restart the system and confirm that it is using PLC link communication mode. Switch to Run mode and repeat initialization until a connection to the PLC is established. If there is still no response from the connected PLC, the warning "PLC communication has failed" is displayed every time initialization is performed. If the warning continues to appear, check if the PLC is connected correctly.
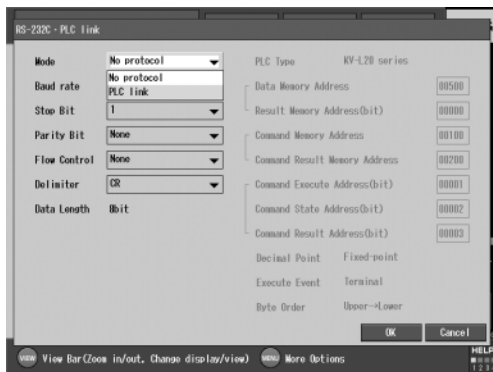
When using the PLC link via RS-232C

Use the following procedure to change the settings.

1 **Select [RS-232C/PLC link] from [Global] in the menu bar.**

The [RS-232C/PLC link] menu appears.

2 **Select [PLC link] in [Mode].**

3 **Select the connected model in [PLC Type].**

Select the connected model to display the settings for the selected PLC type.

See "Types of Compatible PLC Link Connections" (page 10-3) for more details about each model of connected PLC that can be selected in [PLC Type].

► Note

A PLC not listed in "Types of Compatible PLC Link Connections" cannot be used as a PLC link. Try using the PLC in No protocol mode.

4 **Change the settings as required.**

Baud rate

Select 9600 (default), 19200, 38400, 57600, or 115200 (bps) for the baud rate.

► Note

If you selected [SYSMAC C Series] in [PLC type], only "19200" or "9600" can be selected.

Stop bit

Select [1] (default) or [2] for the stop bit.

► Note

If you selected [KV-L20 Series] in [PLC type], the stop bit is fixed to [1].

Parity bit

Select [None] (default), [Odd], or [Even] for the parity bit.

► Note

If you selected [KV-L20 Series] in [PLC type], the parity bit is fixed to [None].

Flow control

Select [None] (default) or [CTS/RTS] for the flow control.

► Note

If you selected [AnN Series] or [Q Series] in [PLC type], the flow control is fixed to [CTS/RTS]. If you selected [KV-L20 Series], [SYSMAC C Series], or [SYSMAC CJ/CS1 Series], the flow control is fixed to [None].

Delimiter

Select [CR] (default) or [CR + LF] for the delimiter of the RS-232C communication.

5 **In [Command Memory Address], set the initial address for the data memory that contains the parameter or command code for the system.**

- The command code and parameter are each set in 16 bit hexadecimal. Only the initial part of the address is set, and multiple addresses cannot be set at the same time.
- The commands that can be used are almost the same as the communication commands and parameters for the system (excluding some of the commands that are handled as binary data). See Page9-10 for more details.

► **Note**

The range of data memory addresses changes depending on the command code contents and parameters.

6 **In [Command Result Memory Address], set the initial address for the data memory that contains the data character string sent back from the PLC as the result of command execution.**

- The character string is sent back as a 16 bit hexadecimal. Only the initial part of the address is set, and multiple addresses cannot be set at the same time.
- The sent character strings are the same as the system communication commands (excluding T1 and T2). See Page9-10 for more details.

► **Note**

The range of data memory addresses changes depending on the type of command and execution result.

Reference

The only reply to trigger commands T1 and T2 is a command echo. The measurement result data is not written into the command result address.

7 **In [Command State Address(bit)], the system provides notification that the writing to [Command Result Memory Address] or [Command Result Address(bit)] is finished after executing the command and sets the data memory address.**

Refer to the written result when [Command State Address(bit)] becomes [1].

► **Note**

The next command will not be executed until the system returns [Command State Address(bit)] to [0]. To execute the next command, briefly release the PLC terminal and check that the system returns the [Command State Address(bit)] value to [0].

8 **In [Command Result Address(bit)], the system provides notification of the results for the executed command and sets the data memory address.**

- When the command finishes normally, the value changes to [1]. When the command finishes with errors, the value changes to [0].
- When it finishes with errors, refer to the error message text in the command result memory address returned from the system for the contents of the error. See Page9-10 for more details about error messages for communication commands.

9 **Select [Terminal] in [Command Execute Type].**

► **Note**

When executing commands with the PLC input terminal, the short-circuited state must be maintained until the [Command State Address(bit)] changes to [1]. Execution of the command cannot be guaranteed if the PLC terminal is opened partway through.

10 **Change the settings for [Byte Order] to match the settings for the connected PLC.**

This sets how to handle the data character string in the data memory.

Reference

The default settings are different depending on the setting selected for [PLC Type] in step 3.

- For KV-L20 series: Upper → Lower
- For other models: Lower → Upper

11 **After completing the settings, select [OK].**

If you have made any changes, a confirmation message appears for the system to be restarted.

12 **Restart the system.**

► **Note**

The changed contents are not effective until the system is restarted.

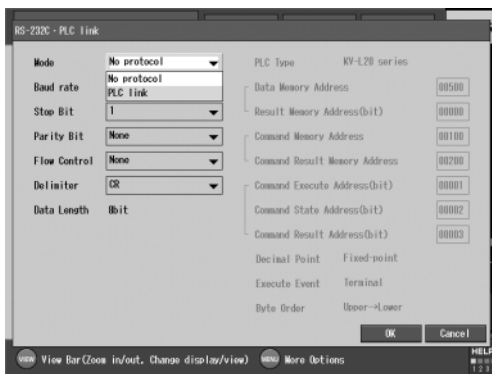Controlling the System or Outputting Data Via PLC Link

When using the PLC link via Ethernet

Use the following procedure to change the settings.

1 **Select [RS-232C/PLC link] from [Global] in the menu bar.**
The [RS-232C/PLC link] menu appears.

2 **Select [PLC link] in [Mode].**

3 **Select the connected model in [PLC Type].**
Select the connected model to display the settings for the selected PLC type.
See "Types of Compatible PLC Link Connections" (Page10-3) for more details about each model of connected PLC that can be selected in [PLC Type].

► **Note**
A PLC not listed in "Types of Compatible PLC Link Connections" cannot be used as a PLC link. Try using the PLC in No protocol mode.

4 **Change the settings as required.**

IP address
Enter the IP address for the unit that the system is communicating with (default: 192.168.000.020).

Port
Enter the port number for the port using the PLC link (default: 8502 (KV-LE20), 5000 (MELSECQ), 9600 (SYSMAC CJ/CS1)).

► **Note**
Changing the [PLC Type] returns the values to the initial values.

Resend time
Enter the resend time (ms) to use if a communication error occurs (default 10000 ms).

5 **In [Command Memory Address], set the initial address for the data memory that contains the parameter or command code for the system.**
• The command code and parameter are each set in 16 bit hexadecimal. Only the initial part of the address is set, and multiple addresses cannot be set at the same time.
• The commands that can be used are almost the same as the communication commands and parameters for the system (excluding some of the commands that are handled as binary data). See Page9-10 for more details.

► **Note**
The range of data memory addresses changes depending on the command code contents and parameters.

6 **In [Command Result Memory Address], set the initial address for the data memory that contains the data character string sent back from the PLC as the result of command execution.**
• The character string is sent back as a 16 bit hexadecimal. Only the initial part of the address is set, and multiple addresses cannot be set at the same time.
• The sent character strings are the same as the system communication commands (excluding T1 and T2). See Page9-10 for more details.

► **Note**
The range of data memory addresses changes depending on the type of command and execution result.

Reference
The only reply to trigger commands T1 and T2 is a command echo. The measurement result data is not written into the command result address.

7 **In [Command State Address(bit)], the system provides notification that the writing to [Command Result Memory Address] or [Command Result Address(bit)] is finished after executing the command and sets the data memory address.**
Refer to the written result when [Command State Address(bit)] becomes [1].

► **Note**
The next command will not be executed until the system returns [Command State Address(bit)] to [0]. To execute the next command, briefly release the PLC terminal and check that the system returns the [Command State Address(bit)] value to [0].

8 **In [Command Result Address(bit)], the system provides notification of the results for the executed command and sets the data memory address.**

- When the command finishes normally, the value changes to [1]. When the command finishes with errors, the value changes to [0].
- When it finishes with errors, refer to the error message text in the command result memory address returned from the system for the contents of the error. See Page9-10 for more details about error messages for communication commands.

9 **Select [Terminal] in [Command Execute Type].**

► **Note**

When executing commands with the PLC input terminal, the short-circuited state must be maintained until the [Command State Address(bit)] changes to [1]. Execution of the command cannot be guaranteed if the PLC terminal is opened partway through.

10 **Change the settings for [Byte Order] to match the settings for the connected PLC.**

This sets how to handle the data character string in the data memory.

Reference

The default settings are different depending on the setting selected for [PLC Type] in step 3.
- For KV-L20 series: Upper → Lower
- For other models: Lower → Upper

11 **After completing the settings, select [OK].**

If you have made any changes, a confirmation message appears for the system to be restarted.

12 **Restart the system.**

► **Note**

The changed contents are not effective until the system is restarted.

Controlling the System or Outputting Data Via PLC Link

Functions Used by the System I/O Terminal

The following ports are installed to the system as I/O terminals.

- Parallel I/O interface (40-pin): Use the specialized parallel connection cable (3 m) OP-51657 (sold separately) (Page 11-2)
- Terminal block interface (OUT 9-pin/IN 8-pin): Installed standard to the system as the terminal block (Page 11-4)

The I/O terminal contains a function that performs each type of output and control input when a power source other than 24 V is supplied to the system.

Main Functions Used by the I/O Terminal

Input

Image Capture

- Trigger input: Captures a camera image at a specified time.

Control

- Command input: Gives directions such as switching program numbers or display template.
- Control input: Performs controls such as momentarily stopping data output or image capture

Output

Result output

- Judgment output
- Data output: Outputs the window result values in 16 bit binary format.

Control

- Flash output: Outputs a signal for strobe light control.
- Control output: Outputs signals such as system errors or signals used to synchronize external devices.

Parallel I/O Interface

Connector Specifications

The following values show the parallel I/O
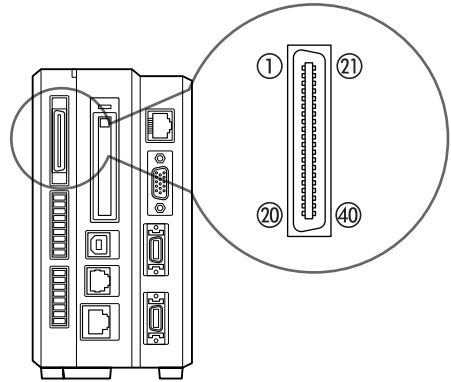connector specifications for the system.

Connector
FX2B-40SA-1.27R (Hirose Electric)

Color flat cable
UL20028-FRX-CF-40 (Fujikura, equivalent
wire gauge AWG28)

Reference

In normal situations, use the specialized parallel
connection cable (3 m) OP-51657 (sold separately).

Pin Settings: When using cable OP-51657 (sold separately)

No.	Signal	Signal description	Signal direction	Circuit diagram (Page 11-11)	Cable color
1	COMIN2	Connector input common terminal	-	-	Brown
2	IN0 (Command parameter)	Command parameter input bit 0 (LSB)	Input	B	Red
3	IN1 (Command parameter)	Command parameter input bit 1	Input	B	Orange
4	IN2 (Command parameter)	Command parameter input bit 2	Input	B	Yellow
5	IN3 (Command parameter)	Command parameter input bit 3	Input	B	Green
6	IN4 (Command parameter)	Command parameter input bit 4	Input	B	Blue
7	IN5 (Command parameter)	Command parameter input bit 5	Input	B	Purple
8	IN6 (Command parameter)	Command parameter input bit 6	Input	B	Gray
9	IN7 (Command parameter)	Command parameter input bit 7 (MSB)	Input	B	White
10	IN8 (Command type)	Command input bit 0 (LSB)	Input	B	Black
11	IN9 (Command type)	Command input bit 1	Input	B	Brown
12	IN10 (Command type)	Command input bit 2	Input	B	Red
13	IN11 (Command type)	Command input bit 3 (MSB)	Input	B	Orange
14	CST	Command execution input	Input	B	Yellow
15	RESET	Reset	Input	B	Green
16	PST	Output data cycle input	Input	B	Blue
17	COMOUT2	Output common terminal	-	-	Purple
18	ACK	Verification of successfully executed command input	Output	D	Gray

No.	Signal	Signal description	Signal direction	Circuit diagram (Page 11-11)	Cable color
19	NACK	Verification of unsuccessfully executed command input	Output	D	White
20	BUSY	Busy signal	Output	D	Black
21	CMD_READY	Command input permission	Output	D	Brown
22	READY1	Trigger 1 input permission	Output	D	Red
23	READY2	Trigger 2 input permission	Output	D	Orange
24	OUT0	Data output bit 0 (LSB)	Output	D	Yellow
25	OUT1	Data output bit 1	Output	D	Green
26	OUT2	Data output bit 2	Output	D	Blue
27	OUT3	Data output bit 3	Output	D	Purple
28	OUT4	Data output bit 4	Output	D	Gray
29	OUT5	Data output bit 5	Output	D	White
30	OUT6	Data output bit 6	Output	D	Black
31	OUT7	Data output bit 7	Output	D	Brown
32	OUT8	Data output bit 8	Output	D	Red
33	OUT9	Data output bit 9	Output	D	Orange
34	OUT10	Data output bit 10	Output	D	Yellow
35	OUT11	Data output bit 11	Output	D	Green
36	OUT12	Data output bit 12	Output	D	Blue
37	OUT13	Data output bit 13	Output	D	Purple
38	OUT14	Data output bit 14	Output	D	Gray
39	OUT15	Data output bit 15 (MSB)	Output	D	White
40	COMOUT2	Connector output common terminal	-	-	Black

► **Note**

• COMOUT2 for Pin 17 and Pin 40 are common.
• Power source 0 V and COMIN1, COMIN2, COMOUT1, COMOUT2, COMOUT_F+, and COMOUT_F- are all isolated.

Controlling the System or Transmitting Data Via the I/O Terminal

Terminal Block Interface

Standard Specifications

The following values show the terminal block specifications for the system.

► **Note**

Tightening with a force above the standard torque may cause damage to the terminal block.
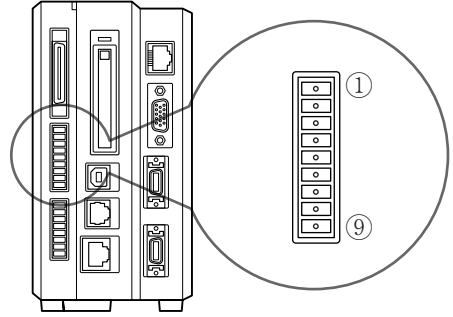
OUT connector

Socket block
MC1.5/9-ST-3.5BK (Phoenix Contact)

Adapted wiring
AWG16 to 28

Terminal block screw torque
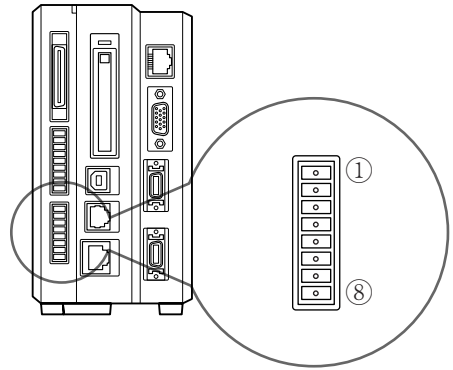0.25 Nm or less

IN connector

Socket block
MC1.5/8-ST-3.5BK (Phoenix Contact)

Adapted wiring
AWG16 to 28

Terminal block screw torque
0.25 Nm or less

Connector Specifications

OUT connector

No.	Signal ( ) indicates what is written on the terminal	Signal description	Signal direction	Circuit diagram (Page 11-12)
1	STO	Output timing indicator	Output	D
2	OR	Total status output	Output	D
3	ERROR (ERR)	Error output	Output	D
4	RUN	Run mode output	Output	D
5	COMOUT1 (COMOUT)	Common for terminal block outputs	-	-
6	FLASH1 (FLS1)	Strobe light output for trigger 1	Output	C
7	FLASH2 (FLS2)	Strobe light output for trigger 2	Output	C
8	COMOUT_F+ (COMF+)	+ common for FLASH output	-	-
9	COMOUT_F- (COMF-)	- common for FLASH output	-	-

► **Note**

• Power source 0 V and COMOUT1, COMOUT_F+, and COMOUT_F- are all isolated.
• COMOUT1 is the common terminal for outputs 1 to 4.
• COMOUT_F+ and COMOUT_F- are common terminals for outputs FLASH1 and FLASH2.

IN Connector

No.	Signal ( ) indicates what is written on the terminal	Signal description	Signal direction	Circuit diagram (Page 11-11)
1	COMIN1 (COMIN)	Common for terminal block inputs	-	-
2	PLC	Initial command read from PLC (PLC Link only)	Input	B
3	TRG1	Trigger 1 input	Input	A
4	TRG2	Trigger 2 input	Input	A
5	TEST	Trial run input	Input	B
6	EXT	Disable trigger input	Input	B
7	24VDC	+ power supply (DC 24 V) input	-	-
8	0V	- power supply (0 V) input	-	-

► **Note**

• Power source 0 V and COMIN1 are all isolated.
• COMIN1 is the common terminal for inputs 2 to 6.

Controlling the System or Transmitting Data Via the I/O Terminal

Principle Actions of the Input/Output Terminal Block

Terminal block interface (OUT)

No.	Signal	Signal description	Details
1	STO	Output timing indicator	Outputs after the program is complete and the judgments are available. Synchronizes an external device with cycles for OUT0-OUT15.
2	OR	Total status output	Outputs an OR result for the total status settings in the output menu.
3	ERROR	Error output	Outputs when an error has occurred during Run mode and a dialog is displayed on the screen. See "Error Messages" (Page 13-21) for the contents of typical errors. Error output is not released for error displays regarding ejecting the memory card.
4	RUN	Run mode output	Outputs during the system's Run mode.
5	COMOUT1	Common for terminal block outputs	Output common for terminal block outputs 1 to 4.
6	FLASH1	Strobe light output for trigger 1	Outputs the strobe light synchronization signal for trigger 1.
7	FLASH2	Strobe light output for trigger 2	Outputs the strobe light synchronization signal for trigger 2.
8	COMOUT_F+	+ common for FLASH output	The + common for FLASH output.
9	COMOUT_F-	- common for FLASH output	The - common for FLASH output.

Reference

When using FLASH1 or FLASH2, make sure to cornect DC 24 V ± 10% between COMOUT_F+ and COMOUT_F-.

Terminal block interface (IN)

No.	Signal	Signal description	Introduction
1	COMIN1	Common for terminal block inputs	Input common for terminal block inputs 2 to 6.
2	PLC	Initial command read from PLC (PLC Link only)	Used when executing command controls for the PLC link function (synchronous rising). The reception of the request may be delayed depending on the status of other processes. Maintain the input on until the value for [Command State Address(bit)] for the PLC changes to "1" (confirmation that command execution has finished).
3	TRG1	Trigger 1 input	Captures images from cameras assigned to trigger 1 (synchronous rising). The trigger can be input when READY1 is on.
4	TRG2	Trigger 2 input	Captures images from cameras assigned to trigger 2 (synchronous rising). The trigger can be input when READY2 is on.
5	TEST	Trial run input	Use when momentarily stopping judgment output for test runs. During input to the TEST terminal, OR output, STO output, and data outputs OUT 0 to 15 are forcefully changed to their normal state (synchronous level). Data output from the communication board is canceled. Once the input is released, output restarts from the processed image results that follow the release.
6	EXT	Disable trigger input	Use when momentarily stopping internal trigger generation or external trigger reception. During input, the READY terminal is forcefully turned off, and all trigger reception is disabled (synchronous level).
7	24VDC	+ power supply (DC 24 V) input	Supplies 24 V power source for the controller.
8	0V	- power supply (0 V) input	Connects to the 0V terminal of the 24 V power source for the controller.

Controlling the System or Transmitting Data Via the I/O Terminal

Parallel I/O interface

No.	Signal	Signal description	Introduction
1	COMIN2	Connector input common terminal	This is the common for inputs on the parallel I/O interface.
2	IN0 (Command parameter)	Command parameter input bit 0 (LSB)	
3	IN1 (Command parameter)	Command parameter input bit 1	
4	IN2 (Command parameter)	Command parameter input bit 2	
5	IN3 (Command parameter)	Command parameter input bit 3	Inputs the command parameters associated with the command codes for IN8-IN11 in binary format (Page 11-16).
6	IN4 (Command parameter)	Command parameter input bit 4	
7	IN5 (Command parameter)	Command parameter input bit 5	
8	IN6 (Command parameter)	Command parameter input bit 6	
9	IN7 (Command parameter)	Command parameter input bit 7 (MSB)	
10	IN8 (Command type)	Command input bit 0 (LSB)	
11	IN9 (Command type)	Command input bit 1	Selects the type of command to be executed for the IN0-IN7 terminals in binary format (Page 11-16).
12	IN10 (Command type)	Command input bit 2	
13	IN11 (Command type)	Command input bit 3 (MSB)	
14	CST	Command confirmation input	Executes commands and parameters from the parallel I/O interface (synchronous rising). • To verify CST reception, verify that CMD_READY falls after CST input. • When verifying that the command has executed completely, check that ACK (success) or NACK (failure) rise after CST input.

| No.	Signal	Signal description	Introduction
15	RESET	Reset	Performs reset operations. • OR output and OUT0 to 15 return to their normal state. • The HIST function in the calculation windows [Count] and other counters return to "0". • The image data in the image archive (including trigger delay images) is completely erased. • The data for all of the output buffers is reset. • A new file name is created for the file on the memory card that the measurement results are output to. • Each individual trigger is released from the state of waiting for the next trigger.
16	PST	Output data switch input	Sends an order to switch data when handshaking operation is performed. After the first STO output, if there is no PST input after the set output cycle time passes, there is a time out and the data is switched automatically.
17	COMOUT2	Connector output common terminal	This is the common for outputs on the parallel I/O interface. It is internally common with COMOUT2 on pin number 40.
18	ACK	Verification output for successfully executed command input	Outputs when the command from the parallel I/O interface finishes successfully.
19	NACK	Verification output of unsuccessfully executed command input	Outputs when the command from the parallel I/O interface finishes successfully.
20	BUSY	Busy signal output	Outputs during image processing or command processing. When the next image process or command process is received during BUSY, there may be a delay before the next process begins.
21	CMD_READY	Permission output for command input	Outputs when a command can be received from the parallel I/O interface. When CMD_READY is off, CST is ignored when it is input.
22	READY1	Permission output for trigger 1 input	Outputs when a signal can be input to trigger 1.

Controlling the System or Transmitting Data Via the I/O Terminal

No.	Signal	Signal description	Introduction
23	READY2	Permission output for trigger 2 input	Outputs when a signal can be input to trigger 2.
24	OUT0	Data output bit 0 (LSB)	
25	OUT1	Data output bit 1	
26	OUT2	Data output bit 2	
27	OUT3	Data output bit 3	
28	OUT4	Data output bit 4	
29	OUT5	Data output bit 5	Outputs the measurement results in 16 bit binary format.
30	OUT6	Data output bit 6	When more than 16 bits are required for output, OUT0 to OUT15 will output in cycles until all of the data has been transmitted.The cycles are synchronized with the STO output
31	OUT7	Data output bit 7	
32	OUT8	Data output bit 8	
33	OUT9	Data output bit 9	
34	OUT10	Data output bit 10	
35	OUT11	Data output bit 11	
36	OUT12	Data output bit 12	
37	OUT13	Data output bit 13	
38	OUT14	Data output bit 14	
39	OUT15	Data output bit 15 (MSB)	
40	COMOUT2	Connector output common	This is the common terminal for outputs on the parallel I/O interface. It is internally common with COMOUT2 on pin number 17.

Input/Output Circuit

Input Circuit

Input circuit diagram

Circuit A (TRG1/TRG2 only, EV compatible)

- Max. superimposed voltage: 26.4 V
- ON voltage: 10.8 V or greater
- ON current: 3 mA or greater
- OFF voltage: 5 V or less
- OFF current: 1 mA or less
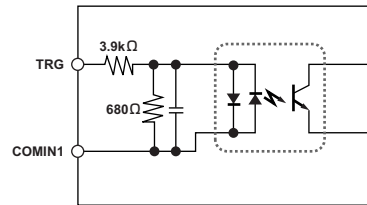
Circuit B (other inputs)

- Max. superimposed voltage: 26.4 V
- ON voltage: 10.8 V or greater
- ON current: 3 mA or greater
- OFF voltage: 5 V or less
- OFF current: 0.3 mA or less
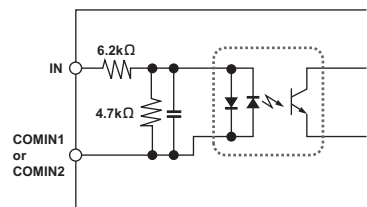
Reference

See "Principle Actions of the Input/Output Terminal Block" (Page 11-6) for common connections.

Example of connections

When connecting a CV input to an NPN output for a PLC
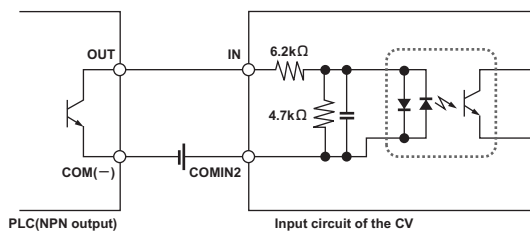
When connecting a CV input to a PNP output for a PLC

Controlling the System or Transmitting Data Via the I/O Terminal
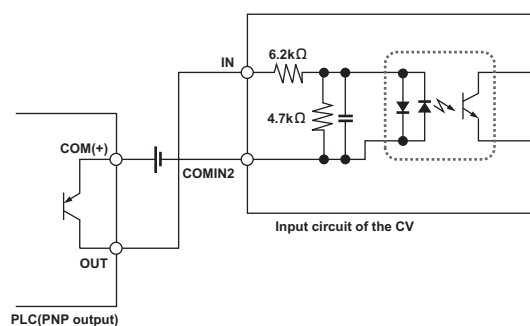
Output Circuit

Output circuit diagram

Circuit C (FLASH1/FLASH2 only)

- Max. superimposed voltage: 30 V
- Max. sink current: 50 mA
- Leakage current: 0.1 mA or less
- Residual voltage: 1 V or less

NPN output circuit diagram
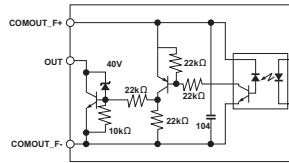
PNP output circuit diagram
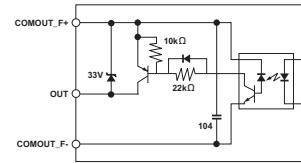
Circuit D (Other outputs)

- Max. superimposed voltage: 30 V
- Max. sink current: 50 mA
- Leakage current: 0.1 mA or less
- Residual voltage: 1 V or less
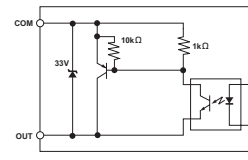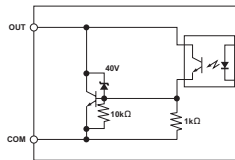
Example of connections

When transmitting an NPN output from the CV to a PLC with a positive common
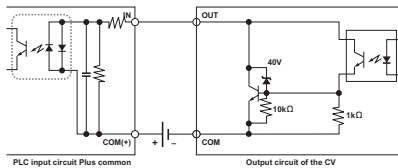
When transmitting a PNP output from the CV to a PLC with a negative common
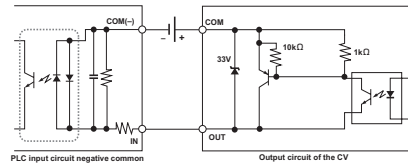
When transmitting an NPN output from the CV to relay
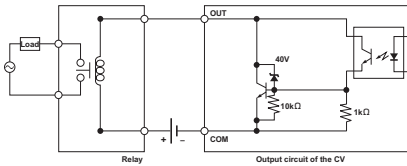
When transmitting a PNP output from the CV to relay
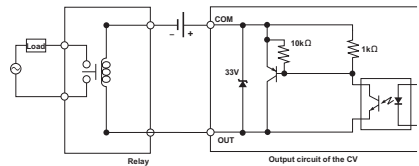
► **Note**

1) The GND output terminal for the terminal block is the COMOUT1 terminal.
2) The GND output terminal for the I/O connector is the COMOUT2 terminal.

When transmitting a FLASH1 NPN output from the CV to the no-voltage input terminal for the CA-DC100 LED light controller

| CA-DC100 EXT input circuit | CV-3001 NPN Flash output circuit |
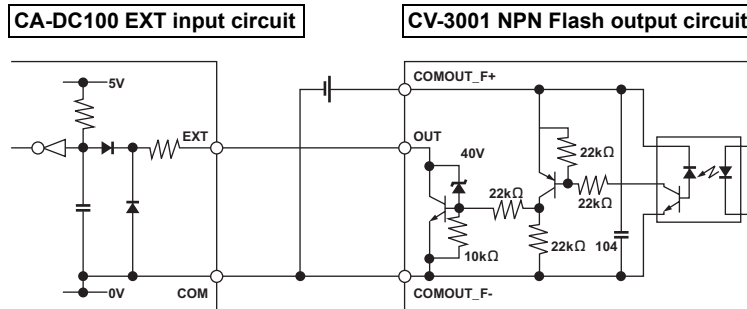
When transmitting a FLASH1 PNP output from the CV to the no-voltage input terminal for the CA-DC100 LED light controller

| CA-DC100 EXT input circuit | CV-3001 PNP Flash output circuit |

► **Note**

1) The GND output terminal for the terminal block is the COMOUT1 terminal.
2) The GND output terminal for the I/O connector is the COMOUT2 terminal.
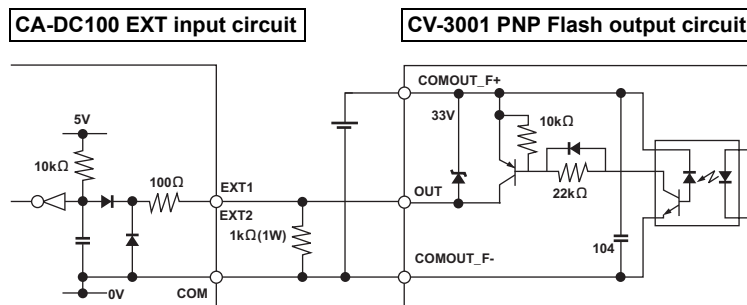
Controlling the System or Transmitting Data Via the I/O Terminal

Using a Command Input from the I/O Terminal

Command Input Timing

▶ **Note**

Except for screen capture, command input is only effective during Run mode.

Basic workflow (example of executing commands handled in real time)

A:1msec or more   **C:500 μ sec or less**

B:Common with STO output time   **D:500 μ sec or more**
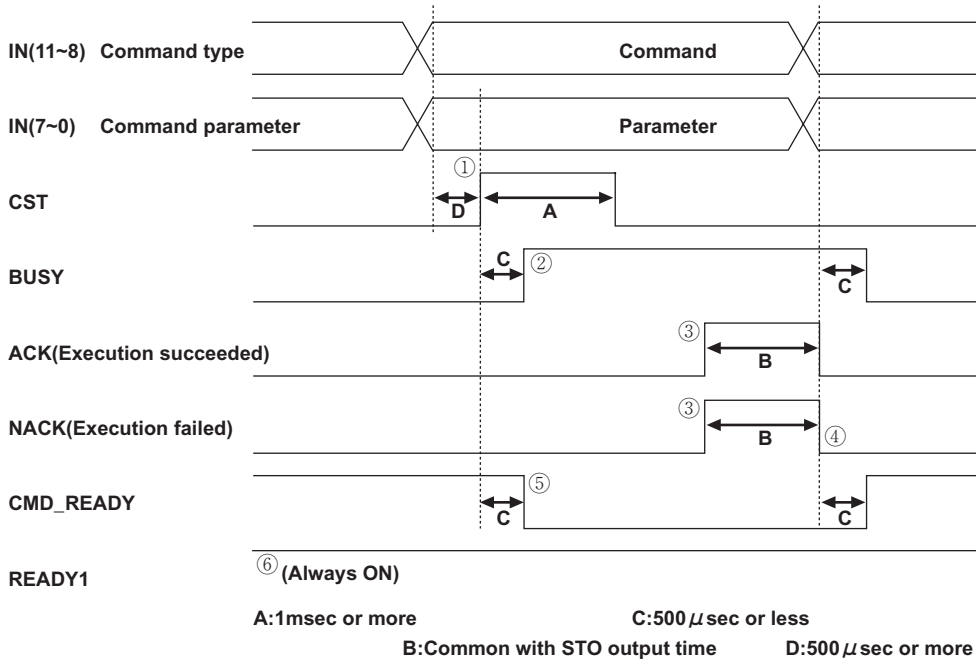
① Command input is activated when CST rises.

② BUSY indicates that an image is being processed or that a command is being processed.

③ The result of the executed command (success or failure), ACK or NACK, can be verified only when the STO output time is on.

④ When ACK or NACK fall, CMD_READY turns on.

⑤ When CMD_READY is off, the CST input is ignored. At this time, the ACK and NACK responses for the CST are also not given.

⑥ For commands that are not executed in real time, READY is turned off while the command is executed.

Timing for commands not executed in real time

When there is no command

TRG1

READY1

When a command is entered

TRG1

READY1

1 μsec or more

CST

ACK

Capture time | Image processing time | Command execution time

Command execution wait time
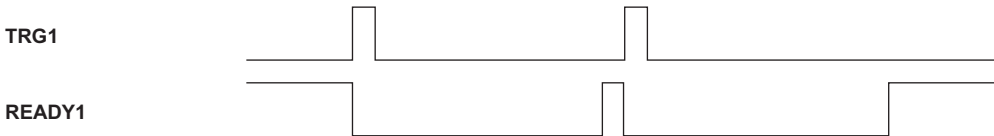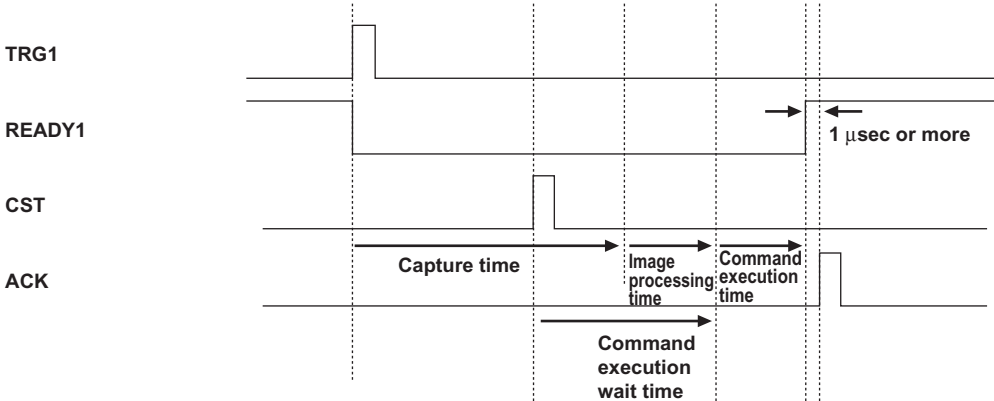
- When a command is entered during processing, the next command is executed when the image processing finishes.
- The READY signal does not turn on until the executed command finishes. However, the next trigger input cannot be received until the READY signal turns on.

When no image is captured

READY1

500 μsec or less | 1 μsec or more

CST

ACK

Command execution time
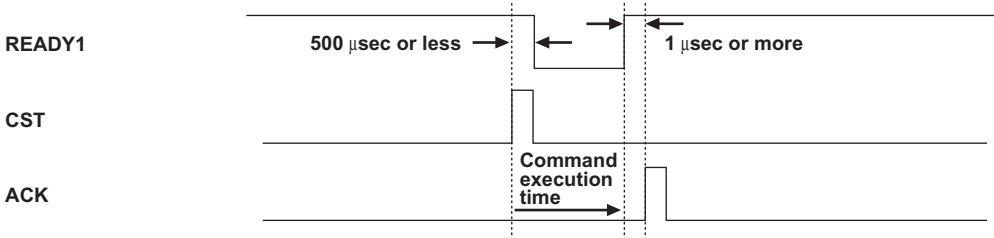
The READY signal does not turn off while a command is executed if the command is executed immediately.

Controlling the System or Transmitting Data Via the I/O Terminal

I/O Command Input Codes Used by the CV

The following represents I/O command input codes that can be used by the CV.

See the explanation starting on the next page for more details on each command.

Command name	Real time execution	Command code				Command parameter							
		IN 11	IN 10	IN 9	IN 8	IN 7	IN 6	IN 5	IN 4	IN1 3	IN 2	IN 1	IN 0
0. Program save	○	0	0	0	0	None (Page 11-17)							
1. Upper 8 bit parameter setting	○	0	0	0	1	0 to 255 (Page 11-17)							
2. Change program number (Internal memory)		0	0	1	0	0 to 255 (Page 11-17)							
3. Change program number (Memory card)		0	0	1	1	0 to 255 (Page 11-17)							
4. Register an image		0	1	0	0	IN7 to IN6: Camera number IN5 to IN0: Saved to number (Page 11-17)							
5. Update base values		0	1	0	1	None (Page 11-17)							
6. Screen capture	○*	0	1	1	0	None (Page 11-18)							
7. Save image	○	0	1	1	1	IN7 to IN6: Camera number IN3 to 2: Compression IN1 to 0: Output type (Page 11-18)							
8. Change window number	○	1	0	0	0	IN6 to IN0: 0 to 127 (Page 11-18)							
9. Change display template	○	1	0	0	1	IN3 to IN0: Select display template number (Page 11-18)							
10. Change result display	○	1	0	1	0	IN2 to IN0: Set result display (Page 11-18)							
11. Save statistical data	○	1	0	1	1	None (Page 11-19)							
12. Change shutter speed		1	1	0	0	IN7 to IN6: Camera number IN3 to IN0: Shutter speed (Page 11-19)							
13. Change camera sensitivity		1	1	0	1	IN7 to IN6: Camera number IN3 to IN0: Camera sensitivity (Page 11-19)							
14. Write command memory value	○	1	1	1	0	0 to 255 (Page 11-19)							
15. Write command memory location	○	1	1	1	1	0 to 127 (Page 11-19)							

1: ON (shorted), 0: OFF (open)

*Can also be used in program mode.

► **Note**

- Except for screen capture, I/O command inputs are only effective during Run mode.
- After entering commands to IN (0 to 11), turn on the CST input (confirmed when it rises) to execute the command.
- Inputs IN0 to IN7 should be set in binary format.
- The time that the ACK output or NACK output are on is the same as the STO output time.
- Commands executed in real time are executed concurrent with measurement, so executing these commands does not have an effect on image processing. However, the execution time for the command may be slower than when executing the command alone.

0. Program save

Saves program data.

Reference

- Operates in the same way as the SS command for no protocol commands (Page 9-30).
- NACK is returned when the data cannot be written to the internal memory or the memory card, or when a memory card is not inserted.

Parameter

None

1. Upper 8 bit parameter setting

Sets the upper 8 bits for the parameter value referenced by Change program number (internal memory), Change program number (CF memory), and Write command memory.

Reference

Maintains the set parameter until the command is run again or until the power is turned off.

Parameter

0 to 255

2. Change program number (Internal memory)

Up to 16 bits are available to activate a specified program from the internal memory.

Reference

- Operates in the same way as the PW and IN commands (Page 9-15).
- When switching into a specified program, changes made to the previous program will not be saved.
- Bits 15 to 8 are set with the "1. Upper 8 bit parameter setting" parameter, and bits 7 to 0 are set in this parameter. When the value exceeds 999 or the set program number does not exist, the program is not changed (in these situations, NACK is returned).

Parameter

0 to 255

3. Change program number (Memory card)

Up to 16 bits are available to activate a specified program from the memory card.

Reference

- Operates in the same way as the PW and CF commands (Page 9-15).
- When switching into a specified program, changes made to the previous program will not be saved.
- Bits 15 to 8 are set with the "1. Upper 8 bit parameter setting" parameter, and bits 7 to 0 are set in this parameter. When the value exceeds 999 or the set program number does not exist, the program is not changed (in these situations, NACK is returned).

Parameter

0 to 255

4. Register an image

The most recently captured image from the specified camera is saved as a registered image.

Reference

- Operates in the same way as the BS command (Page 9-18).
- If an image has been recently loaded into the camera, that image is registered.
- The location for the image registration is set with IN5 to IN0.
- The base values are automatically updated after registration. If there is not enough work memory while updating, NACK is returned.
- If the command cannot be executed for another reason, such as lack of space in the memory card, NACK is returned.

Parameter

- IN5 to IN0: Registration number 0 to 63
- IN7 to IN6: Camera number (0: Camera 1, 1: Camera 2, 2: Camera 3, 3: Camera 4)

5. Update base values

Updates the base values using the most recent registered image as standard.

Reference

- Operates in the same way as the RR command (Page 9-29).
- The base values are values referenced by calculations and the reference position for position adjustment.
- If there is not enough window memory while updating, NACK is returned.

Parameter

None

Controlling the System or Transmitting Data Via the I/O Terminal

6. Screen capture

Performs screen capture.

Reference

- Operates in the same way as screen capture from the remote control console or the BC command (Page 9-17).
- If screen capture is already being executed, the command response may be slow.
- If the command cannot be executed for another reason, such as lack of space in the memory card, NACK is returned.

Parameter

None

7. Save image

Saves all of the image data in the image buffer as bitmap format images (24-bit color: color camera, 8-bit grayscale: monochrome camera) in the "/cv/ image" folder in the memory card.

Reference

- Operates in the same way as the BT command (Page 9-19).
- The image is saved with the file name "(time)_(date)_(camera number)_(count, 10 digits).bmp".
- There is a slight delay when accessing the memory card.
- If the command cannot be executed for another reason, such as lack of space in the memory card, NACK is returned.
- Any existing files with the same name are overwritten.

Parameter

- IN7 to IN6: Camera number (0: Camera 1, 1: Camera 2, 2: Camera 3, 3: Camera 4)
- IN3 to 2: Compression (0: none, 1: 1/2, 2: 1/4, 3: 1/8)
- IN1 to 0: Output type (0: NG images only, 1: All images, 2: OK images only)

8. Change window number

Changes the current window selection to the specified window number.

Reference

- Operates in the same way as the UW command (Page 9-16).
- It is used to check data results or the window position.
- When display is complete, ACK is returned.
- If a window number that does not exist is entered, NACK is returned.

Parameter

IN6 to IN0: Value of window number (0 to 127)

9. Change display template

Changes the display template with the selected template number.

Reference

- Operates in the same way as the DS and PT commands (Page 9-16).
- When changes to the display are complete, ACK is returned.
- If a template number that does not exist or a template number that results in nothing being displayed are entered, NACK is returned.

Parameter

IN3 to IN0: Value of template number (0 to 9)

10. Change result display

Changes the result display with the selected result display mode.

Reference

- Operates in the same way as the DS and RS commands (Page 9-16).
- If the display tries to switch to a result display mode that results in nothing being displayed, NACK is returned.

Parameter

IN2 to IN0: Set result display (0: No display, 1: Default-1, 2: Default-2, 3: Calc. results, 4: Custom)

11. Save statistical data

Outputs accumulated statistical data to the memory card. See "Saving Recorded Results to a Memory Card (Save)" (Page 6-5) for more details about the contents of the saved files.

Reference
- Operates in the same way as the ST command (Page 9-33).
- If the command cannot be executed for another reason, such as lack of space in the memory card, NACK is returned.

Parameter

None

12. Change shutter speed

Changes the shutter speed of the specified camera.

Reference
- Operates in the same way as the CW and SH commands (Page 9-28).
- NACK is returned when the selected camera is not connected or an unsuitable shutter speed is set.

Parameter
- IN7 to IN6: Camera number (0: Camera 1, 1: Camera 2, 2: Camera 3, 3: Camera 4)
- IN3 to IN0: Shutter speed (0: 1/15, 1: 1/30, 2: 1/60, 3: 1/120, 4: 1/240, 5: 1/500, 6: 1/1000, 7: 1/2000, 8: 1/5000, 9: 1/10000, 10: 1/20000)

13. Change camera sensitivity

Changes the camera sensitivity of the specified camera.

Reference
- Operates in the same way as the CW and SE commands (Page 9-28).
- NACK is returned when the selected camera is not connected or an unsuitable camera sensitivity is set.

Parameter
- IN7 to IN6: Camera number (0: Camera 1, 1: Camera 2, 2: Camera 3, 3: Camera 4)
- IN3 to IN0: Camera sensitivity setting (1 to 9)

14. Write command memory value

Writes a 16 bit value to the specified command memory (CM000 to 127). For the 16 bit value, the upper 8 bits are set in the upper 8 bit parameter setting (Page 11-17), and the lower 8 bits are set in IN7 to IN0.

Reference
- Operates in the same way as the MW command (Page 9-27).
- If the write location for the command memory has never been set, data is written to CM000.
- If the command if not executed correctly, the previous data is maintained.
- Upper limits or lower limits are not applied to the input values for command memory settings.

Parameter
- IN7 to IN0: Lower 8 bits of the value you want to write (0 to 255)
- Combined with the upper 8 bit parameter setting, the input value can be set between 0 and 65535.

15. Set write command memory location

Set the write location (CM000 to 127) when writing to command memory.

Reference
- After this parameter is set once, the location for writing is saved until the next time the write command memory location parameter is set, or until the power to the system is turned off.
- NACK is returned if IN7 is set to [1].
- If the command is not executed correctly, the previous data is maintained.

Parameter

IN6 to IN0: Value you want to write (0 to 127)

Controlling the System or Transmitting Data Via the I/O Terminal

Steps for I/O Command Control

The following procedure is used when controlling the system with I/O commands.

Exampling of changing to program number 15 for internal memory using I/O commands
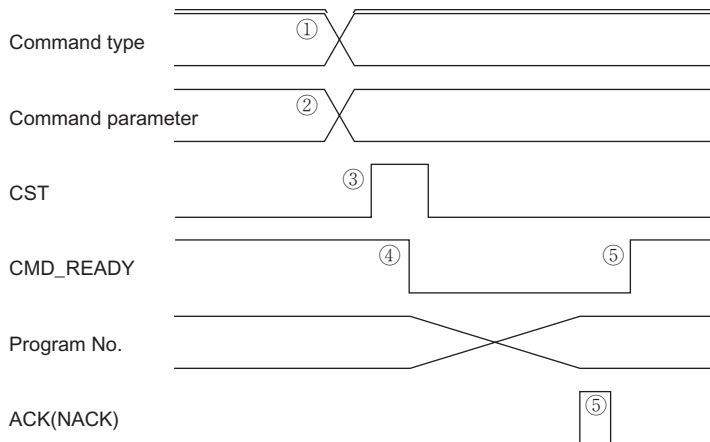
① Enter the command code for changing program numbers (internal memory) into IN8 to IN11.

    IN11: 0 (OFF)

    IN10: 0 (OFF)

    IN9: 1 (ON)

    IN8: 0 (OFF)

② Enter the program number to change to, program number 15, in IN7 to IN0.

    IN7: 0 (OFF)

    IN6: 0 (OFF)

    IN5: 0 (OFF)

    IN4: 0 (OFF)

    IN3: 1 (ON)

    IN2: 1 (ON)

    IN1: 1 (ON)

    IN0: 1 (ON)

③ Turn the CST input on.

④ CMD_READY turns off and program switching begins.

⑤ After the system has finished switching to program number 15, ACK turns on momentarily. After ACK falls, CMD_READY turns on.

► **Note**

- The amount of time to execute the program switching command depends on the settings. To detect when switch has completed watch for ACK or CMD_READY to rise.
- During measurement, the program switching command is performed after measurement is completed. During measurement result output, the command is performed after one measurement is output. During all other output, the command is performed after the output is canceled.
- The length of time that ACK or NACK are active for is the same as the set output time for STO (default: 10 ms).

Outputting Data from I/O Terminal

Output Order

The data set to be output from OUT0 to OUT15 are output in 16 bit cycles.

The items to output and their order can be set as necessary in [Output] (Page 4-280).

See the next page for examples of output contents and timing from each terminal.

Reference
- STO output is always output at least once, even when [Output] has not been set.
- If the system is set to Program mode or if the TEST terminal (page 11-42) is turned on, then data will not be output.

Output Data

The following table indicates the output data for each pin.

1)	**Total Count**	OUT0 to OUT15: Bit0 to Bit15
2)	**Inspection window judgment value**	**When up to 16 judgment windows are selected:** • OUT0 to OUT15: Selected windows 1 to 16 • When 15 or fewer judgment windows are selected, the remaining terminals output as [0].
		When 17 or more judgment windows are selected: • First output OUT0 to OUT15: Selected windows 1 to 16 • Second output OUT0 to OUT15: Selected windows 17 to 32 • First the selected windows 1 to 16 are output, and then the selected windows 17 to 32 are output. • When 31 or fewer judgment windows are selected, the remaining terminals output as [0].
3)	**Inspection window measurement value** (See Page 4-294 for more details about the data format for each measurement value.)	**For results other than calculation:** OUT0 to OUT15: Bit0 to Bit15 (numbers below the decimal point are dropped)
		For calculation results First output OUT0 to OUT15: Bit0 to Bit15 (numbers below the decimal point are dropped) Second output OUT0 to OUT15: Bit16 to Bit31 (First the lower 16 bits are output, then the upper 16 bits are output.)

► Note
- For measurement value and calculation value output data, only the integer portion of the number is output, regardless of the result. To display the portion of the value after the decimal point, use the calculation function (Page 4-253) to multiply the data by 10x to 1000x and output the value as an integer.
- Negative data values are output in two's complement binary format.
- When [All] is selected for the output items to detect in the [Output] menu, regardless of the actual count, all data for the output items set to be detected in the inspection window are output. In this situation, the output time from the I/O terminal increases a great deal and may effect the image processing time.
- When the item cannot be measured ([- - - -] is displayed), the measurement value is output as [0]. Use the count output simultaneously to determine which values are output as [0] even when they are measured correctly.
- When the output results fall beyond the output range, output through the calculation window (32 bit output).
  The following values show the I/O output range for count and results other than calculation.
  – I/O output range for count and results other than calculation:
    For positive measurement data: ($0 \leq x \leq 65535$: Output as is), ($x > 65535$: Output as 65535)
    For negative measurement data (output in two's complement binary): ($0 \leq x \leq 32767$: Output as is), ($x > 32767$: Output as 32767)
    ($-32768 \leq x < 0$: Output as is), ($x < -32768$: Output as -32768)
  – I/O output range of calculation results: Outputs in two's complement binary output, regardless of the results.
    ($0 \leq x \leq 9999999$: Output as is), ($x > 9999999$: Output as 9999999),
    ($-9999999 \leq x < 0$: Output as is), ($x < -9999999$: Output as -9999999)
- When judgment output is set to skip unexecuted windows, the bit for the unexecuted window is aligned to the front and then output.

Controlling the System or Transmitting Data Via the I/O Terminal

Output Example

When the program is set to perform the following measurements, the output signal follows the time chart in the diagram below.

- Measurement Conditions

   W000: Area, W001: Blob (Count setting 3), W002: Edge width, W003: Stain,

   W004: Pattern search, C000: Calculation

- Output Settings

   C000: Calculation, W001: Angle (all), W001: Pos. XY (Primary target),

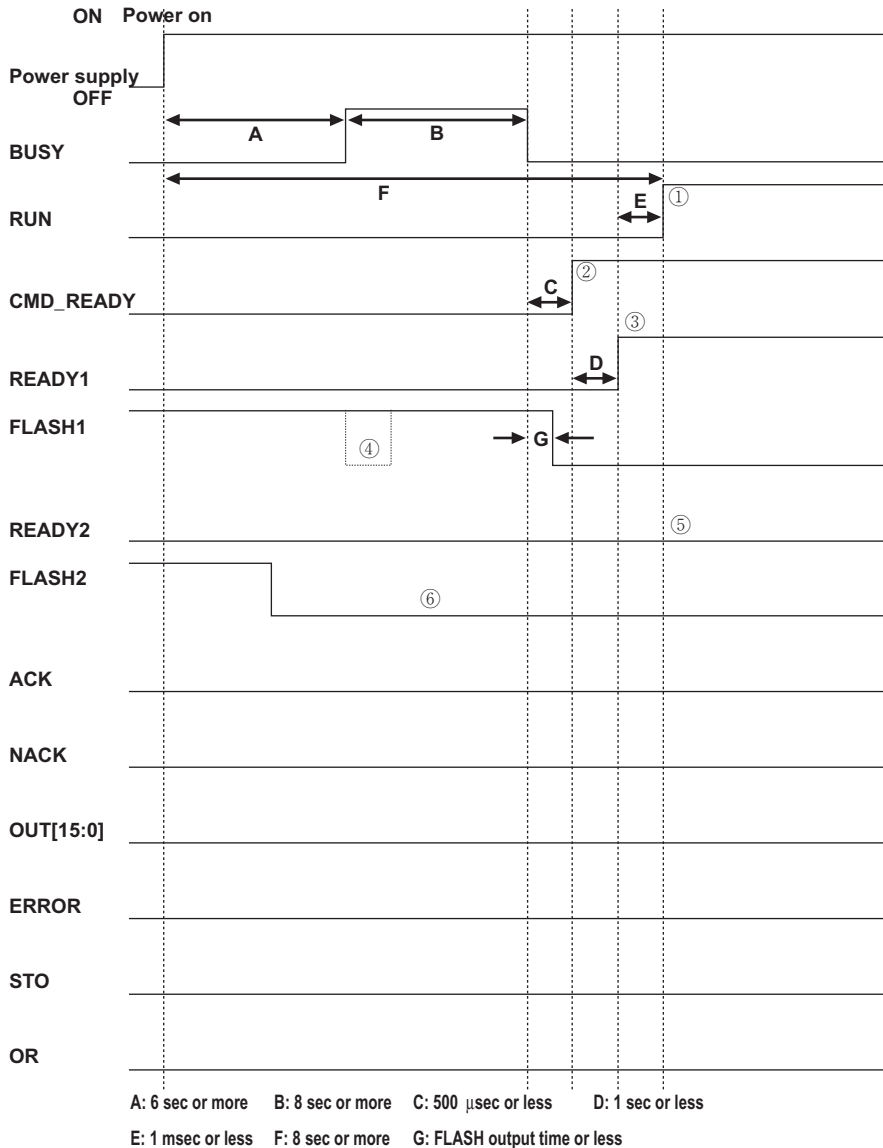   Judgment (W000, W002, W003, C000)

With [Handshaking] set to [OFF], the system will run through the eight 16 bit cycles using the timing set in [Terminal I/O] in the [Global] menu (Cycle time). Each time a cycle is activated, the STO terminal outputs for the length of time set in [STO Output time].

TRG

	①	②	③	④	⑤	⑥	⑦	⑧
OUT0	C000 Calculation results 0 to 15 bit (lower 16 bits)	C000 Calculation results 16 to 31 bit (upper 16 bits)	W001 Angle for first target (16 bits)	W001 Angle for second target (16 bits)	W001 Angle for third target (16 bits)	W004 Pos. X for primary target	W004 Pos. Y for primary target	W000 Judgment
OUT1								W002 Judgment
OUT2								W003 Judgment
OUT3								C000 Judgment
OUT4								0
OUT5								0
OUT6								0
OUT7								0
OUT8								0
OUT9								0
OUT10								0
OUT11								0
OUT12								0
OUT13								0
OUT14								0
OUT15								0

OUT0~15   ① ② ③ ④ ⑤ ⑥ ⑦ ⑧

STO

A: STO Output rise time   B: STO Output time   C: Output cycle time
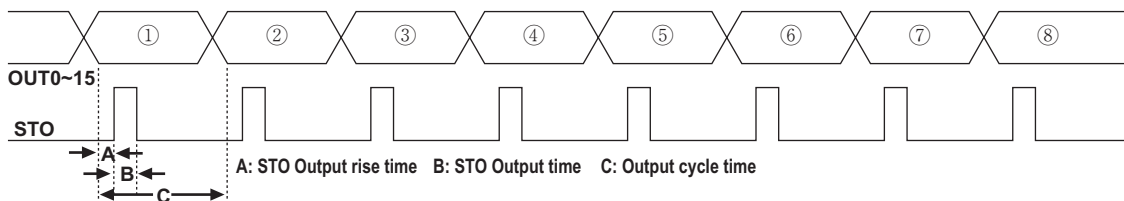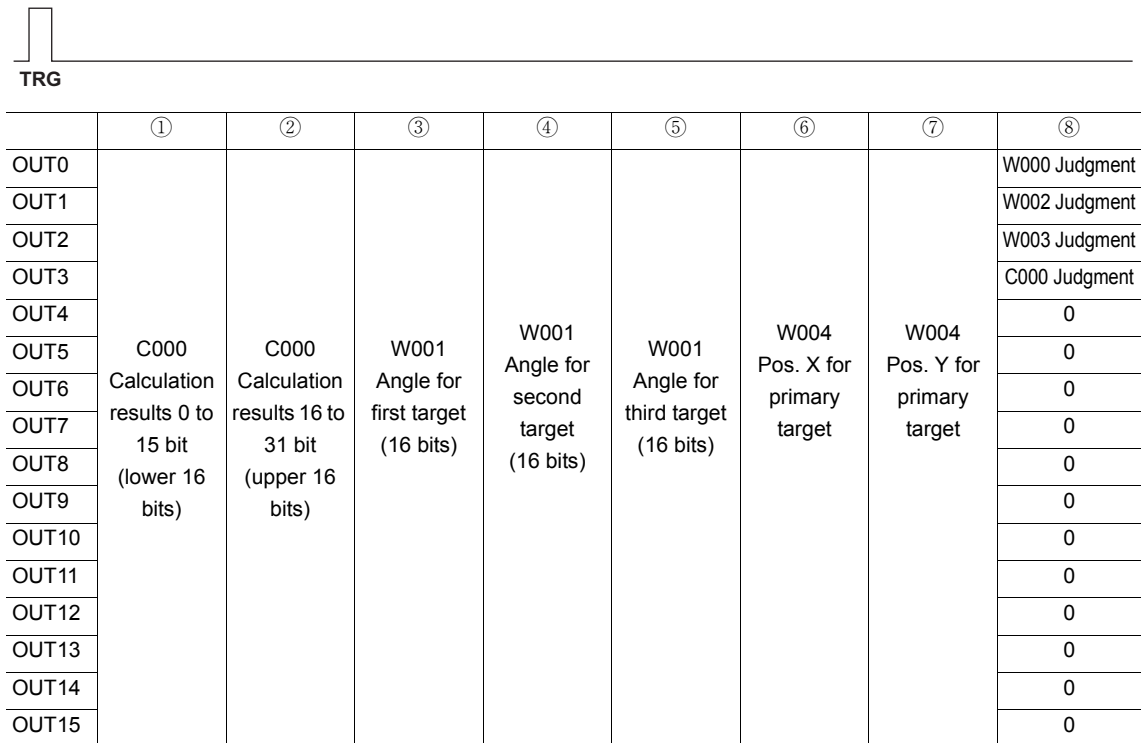
- See "Changing the Terminal Output Settings (Terminal I/O)" (Page 7-2) for more details on setting A through C in the above diagram.
- The output time from the I/O terminal for one inspection is (number of cycles) x (cycle time).
- When the output time from the I/O is longer than the trigger input cycle, the output is not completed in time and may effect the image processing time.

Timing Chart

1. I/O Operations when Powering On

A: 6 sec or more B: 8 sec or more C: 500 μsec or less D: 1 sec or less

E: 1 msec or less F: 8 sec or more G: FLASH output time or less

① The RUN terminal turns on during Run mode, and off during Program mode.

② Commands can be input when CMD_READY is on. Commands input before this are ignored.

③ TRG1 can be input when READY1 is on.

④ When starting up in Program mode, FLASH1/2 are turned on and off.

⑤ When there are no window settings for TRG2, READY2 remains off. When settings for TRG2 are being used, READY2 will operate the same as READY1.

⑥ When TRG2 is set to be used, FLASH2 turns on with the same timing as FLASH1.

Controlling the System or Transmitting Data Via the I/O Terminal

Normally open/normally closed timing
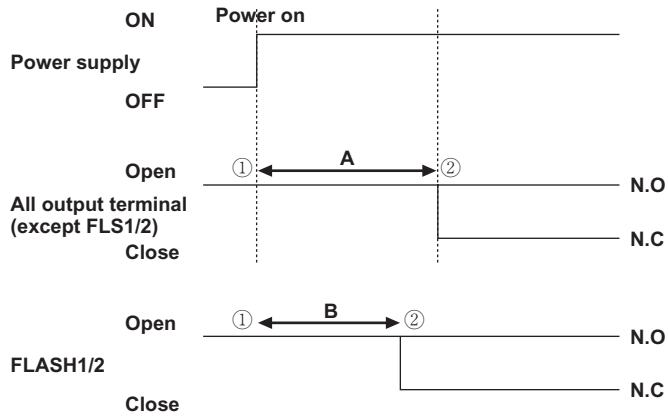
A: 6 sec or more   B: 5 sec or more

① The system enters normally open state immediately after startup, regardless of the settings.

② The normally closed settings are reflected after a short period of time passes.

2. Typical Operations for External Trigger Input

Typical operations when using only one trigger, either trigger 1 or trigger 2
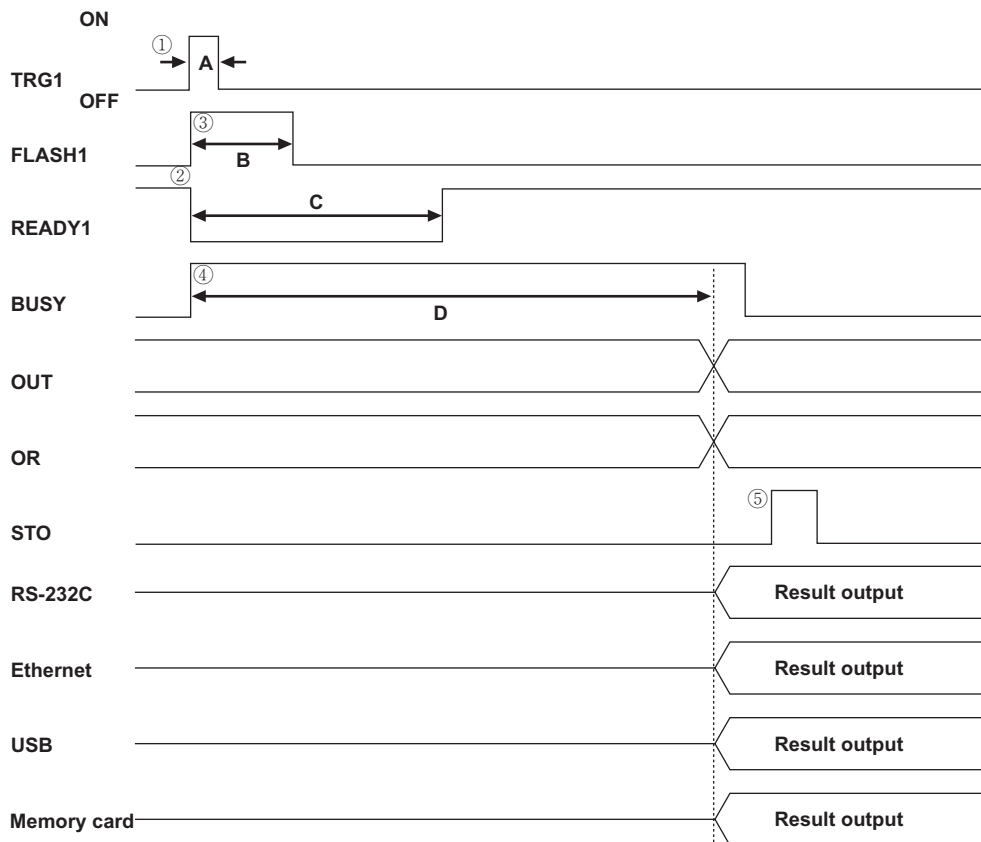
A: TRG minimum input time (1 ms or more)

B: FLASH output time (variable depending on settings, 1 ms or more)

C: Image capture time (Shutter time + image transfer time)

D: Measurement time (Shutter time + image transfer time + image processing time)

① The camera begins capturing images when the trigger is input. When [Continuous] is set in [Run Screen update mode] (Page 7-9), TRG2 cannot be used.

② The trigger can be input when READY output is on. After inputting the trigger, the READY output turns off for only a short period of time (shutter speed + image transfer time). When capturing simultaneously from three or more mega pixel color cameras, the internal processing delays the image transfer time by up to 36 ms.

③ With the trigger input, the FLASH output turns on for the output time (varies according to settings). See "Typical operations when using sequential triggers for trigger 1 and trigger 2 simultaneously" (Page 11-29) for more details.

④ When BUSY is on, internal processing captures the image from the camera and performs image processing. When all of the processes have finished, the BUSY output turns off.The measurement time displayed as D is the time from trigger input to completion of image processing.

⑤ After BUSY turns off, data output begins. The I/O outputs turn on after the STO rise time passes (varies according to settings). See "Terminal data output timing (Handshake OFF)" (Page 11-31) for more details.

Controlling the System or Transmitting Data Via the I/O Terminal

Typical operations when using individual triggers (trigger 1 and trigger 2)

► **Note**

See Page 11-28 for how to connect four cameras, including mega pixel color cameras.
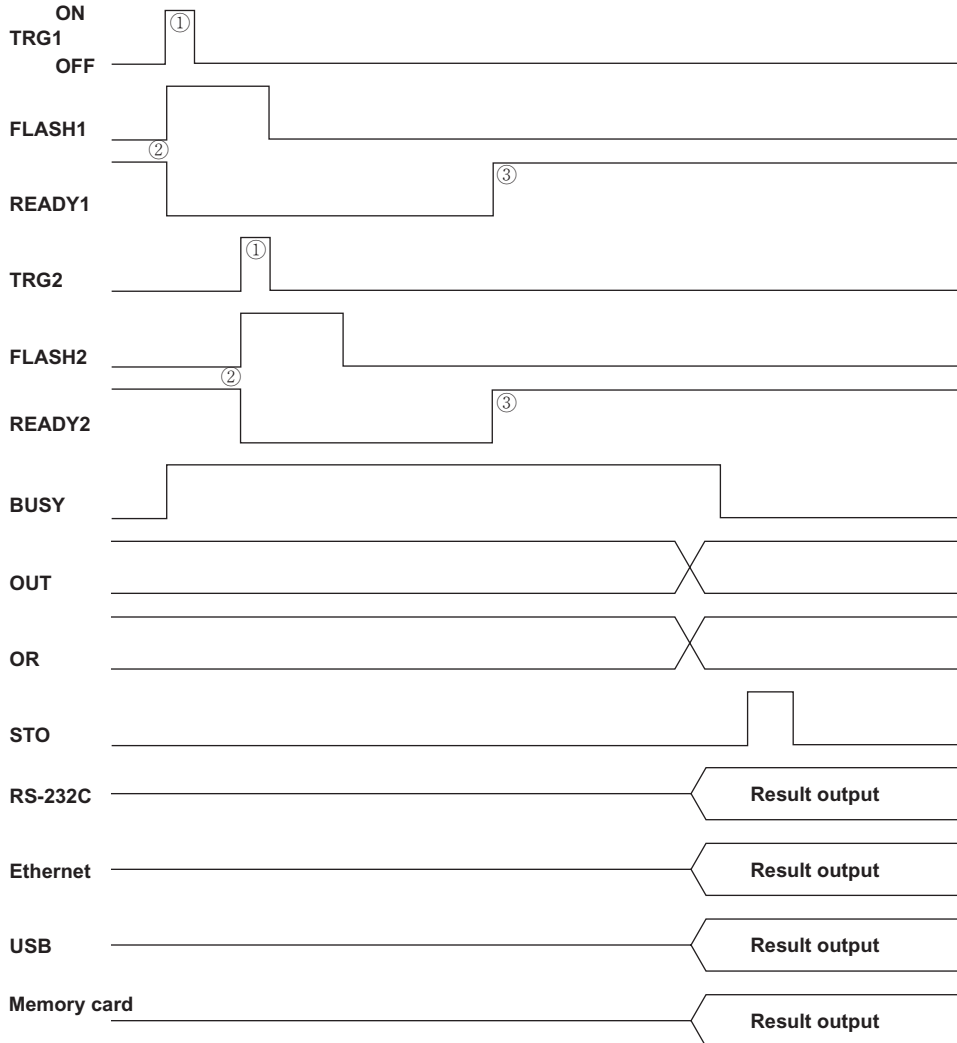
① Either TRG1 or TRG2 may be input first, but once a specific trigger has be used, it cannot be used again until the remaining trigger has been input. In other word, the 2 trigger cycle must be completed in order to start a new 2 trigger cycle.

    Correct operation examples:
    (TRG1, TRG2), (TRG1, TRG2), (TRG1, TRG2), etc.
    (TRG2, TRG1), (TRG1, TRG2), (TRG2, TRG1), etc.
    Incorrect operation examples:
    (TRG1, TRG2), (TRG1, TRG1), (TRG1, TRG1), etc.
    (TRG2, TRG2), (TRG1, TRG1), (TRG2, TRG2), etc.

② TRG1 can be input when READY1 is on. TRG2 can be input when READY2 is on.

③ READY1 and READY2 will only turn on after image capture and transfer has been completed for both TRG1 and TRG2. When capturing simultaneously from three or more mega pixel color cameras, the internal processing delays the image transfer time by up to 36 ms.

■ Reference

To clear the wait state that the system enters after the first trigger, enter a RESET input. In this situation, the captured image stored in the image buffer by the first trigger input is erased, and no image processing takes place.

► Note

When [Continuous] is set in [Run Screen update mode] (Page 7-9), or [Multi-Image] or [Sequential] trigger are used in the [Camera] settings, TRG2 cannot be used. TRG1 input will perform image processing regardless of the settings.

Controlling the System or Transmitting Data Via the I/O Terminal

Typical operations when using individual triggers (trigger 1 and trigger 2) (When connecting three or more mega pixel color cameras)

In the [Trigger] settings in the [Camera] settings menu (Page 4-14), when there is a camera with [Disable] displayed for [Trg1,2 Multiple:], the following timing chart is used (result output timing is the same as normal, as shown on the previous page).
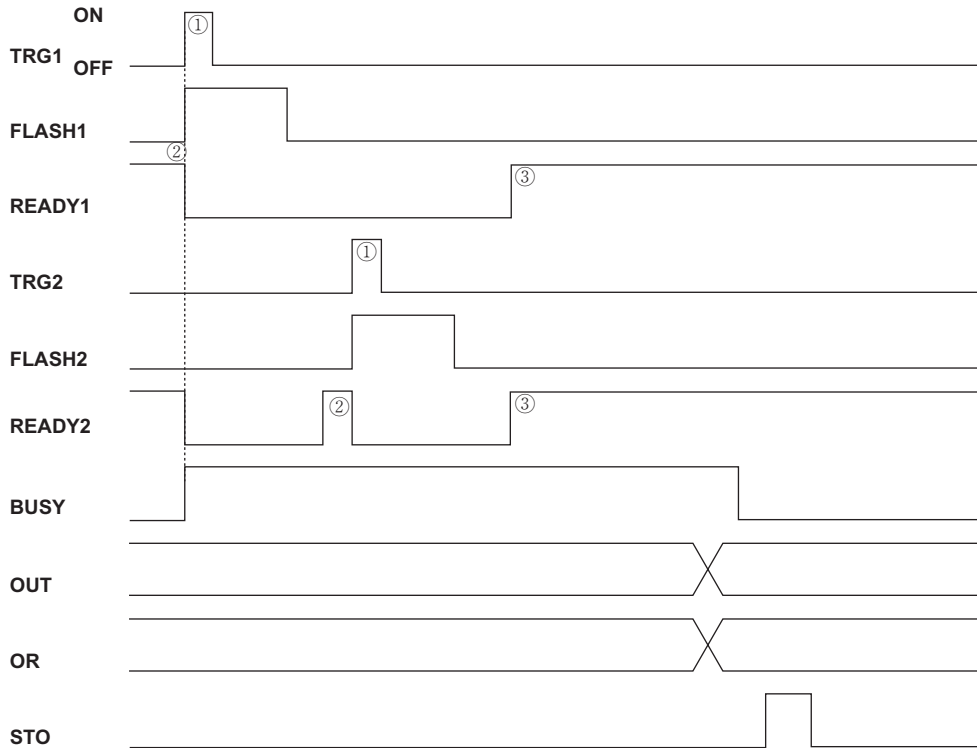
① Either TRG1 or TRG2 may be input first, but once a specific trigger has be used, it cannot be used again until the remaining trigger has been input. In other word, the 2 trigger cycle must be completed in order to start a new 2 trigger cycle.

Correct operation examples:
(TRG1, TRG2), (TRG1, TRG2), (TRG1, TRG2), etc.
(TRG2, TRG1), (TRG1, TRG2), (TRG2, TRG1), etc.

Incorrect operation examples:
(TRG1, TRG2), (TRG1, TRG1), (TRG1, TRG1), etc.
(TRG2, TRG2), (TRG1, TRG1), (TRG2, TRG2), etc.

② When the READY output for each camera is on, a TRG can be input, but both TRG1 and TRG2 cannot be input at the same time. After the first TRG is input and the image from the camera has been captured and transferred, the next TRG can be input.

③ READY1 and READY2 will only turn on after image capture and transfer has been completed for both TRG1 and TRG2.

Reference

- To clear the wait state that the system enters after the first trigger, enter a RESET input. In this situation, the captured image stored in the image buffer by the first trigger input is erased, and the image processing does not take place.
- The sequential trigger function (Page 4-15) automatically inputs TRG2 after capturing an image with TRG1.

► Note

When [Continuous] is set in [Run Screen update mode] (Page 7-9), or [Multi-Image] (Page 4-17) or [Sequential] trigger (Page 4-15) are used in the [Camera] settings, TRG2 cannot be used. TRG1 input captures an image, regardless of the settings.

Typical operations when using the sequential trigger function for trigger 1 and trigger 2

TRG1   ON / OFF ①

FLASH1

READY1   ③

FLASH2

READY2

TRG1 capture/ transmission	TRG2 capture/ transmission	Image processing

BUSY

OUT

OR

STO

RS-232C   Result output

Ethernet   Result output

USB   Result output

Memory card   Result output
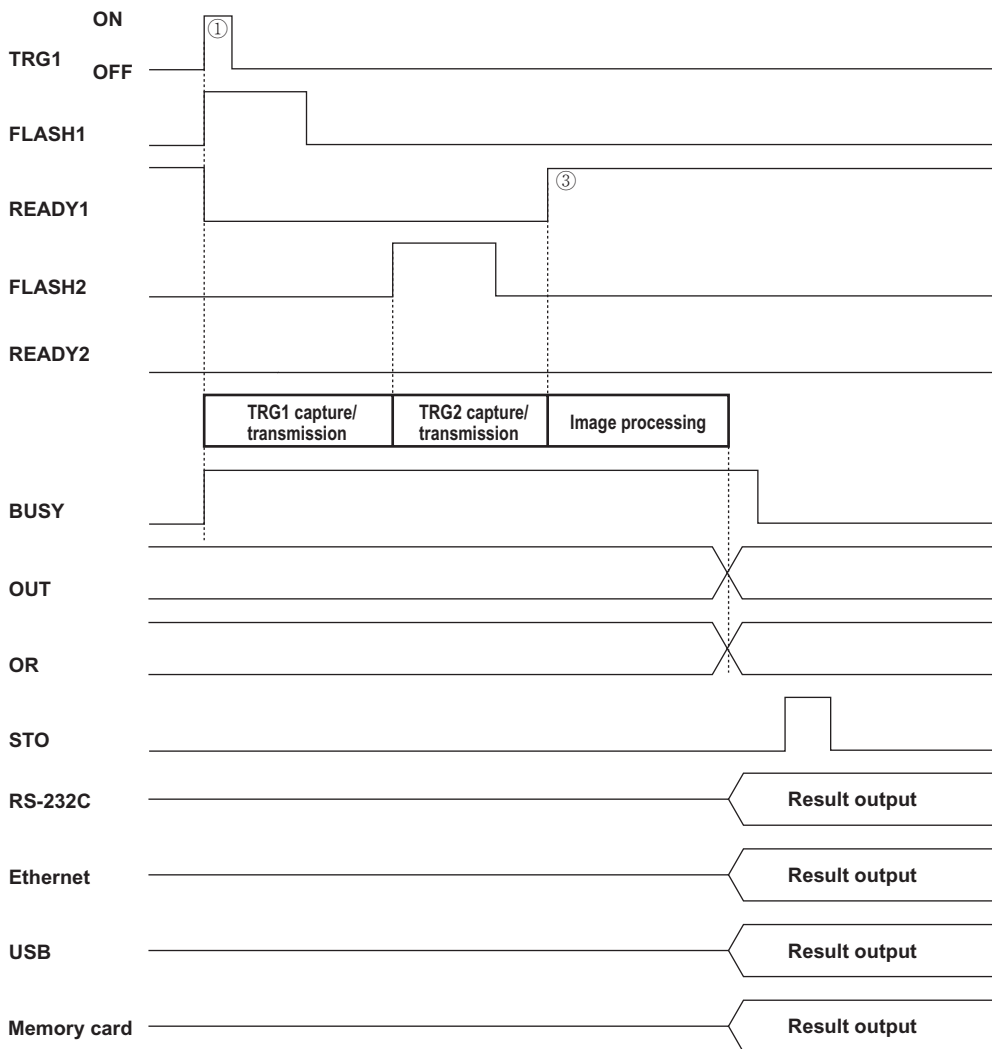
① When using the sequential trigger, only TRG1 is effective.
② After transfer from the TRG1 camera has finished, the image capture and transfer begins for TRG2. FLASH output operates as each image is captured.
③ READY1 turns on when capture from the cameras connected to both TRG1 and TRG2 have completed.

Controlling the System or Transmitting Data Via the I/O Terminal

FLASH output timing

▶ **Note**

When [Continuous] is set in [Run Screen update mode] (Page 7-9), TRG input is not used in conjunction with FLASH output.

When FLASH ON-Delay is ON
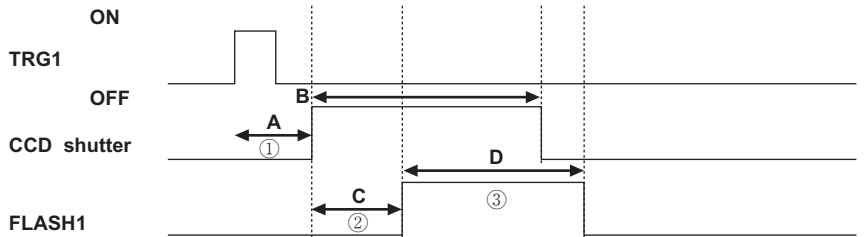
A: For CV-035C/035M, CV-S035C/S035M: 60 μs (response delay 0 to 5 μs)
    For CV-200C/200M, CV-S200C/S200M: 60 μs (response delay 0 to 50 μs)
B: Shutter speed

C: FLASH output start on-Delay (0 to 500 μs) ±10 μs

D: FLASH output time (0 to 999.9 ms)

① When TRG input is received, the controller gives the order to operate the CCD shutter for the camera.

② Based on the timing for the order to operate the CCD shutter, the time to start the FLASH output is set as the FLASH ON-Delay.

③ The FLASH output time sets how long the FLASH output is turned on.

Reference

See "Changing the Terminal Output Settings (Terminal I/O)" (Page 7-2) for details on how to change the FLASH ON-Delay and the FLASH output time.

When FLASH ON-Delay is OFF
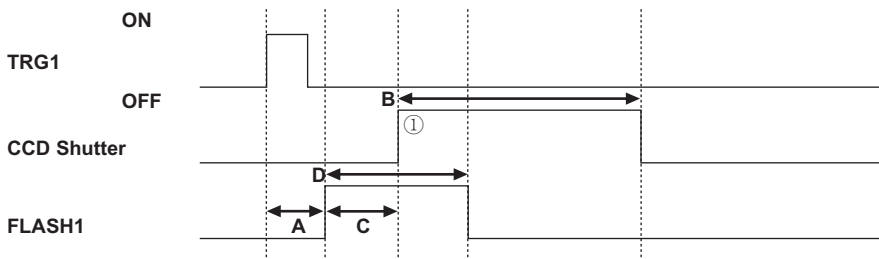
A: 60 μs (±10 μs)*   B: Shutter speed

C: For CV-035C/035M, CV-S035C/S035M: Absolute value of the FLASH ON-delay (-500 to 0 μs) (response delay 0 to 5 μs)
    For CV-200C/200M, CV-S200C/S200M: Absolute value of the FLASH ON-delay (-500 to 0 μs) (response delay 0 to 5 μs)

D: FLASH output time (0 to 999.9 ms)

* Value 90 μs (±10 μs) when N.C. is used.

① When the FLASH ON-Delay is negative, the FLASH output turns on first after the TRG input is received. Then there is a delay for the absolute value of the FLASH ON-Delay, and an order is given to operate the CCD shutter for the camera.

Terminal data output timing (Handshake OFF)
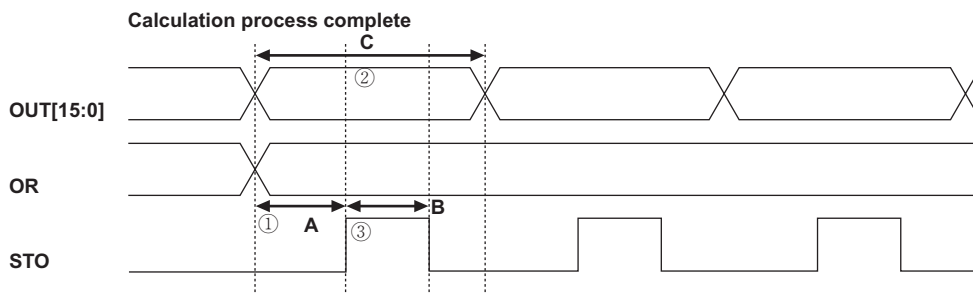
A: STO Output rise time (1 to 999 ms)   B: STO Output time (1 to 999 ms)） C: Output cycle (2 to 1000 ms)

Be sure to keep "A+B ≦ C".

① See [Changing the Terminal Output Settings（Terminal I/O)] (Page 7-2) for more details about changing the time periods for A to C.

② Measurement result data is output to OUT [15:0]. Measurement result data switches OUT [15:0] in order according to the output cycles set in the [OUTPUT] menu.

③ With [Handshaking] set to [OFF], the system will run through the 16 bit cycles using the timing set in [Terminal I/O] in the [Global] menu (Cycle time). Each time a cycle is activated, the STO terminal outputs for the length of time set in [STO Output time] passed.

Reference

See "Outputting Data from I/O Terminal" (Page 11-21) for more details about terminal data output.

Controlling the System or Transmitting Data Via the I/O Terminal

Terminal data output timing (Handshake ON)

A: STO Output rise time (1 to 999 ms)   B: STO Output time (1 to 999 ms)   C: Output cycle (2 to 1000 ms)

D: PST OFF response time (0.5 ms or less)   E: PST minimum input time (1.0 ms or more)   F: PST ON response time (0.5 ms or less)

Be sure to keep "A+B ≦ C"
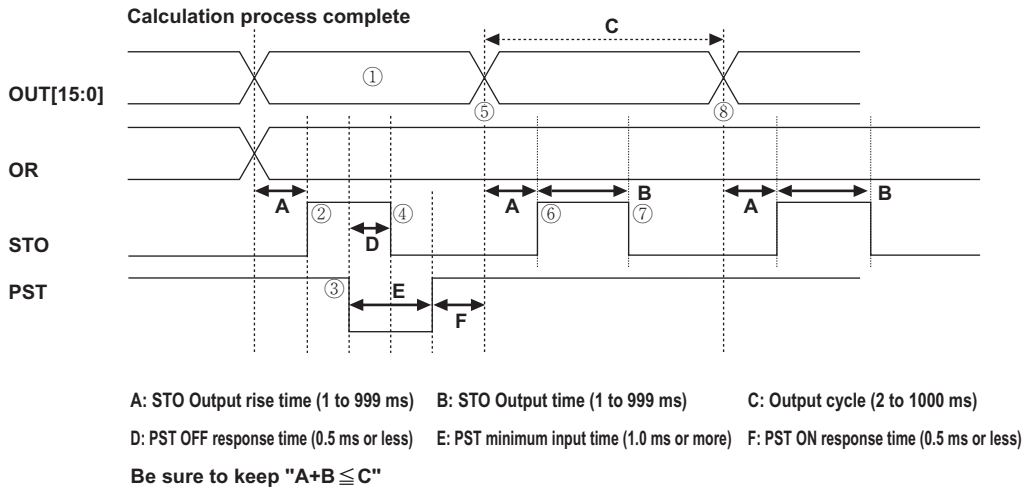
① Measurement result data is output to OUT [15:0]. Measurement result data switches OUT [15:0] in order according to the output cycles set in the [OUTPUT] menu.

② After image processes has finished, the first data is output and STO output turns on after A (STO rise time).

③ When [Handshaking] is set to [ON], data switches when PST input falls.

④ After checking that STO is rising, PST input switches from on to off and STO output turns off.

⑤ Next the PST input switches from off to on and the data is switched.

⑥ After the data has switched, STO output turns on after A (STO rise time). The next output data is switched in order by repeating steps 4 to 6. After all of the measurement result data cycles have finished being output, sending more PST inputs will not switch more data or turn STO on and off.

⑦ After STO output turns on, if there is no input to switch the PST input from on to off, the STO output automatically turns off after B (output time).

⑧ After STO output turns off, if there is no input to switch the PST input from off to on, the OUT automatically switches after C (output cycle). In other words, if there is no handshake operation from the PST input, [Handshake ON] acts the same as [Handshake OFF].

Reference

See [Outputting Data from I/O Terminal] (Page 11-21) for more details about terminal data output.

Double buffer measurement

This system uses a double buffer structure, so the next trigger can be input when the READY terminal turns on, even if the previous measurement has not finished yet. Trigger input is synchronized with the READY terminal, and the trigger can be input at the trigger interval displayed on the screen.

Normal measurement (not using double buffer)
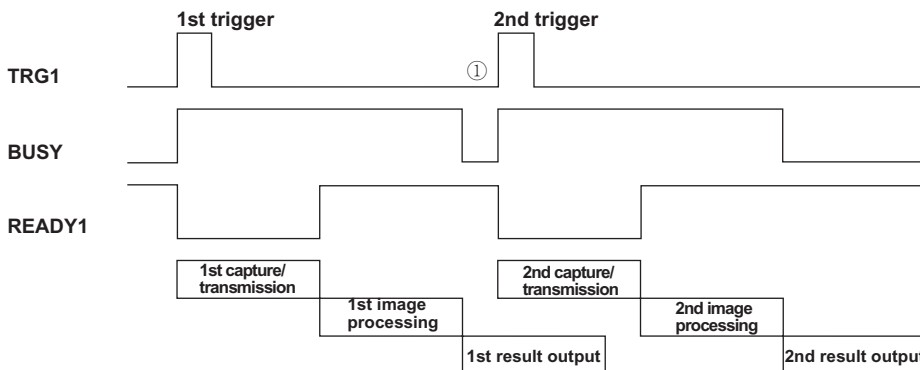
① When confirmation is received with BUSY that the previous image processing has completed, input the trigger.
   The shortest processing cycle is the measurement time (image capture time + image processing time).

Double buffer measurement (when image processing time is shorter than image capture time)
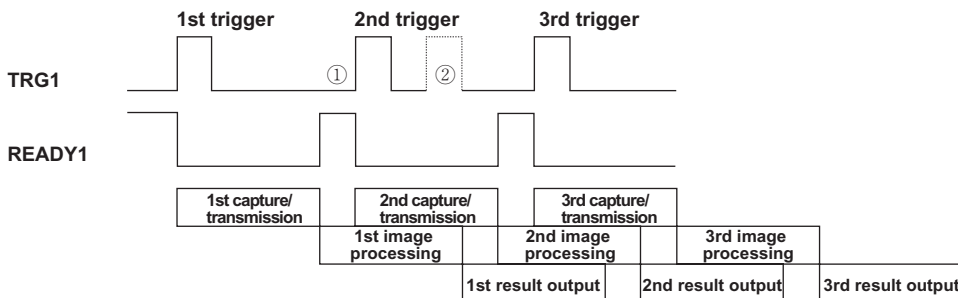
① When READY1 terminal turns on, the next trigger is input.
   The shortest processing cycle is the displayed trigger interval (image capture time).
② TRG input is ignored when the READY1 terminal is off.

Controlling the System or Transmitting Data Via the I/O Terminal

Double buffer measurement (when image processing time is longer than image capture time)
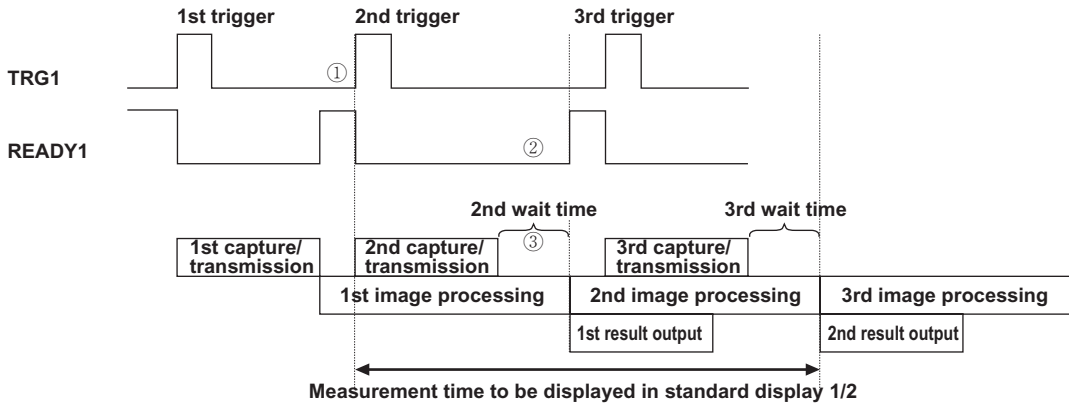
① When READY1 terminal turns on, the next trigger is input.

   The shortest processing cycle is the displayed trigger interval (image processing time).

② If the second image capture completes before the first image processing is completed, READY will not turn on.

③ The second image capture data that is captured while the first image processing takes place waits to begin image processing until the first image processing is complete.

④ During step 3 above, the measurement time display includes the wait time, so the displayed value for the measurement time is displayed longer than normal (displayed value for trigger interval does not change).

READY behavior when output cycle is longer than trigger input cycle

When the output cycle is longer than the trigger input cycle, the off time for READY may become longer even if image transfer and image processing have finished. This function allows the data output buffer to clear.

When using output to terminal, RS-232C, Ethernet, and USB
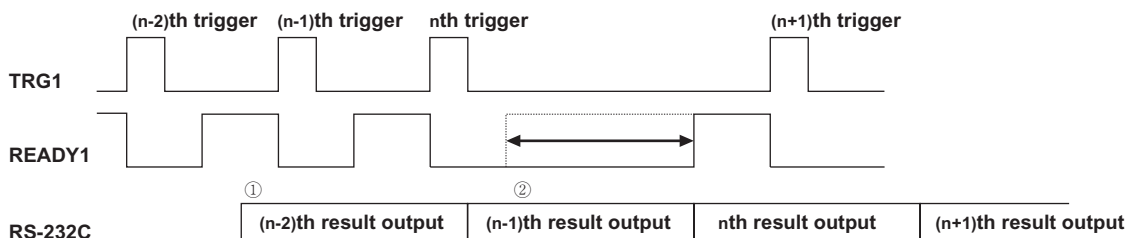
① When switching from Output cycle to Trigger input cycle, measurement result data that could not be output within the trigger cycle is stored in the output buffer and the next result is output.

② When the output buffer is completely filled, the system will become unable to receive the next measurement, and the READY terminal remains off until the output buffer is cleared. The trigger input cannot be received in this state.

In the timing chart, the READY1 signal remains off until the results for the nth trigger can be output. During this period, the (n+1)th trigger cannot be input.

Reference

When performing continuous measurement, set the trigger input cycle to be longer that the output cycle for one measurement or set a high speed data output cycle for one measurement.

When using output to a memory card
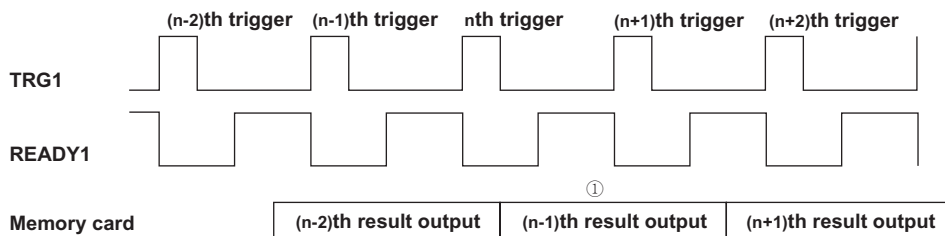
① When the output buffer is full, the output data to the memory card is skipped (does not affect output to READY1).
In the above example, when the system tries to output the results for the nth trigger, the output buffer is filled and the nth data is skipped.

Controlling the System or Transmitting Data Via the I/O Terminal

3. Typical Operations for Internal Trigger Input
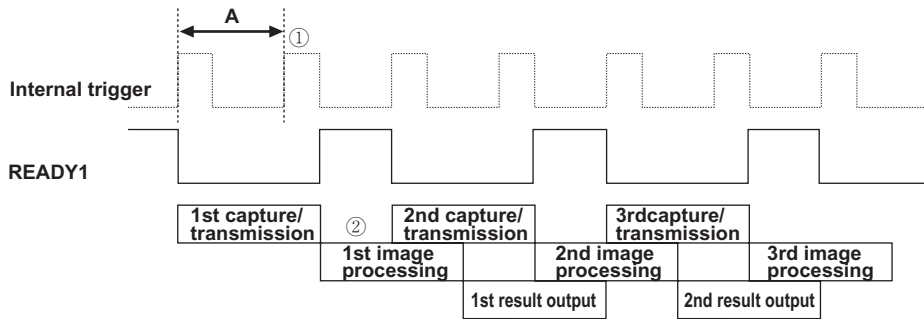
A: Internal trigger interval time (1 to 999ms)

① When internal trigger is selected, the set internal trigger interval time cycle repeats and the trigger signal is generated. The trigger signal that is generated when READY1/2 are on and the system begins capturing images. But when READY1/2 are off, the trigger signals are ignored and a time lag develops for the image capture until the trigger signal is generated for the next interval cycle.

To perform processing at the shortest cycle, set the internal trigger interval time to 1 ms in order to reduce the time lag. To perform image capture at a constant cycle, set an internal trigger interval time longer than the displayed trigger interval time (when READY1/2 are off, the internal trigger will not be generated).

② The internal trigger can be operated with the double buffer. The method behaves the same as the external trigger input during double buffer.

► Note

- When the settings use TRG1 and TRG2, both triggers are generated at the same time.
- For internal trigger mode, the READY1/2 outputs are set on or off and the external trigger input is ignored.
- When using sequential trigger (Page 4-15), only the READY1 output is turned on or off.

Stopping internal triggers

When the internal trigger is generated during Run mode, trigger generation cannot be stopped. However, the following methods can be used to control the trigger as if it were stopped.

Stopping result output with TEST terminal input

Used to continue capturing images while forcefully stopping only the result outputs.
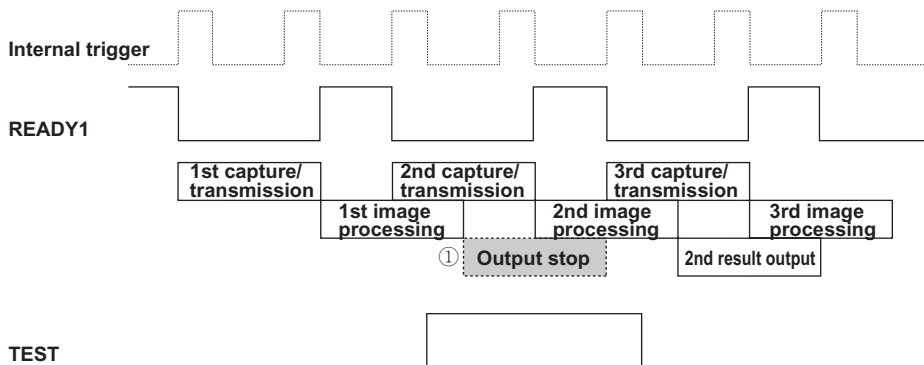
① When the TEST terminal is on, the result output data is ignored.

Stopping image capture with EXT terminal input

Used to stop image processing. However, the result output data of the triggers received up to that point in time is not stopped.
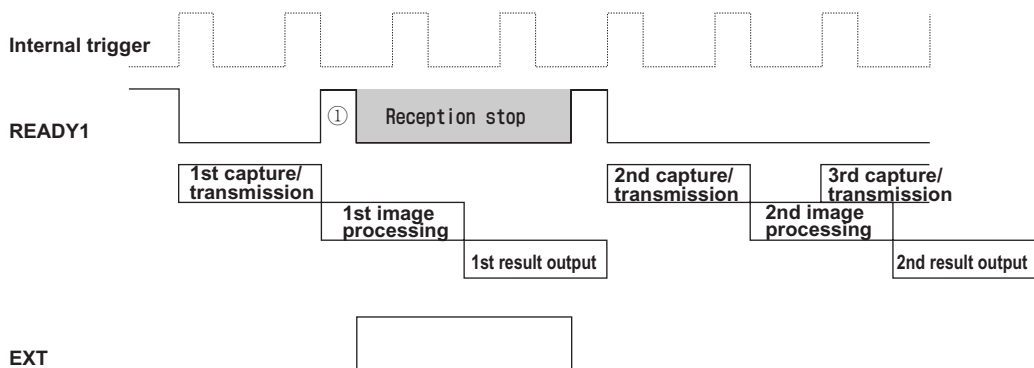
① When the EXT terminal is on, the READY1/2 outputs are turned off.
   However the internal triggers are not generated and images are not captured.

Controlling the System or Transmitting Data Via the I/O Terminal

4. Typical Multi-Image Operations
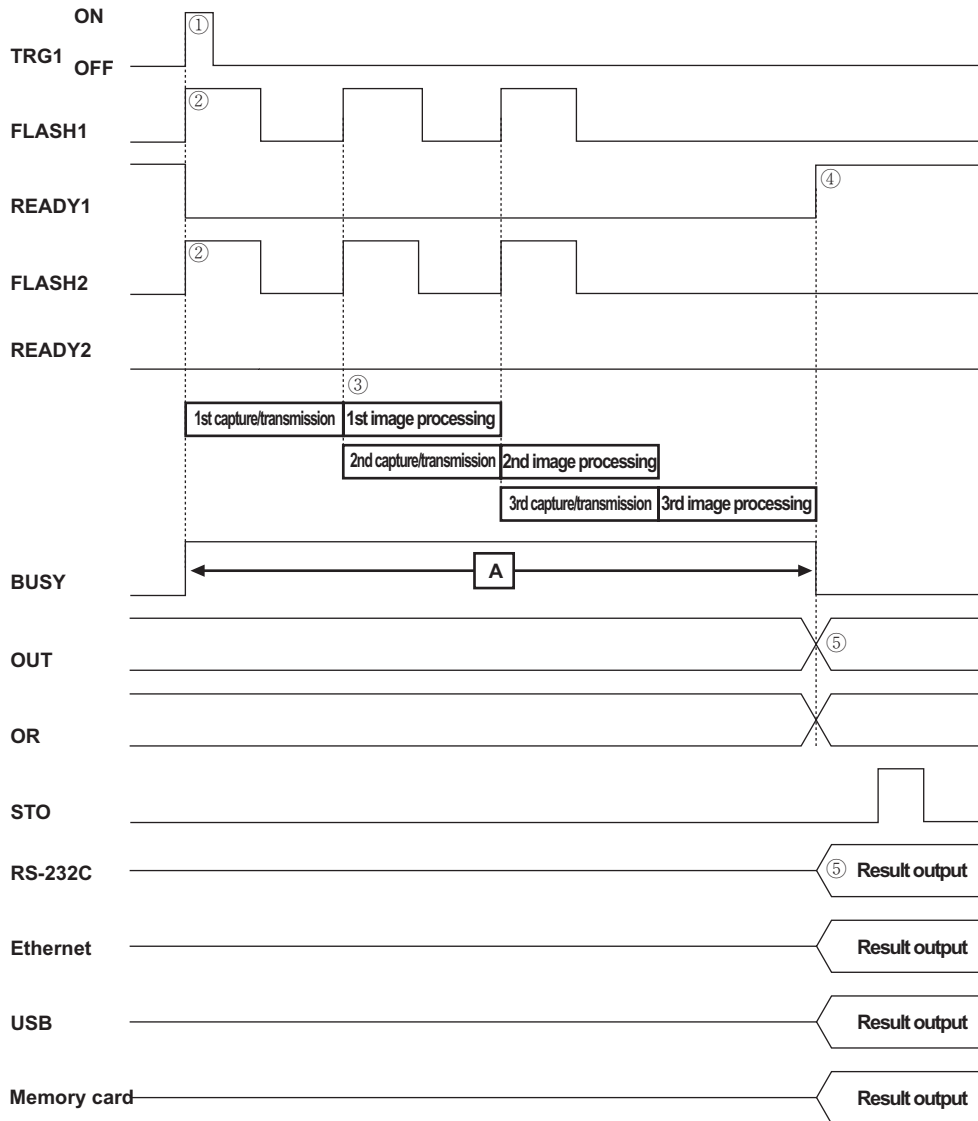
A: Measurement time, trigger interval (trigger interval without multi-image capture x (number of multi-image capture-1) + measurement time without multi-image capture)

① When using multi-image capture, only TRG1 is effective.
② Even when trigger 1 and trigger 2 are used individually, using TRG1 automatically repeats simultaneous image capture for the number set in multi-image capture. However, when sequential trigger (Page 4-15) is turned on, or when simultaneous capture is not possible for the combination of cameras, sequential trigger is used to

capture images from the cameras for trigger 1 and trigger 2. Therefore, FLASH2 will be output with a delay after FLASH1.

③ With multi-image capture, the second image capture and transfer and any later captures use the double buffer and perform the image processing for the previous image capture at the same time.

④ When using multi-image capture, the next TRG input is possible after all of the image processing is complete.

⑤ The inspection windows will be treated as "unexecuted windows" if image processing does not occur for all of the captures during multi-image capture in [Execute Condition] (Page 4-247).

Reference

If a RESET signal is input during multi-image capture, the RESET operation occurs after the multi-image capture is performed.

► Note

Multi-image capture only operates while during Run mode while in the top menu of Program mode. It does not operate while the screen display is Continuous mode, while in the image registration menu, or when performing a test.

Controlling the System or Transmitting Data Via the I/O Terminal

5. Operations when Using Control Terminal Inputs

RESET terminal operations

Use to return each output terminal to its normal state and to clear the trigger wait state.

RESET operations are also performed when switching the program number.

Reference

See Page 11-9 for more details about RESET operations.

When trigger is not input

A: RESET minimum input time (1 ms or more)   B: RESET time (1s or less)

C: RESET response delay time (500 μs or less)
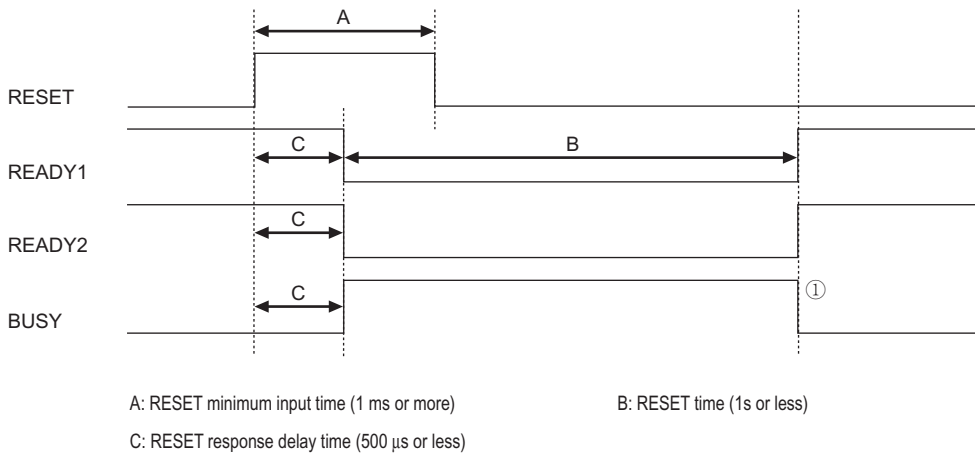
When trigger is input

D: 0 ms or more
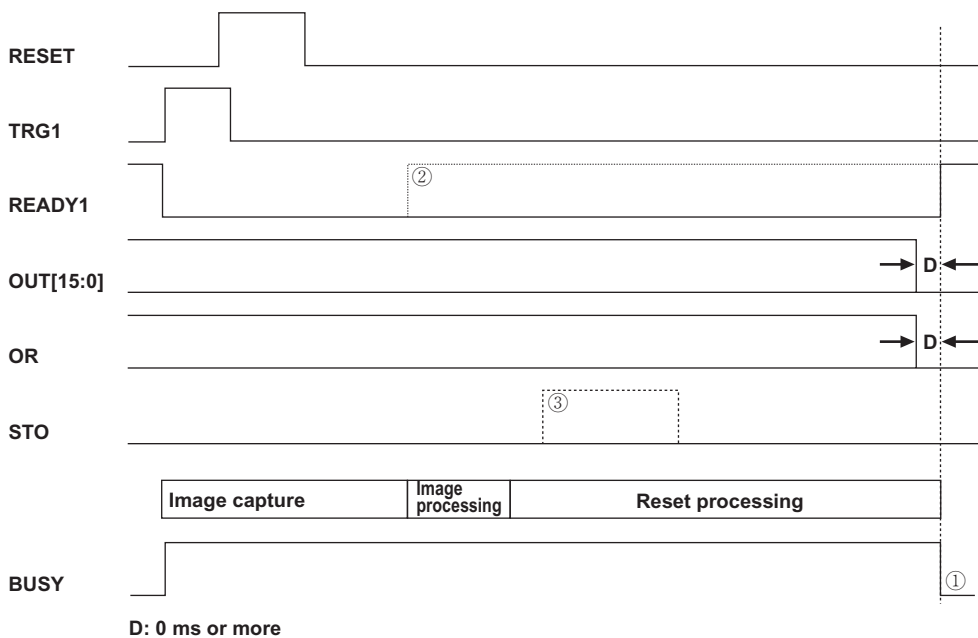
When data is output
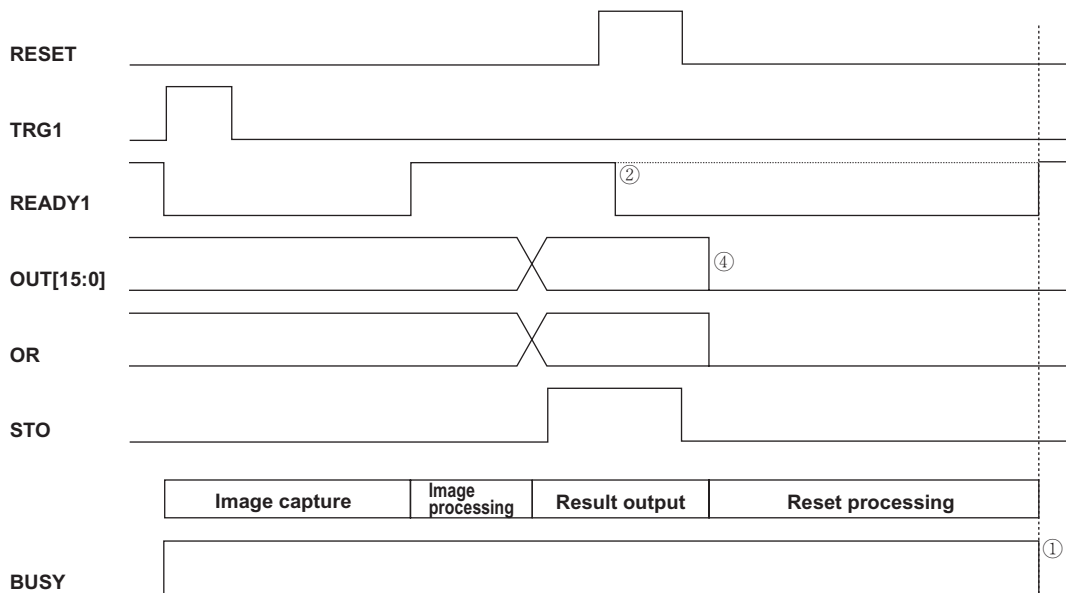
① Confirmation of the completion of RESET processing occurs when BUSY falls.

② During RESET processing, the READY1/2 terminals are forcibly turned off for a moment and turned on after reset operations have completed. The Reset operation causes all of the outputs to return to their normal state and resets the TRG1/TRG2 input cycle. However, when using multi-image capture (Page 4-17), reset processing occurs after the multi-image capture is complete.

③ If RESET is input before the data output, none of the data is output.

④ New data is not output until the reset processing has finished.

Controlling the System or Transmitting Data Via the I/O Terminal

TEST terminal operations

Output operations can be canceled with the TEST terminal.

Resets all of the current terminal outputs to their normal state with one shot input. It is used to run the current program without effecting external devices.This can be useful with testing program modifications.
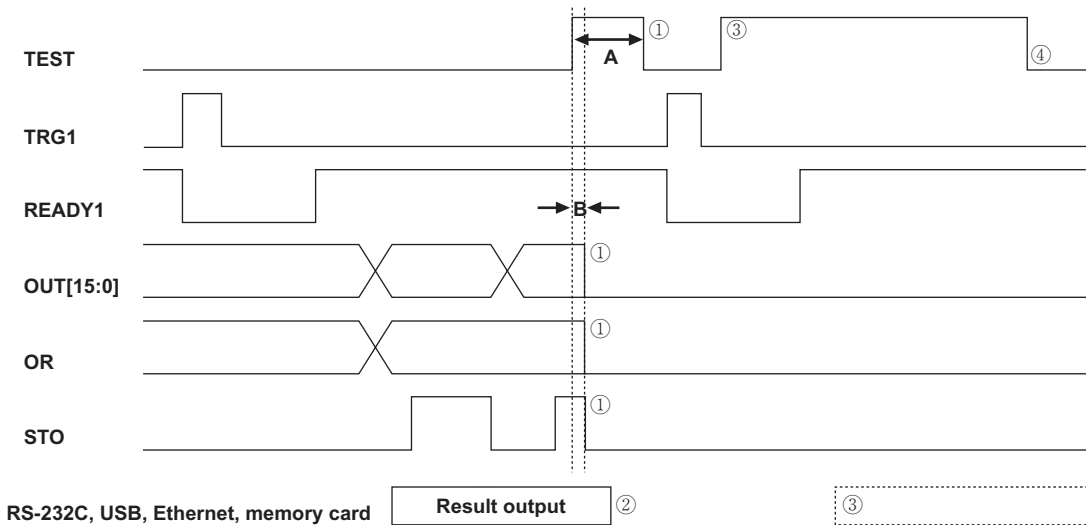
A: TEST minimum input time (1 ms or more)   B: 500 μs or less

① While TEST input is on, terminal output (OUT[15:0], OR, STO) are forced into normal state (response delay is within 500 μm).

② For output to RS-232C, USB, Ethernet, or memory cards, the data that is being output for the current trigger will still be output, even if the TEST terminal is turned on. Output data for subsequent triggers will not be output.

③ When the TEST terminal is turned on before starting output for the result of one trigger, none of that trigger is output. The trigger will not output on the terminal even if the TEST terminal is turned off.

► Note

When past trigger results are output with delay from the output buffer, the output processing continues internally even when the TEST terminal is turned on. Therefore, when the TEST terminal is turned off, the terminal output may restart. To completely stop delayed output, use the RESET terminal to clear the output buffer.

EXT terminal operations

Image capture operations can be canceled with the EXT terminal. Used to stop the reception of internal triggers or trigger inputs from an external devices.
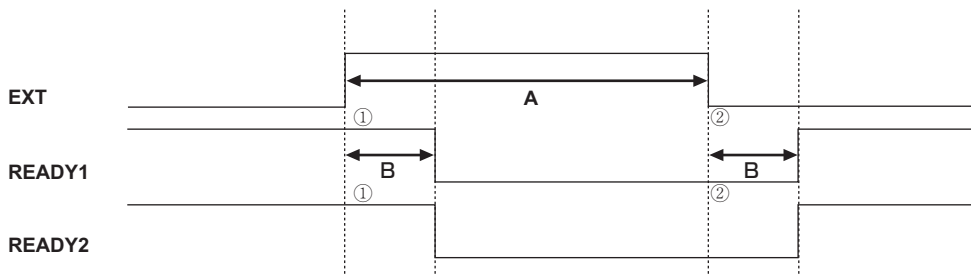
A: EXT minimum input time (1 ms or more)   B: READY response delay (500 μs or less)

① When EXT input is on, READY1 and READY2 output are turned off. At this time, the trigger cannot be input (from external terminal, RS-232C, USB, Ethernet, or remote control console). Even when internal trigger is selected, image capture and image processing stop when READY is turned off. Result output data for the trigger input that is received before EXT input is turned on continues processing regardless of the EXT state.

② When EXT input is turned off, the system returns the READY1 and READY2 output to the on state.

Time chart for controlling with a command input from the I/O terminal

See "Using a Command Input from the I/O Terminal" (Page 11-14).

Controlling the System or Transmitting Data Via the I/O Terminal

TEST terminal operations for total status output (OR) when the HOLD function is turned on

Normally, the system maintains the updates of judgment output status for each trigger until the NG judgments are cleared with the TEST input.
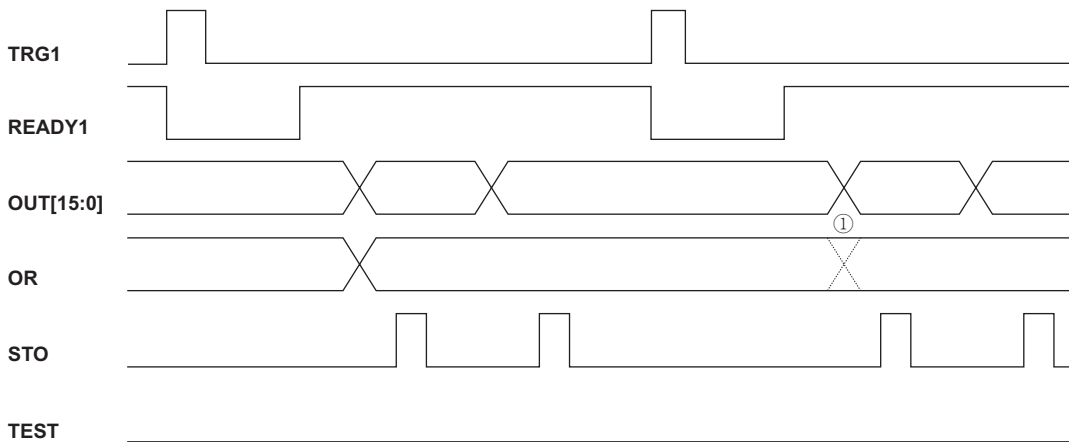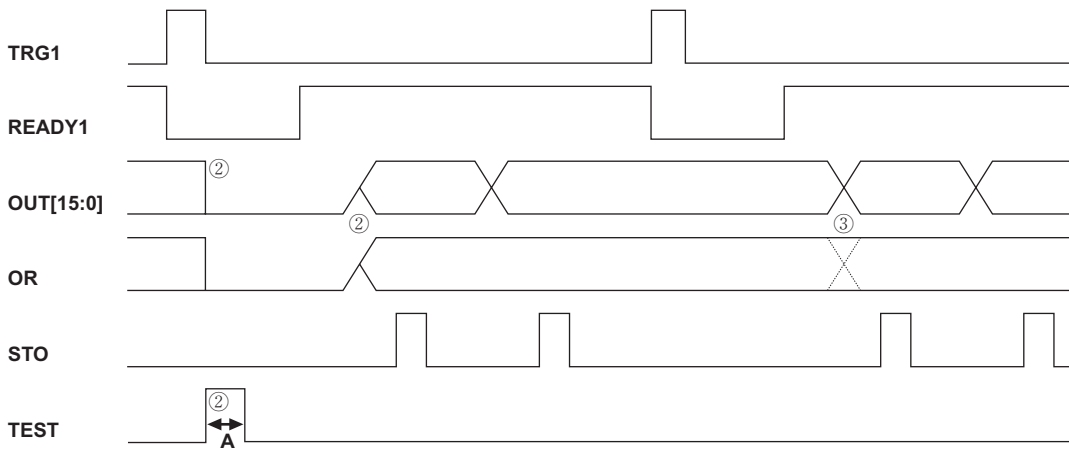
A: TEST minimum input time (1 ms or more)

① When the HOLD function is turned on and the previous judgment result is NG, the OR output remains NG and does not change, regardless of the actual judgment result.

② Turning the TEST input on and off clears the hold and returns all of the terminals to their normal state and the OR output state is updated with the result output for the next OR trigger.

③ When the previous judgment result is NG because a TEST input has not been entered, the OR output remains NG and does not change, regardless of the actual judgment result.

Reference

Hold state is erased when performing RESET processing, switching Programs, or turning off the power to the system.

Chapter

12

Specifications

Specifications

Main Specifications

Controller Unit (CV-3501/3001)

		CV-3501	CV-3001
Number of pixels		When CV-200C/S200C/200M/S200M is connected • 2 megapixel mode: 1600 (H) x 1200 (V), approx. 1,920,000 pixels • 1 megapixel mode: 1024 (H) x 960 (V), approx. 980,000 pixels When CV-035C/S035C/035M/S035M is connected • Normal mode: 512 (H) x 480 (V), approx. 240,000 pixels	512 (H) x 480 (V), approx. 240,000 pixels
Camera input		• Two color/monochrome cameras (CV-200C/S200C/035C/S035C/200M/S200M/035M/S035M can be connected. Mixed connection is possible.) • Two extra cameras can be connected by using expansion unit CV-E300. Up to four cameras can be connected.	Two color/monochrome cameras (CV-035C/S035C/035M/S035M can be connected. Mixed connection is possible.)
Programs registration		Maximum 1000 programs each in the system and memory card (depending on the memory capacity and program data), externally selectable.	
Number of registered screens		Maximum 1000 screen for each program (depending on the capacity of the internal memory and memory card) Compression save function.	
Internal memory (Max. number of registered settings*)		About 60 MB (1000 settings)	About 15 MB (550 settings)
		• * Typical example when using standard mode: monochrome camera x 1, registered image x 1 (compressed), 9 measurement windows	
Window setting	Measurement window	128 windows/1 program	
	Mask window	4 mask windows/1 inspection window	
Color extraction function (only when a color camera is connected)		Color binary processing, color shade processing, gray scale processing (colors can be numerically specified with HSB or RGB values.)	
Measurement tool	Area sensor	Shapes are rectangle, rotated rectangle, circle, oval, ring, arc, polygon (up to 12 sides), auto-adjusting rectangle, and auto-adjusting circle	
	Position detection — Pattern search	• Multiple search possible • For both pattern area and search area, the shapes are rectangle, rotated rectangle, circle, oval, ring, arc, and polygon (up to 12 sides) • Pattern area can be masked (4 positions/1 area).	
	Position detection — Pattern sort	• Simultaneous classification search through up to 256 patterns possible • For both pattern area and search area, the shapes are rectangle, rotated rectangle, circle, oval, ring, arc, and polygon (up to 12 sides) • Pattern area can be masked (4 positions/1 area)	
	Position detection — ShapeTrax	• Multiple search possible • For both pattern area and search area, the shapes are rectangle, rotated rectangle, circle, oval, ring, arc, and polygon (up to 12 sides) • Pattern area can be masked (4 positions/1 area).	
	Position detection — Edge position	• Angles can be measured. • Shapes are rectangle, rotated rectangle, circle, oval, ring, arc, polygon (up to 12 sides), auto-adjusting rectangle, and auto-adjusting circle	
	Position detection — Trend edge position	• Circle or straight line can be measured from the detection result. • Shapes are rectangle, rotated rectangle, ring and arc.	
	Position detection — Blob (Center of gravity)	Shapes are rectangle, rotated rectangle, circle, oval, ring, arc, polygon (up to 12 sides), auto-adjusting rectangle, and auto-adjusting circle	

			CV-3501	CV-3001
Measure-ment tool (cont.)	Inspection tool	Edge width	Shapes are rectangle, rotated rectangle, circle, oval, ring, arc, polygon (up to 12 sides), auto-adjusting rectangle, and auto-adjusting circle	
		Edge pitch	Shapes are rectangle, rotated rectangle, circle, oval, ring, arc, polygon (up to 12 sides), auto-adjusting rectangle, and auto-adjusting circle	
		Number of edges	Shapes are rectangle, rotated rectangle, circle, oval, ring, arc, polygon (up to 12 sides), auto-adjusting rectangle, and auto-adjusting circle	
		Edge angle	Shape is rectangle.	
		Edge pair	Shapes are rectangle, rotated rectangle, circle, oval, ring, arc, polygon (up to 12 sides), auto-adjusting rectangle, and auto-adjusting circle	
		Trend edge gap	Shapes are rectangle, rotated rectangle, ring and arc.	
		Blob (characteristic quantities)	• Number of blobs, center of gravity, main axis angle, area, feret diameter, perimeter, roundness. • Shapes are rectangle, rotated rectangle, circle, oval, ring, arc, polygon (up to 12 sides), auto-adjusting rectangle, and auto-adjusting circle	
		Stain detection	• Subtract stain detection by using subtract filter • Stain grouping function supporting multiple stain detection and position measurement. • Shapes are rectangle, rotated rectangle, circle, oval, ring, arc, polygon (up to 12 sides), auto-adjusting rectangle, and auto-adjusting circle	
		Intensity inspection	Shapes are rectangle, rotated rectangle, circle, oval, ring, arc, polygon (up to 12 sides), auto-adjusting rectangle, and auto-adjusting circle	
		Color (only when a color camera is connected)	• RGB and HSV measurement supported • Shapes are rectangle, rotated rectangle, circle, oval, ring, arc, and polygon (up to 12 sides)	
		Draw shape	• Calculation result can be reflected. • Shapes are point, line, and circle.	
		OCR	• Character recognition for max. 2 lines of 20 characters per line • Shape is rectangle	
Multi-image capture			• 1 to 32-time multi-measurement (maximum, minimum and average values) • Error values can be excluded from the measurement result.	
Select execute function			Can set whether to execute the results (OK/NG) for other measurement and calculation windows in each measurement window.	
Image capture range	Processing area setting function		• The applicable 980,000 pixels (1024 (H) x 960 (V)) can be captured from 1,980,000 pixels (1 megapixel mode). • The applicable 240,000 pixels (512 (H) x 480 (V)) can be captured from 320,000 pixels (normal mode).	The applicable 240,000 pixels (512 (H) x 480 (V)) can be captured from 320,000 pixels.
	Scanning method selection function (only when monochrome camera is connected)		Progressive/interlace selectable	
	Capture start/end line setting function		Desired capture start/end line can be set within the image capture range. (Two lines are counted as one unit with the interlace method.)	

Specifications

			CV-3501	CV-3001
Correction function	Position adjustment		Batch, individual (maximum 64 settings), X, Y, ±180° rotation.	
	Camera gain adjustment		Sensitivity adjustment, offset, and span adjustment (RGB batch/individual and span can be set for each of 16 brightness levels. RGB individual setting can be supported when color camera is conencted.)	
	White balance adjustment (only when a color camera is connected)		Manual setting using white paper	
	Filter function	Number of times	The same type of filter can be used up to 9 times. 13 steps. (For binarization and subtract only: 1 step/window)	
		Type	Expand, shrink, average, median, edge sharpening, edge extract X, edge extract Y, Sobel, Prewitt, Roberts, Laplacian, binary, subtract, illumination adjustment, contrast conversion, image extraction	
	Scaling function		X and Y calibration setting for each camera. Conversion from measurement values and calculation values is supported.	
Calculation function	Numerical calculation	Number of windows	128 calculations/1 program	
		Arithmetic operation	Sum (+), subtract (-), multiply (x), divide (÷)	
		Arithmetic function	Square, exponential, counting fractions as one, round-off fractions, maximum, minimum, average, average within range, square root, absolute value, remainder, distance, angle, sin, cos, tan, asin, acos, atan, π	
		Comparative operator	<, ==, Not	
		Geometric calculation	Distance between 2 points, angle of line segment, circle radius, circle center, average angle, straight line, cross point, distance between a point and a straight line, straight line angle, angle between the two crossed lines, perpendicular line between a point to a line, perpendicular bisector , midpoint	
		Coordinate conversion function.	Coordinate system conversion, rotating matrix	
		Type conversion function	Coordinate constant conversion, constant coordinate conversion, angle unit conversion	
		Logical operator	AND, OR, NOT, XOR	
		Journalizing function	Maximum value index output, minimum value index output	
		System function	Number of measurement times, measurement time, year, month, day, time, minute, second	
		Time axis operation function	Previous measurement result acquisition operator	
	Command memory		128 command memories that can be rewritten from external devices or the remote control console during operation are installed.	
Support functions	Statistics	Number of data points	Max. 20000 data (can be saved into a memory card in a batch)	
		Statistic data	Maximum, minimum, average value, deviation (3σ), total status OK/NG times	
	Save screen		The following number of images can be saved in the system's memory: • Maximum 511 images (monochrome camera normal mode) • Maximum 127 images (monochrome camera 1 megapixel mode) • Maximum 63 images (monochrome camera 2 megapixel mode) • Maximum 169 images (color camera normal mode) • Maximum 41 images (color camera 1 megapixel mode) • Maximum 22 images (color camera 2 megapixel mode) (These are the maximum values with only one camera connected, and [Condition] set to [All Images].)	The following number of screens can be saved in the system's memory: • Maximum 511 images (when using a monochrome camera) • Maximum 169 images (when using a color camera) (These are the maximum values with only one camera connected, and [Condition] set to [All Images].)

		CV-3501	CV-3001
Support functions (cont.)	Setting assist function	Image Zoom	Between 4% and 1600% during setting or operation (6% and 2500% during full screen display) (Size can be set for each screen while diplaying multiple screens.)
		Edge derivative wave display	Edge waveform can be graphically displayed during setting or operation, and edge intensity and measurement values (some are not supported) can be displayed during setting.
		Profile display	Trend edge position and gap can be graphically displayed during setting or operation.
		Stability display	Stain detection (stain level) is displayed during setting or operation.
		Shift all windows	Selected windows from an identical camera or an identical registered image can be shifted in the desired XY direction in a group.
	Configure Image Options function	Number of image option configurations	10 templates/1 program (within which 4 templates are specified values), externally selectable
		Number of screens simultaneously displayed	Max. 5 screens can be displayed at the same time (when 5 scr. (HORIZONTAL)/5 scr. (VERTICAL) is selected).
		Trigger delay	Up to the past three images (NG images) can be displayed as hold images. measurement results and measurement time can be viewed. (The number of displayable times varies between 0 and 3 depending on camera's connection state.)
	Screen customize function	Number of custom screens	10 screens/1 program
		Custom item	Character string: Measurement value (decimal point can be specified), result, custom character, graphics, active text
		Measurement result interlink	• Display color can be changed according to the result for figures and custom characters. • Can set a message in the allocation table that relates to the measurement value (active text)
	Custom menu function		Shortcut menu to a desired program screen can be created (20 menus/program).
	Overwrite function while the machine is running		Upper/lower tolerance or command memory can be rewritten during opration.
	Memory card save function		• Measurement value, judgment result, NG count, measurement image (compressible), stored image (compressible), captured image, statistics analysis data, RS-232C communication log, program data • Can save data during test run (except for program data).
	Peripheral functions		Screen capture function, password function, re-test function, file management function, I/O monitoring, RS-232C monitoring (with log save function)
Memory card			Supports NR-M32 (32 MB), GR-M256 (256 MB), and CV-M1G (1 GB). Supports VFAT and FAT32.

Specifications

			CV-3501	CV-3001
Interface	Control input	External trigger input	Images from up to four cameras can be captured at the same time (except for color megapixel cameras). Individual capture can be selected (when CV-E300 is not connected, images from up to two cameras can be captured at the same time).	2-camera simultaneous capture/ individual capture can be selected.
		Control input	18 inputs Input rating 26.4 V or less, 2 mA or more	
	Control output	General purpose output	27 outputs NPN/PNP (including two FLASH outputs linked to external trigger.)	
		Total status output	1 output, NPN/PNP open collector, maximum 50 mA (30 V or less)	
	Monitor output	Analog RGB output	SVGA 800x600 (24-bit color 60 Hz)	
	RS-232C		Numerical value output, image data (compressible) and control input/output enabled. Can be used simultaneously with other communication ports. Maximum baud rate of 115200 bps is supported.	
	PLC link		Numerical value output and control input/output using the RS-232C port or Ethernet port enabled. Following PLCs are supported via link unit: • Keyence Corp.: KV-700 series, KV-1000 series • Mitsubishi Electric: A series (RS-232C only), Q series • OMRON: SYSMAC C series (RS-232C only), CJ/CJ1 series	
	Ethernet		Numerical value output, image data (compressible) and control input/output enabled. Can be used simultaneously with other communication ports. 100BASE-TX/10BASE-T	
	USB		Numerical value output, image data (compressible) and control input/output enabled. Can be used simultaneously with other communication ports. USB2.0, HI-SPEED supported	
Display language			Japanese/English/German selectable	
Rating	Power supply voltage		24 V DC ±10%	
	Current consumption		1.8 A (at maximum load with two cameras connected)/ 2.8 A (at maximum load with four cameras connected)	1.4 A (at maximum load with two cameras connected)
Environ-mental resistance	Ambient operating temperature		• With two cameras connected: 0 to +50 °C (0 to +45 °C with megapixel camera connected) • With four cameras connected: 0 to +45 °C (0 to +40 °C with megapixel camera connected)	0 to 50 °C
	Ambient operating humidity		35 to 85% RH (no condensation)	
Weight			Approx. 950 g	

Megapixel Color Camera (CV-200C/S200C)

	CV-200C	CV-S200C
Image element	1/1.8 type color CCD imager, square element all pixels reading, 2,010,000 pixels	
Effective pixels	Color 1,920,000 pixels, 1600 (H) x 1200 (V) (In the 1 megapixel mode, 980,000 pixels (1024 x 960) of the 1,920,000 pixels are the processing range.)	
Scanning method	Progressive (59 ms: 2 megapixel mode, 48 ms: 1 megapixel mode)	
Transfer system	Digital serial transfer	
Electronic shutter	1/15, 1/30, 1/60, 1/120, 1/240, 1/500, 1/1000, 1/2000, 1/5000, 1/10000, 1/20000 0.05 msec to 9000 msec can be set by manually inputting the value.	
Lens mount	C-mount	Special mount (M15.5 P0.5 male)
Environmental resistance	**Ambient operating temperature** 0 to +40 °C	• Head: 0 to +40 °C • Relay unit: 0 to +40 °C (35 °C or less at the time of partial capture of 50 lines or less)
	Ambient operating humidity 35 to 85% RH (no condensation)	
Weight	Approx. 110 g (lens not included)	• Head: approx. 210 g (cable, lens not included) • Relay unit: approx. 70 g

Standard Color Camera (CV-035C/S035C)

	CV-035C	CV-S035C
Image element	1/3 type color CCD imager, square element all pixels double-speed reading, 350,000 pixels	
Effective pixels	Color 320,000 pixels, 657 (H) x 494 (V) (In the normal mode, 240,000 pixels (512 x 480) of the 320,000 pixels are the processing area.)	
Scanning method	Progressive (16 ms)	
Transfer system	Digital serial transfer	
Electronic shutter	1/15, 1/30, 1/60, 1/120, 1/240, 1/500, 1/1000, 1/2000, 1/5000, 1/10000, 1/20000 0.05 msec to 9000 msec can be set by manually inputting the value.	
Lens mount	C-mount	Special mount (M10.5 P0.5 male)
Environmental resistance	**Ambient operating temperature** 0 to +50°C	• Head: 0 to +50 °C • Relay unit: 0 to +40 °C
	Ambient operating humidity 35 to 85% RH (no condensation)	
Weight	Approx. 100 g (lens not included)	• Head: approx. 160 g (cable included) • Relay unit: approx. 70 g

Specifications

Megapixel Monochrome Camera (CV-200M/S200M)

	CV-200M	CV-S200M
Image element	1/1.8 type monochrome CCD imager, square element all pixels reading, 2,010,000 pixels	
Effective pixels	1,920,000 pixels, 1600 (H) x 1200 (V) (In the 1 megapixel mode, 980,000 pixels (1024 x 960) of the 1,920,000 pixels are the processing range.)	
Scanning method	Progressive (59 ms: 2 megapixel mode, 48 ms: 1 megapixel mode) Interlace (33 ms: 2 megapixel mode, 28 ms: 1 megapixel mode) Interlace is a scanning process where odd lines and even lines are added.	
Transfer system	Digital serial transfer	
Electronic shutter	1/15, 1/30, 1/60, 1/120, 1/240, 1/500, 1/1000, 1/2000, 1/5000, 1/10000, 1/20000 0.05 msec to 9000 msec can be set by manually inputting the value.	
Lens mount	C-mount	Special mount (M15.5 P0.5 male)
Environmental resistance — Ambient operating temperature	0 to +40 °C	• Head: 0 to +40 °C • Relay unit: 0 to +40 °C (35 ×C or less at the time of partial capture of 50 lines or less)
Environmental resistance — Ambient operating humidity	35 to 85% RH (no condensation)	
Weight	Approx. 110g (lens not included)	• Head: Approx. 210 g(cable, lens not included) • Relay unit: approx. 70 g

Standard Monochrome Camera (CV-035M/S035M)

	CV-035M	CV-S035M
Image element	1/3 type monochrome CCD imager, square element all pixels double-speed reading, 350,000 pixels	
Effective pixels	320,000 pixels, 657 (H) x 494 (V) (In the normal mode, 240,000 pixels (512 x 480) of the 320,000 pixels are the processing area.)	
Scanning method	Progressive (16 ms), interlace (9 ms) Interlace is a scanning process where odd lines and even lines are added.	
Transfer system	Digital serial transfer	
Electronic shutter	1/15, 1/30, 1/60, 1/120, 1/240, 1/500, 1/1000, 1/2000, 1/5000, 1/10000, 1/20000 0.05 msec to 9000 msec can be set by manually inputting the value.	
Lens mount	C-mount	Special mount (M10.5 P0.5 male)
Environmental resistance — Ambient operating temperature	0 to +50 °C	• Head: 0 to +50 °C • Relay unit: 0 to +40 °C
Environmental resistance — Ambient operating humidity	35 to 85% RH (no condensation)	
Weight	Approx. 100 g (lens not included)	• Head: approx. 160 g (cable included) • Relay unit: approx. 70 g

Outside Dimensions

Controller Unit (CV-3501/3001)
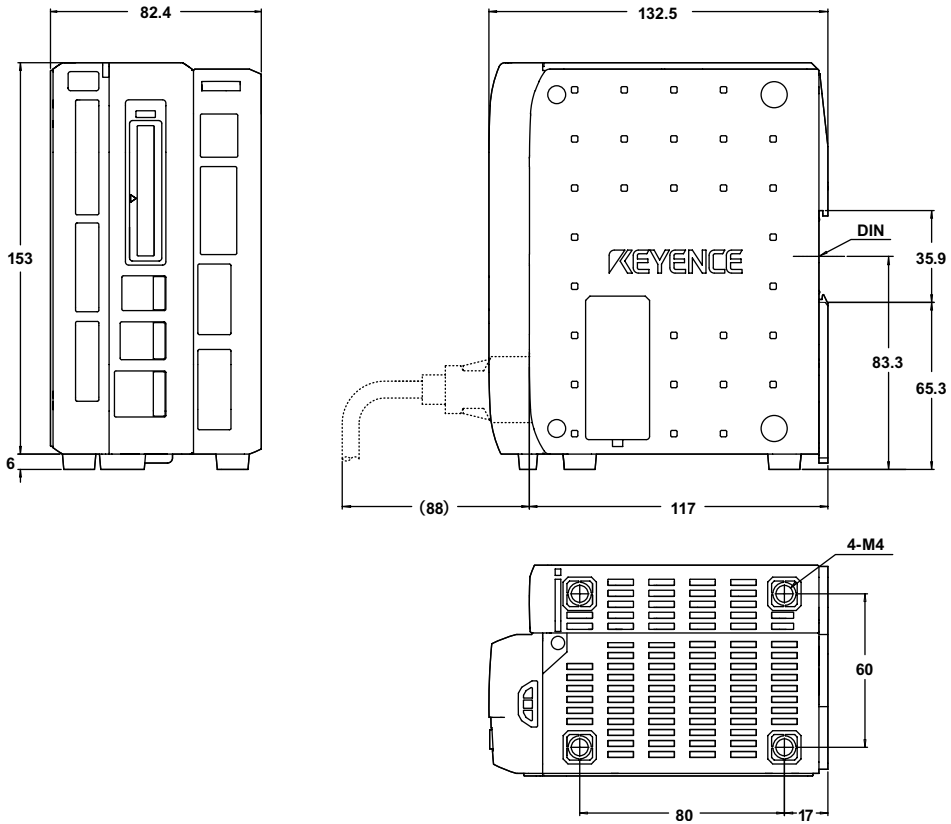
With the camera expansion unit CV-E300 connected (CV-3501 only)

Specifications

Remote Control Console (OP-42342)

47
2.1
17.1
11.2
112.7
4
φ4.5
Cable length 3m

28.8
17.1
5.5
78
φ20
φ11
Unit：mm
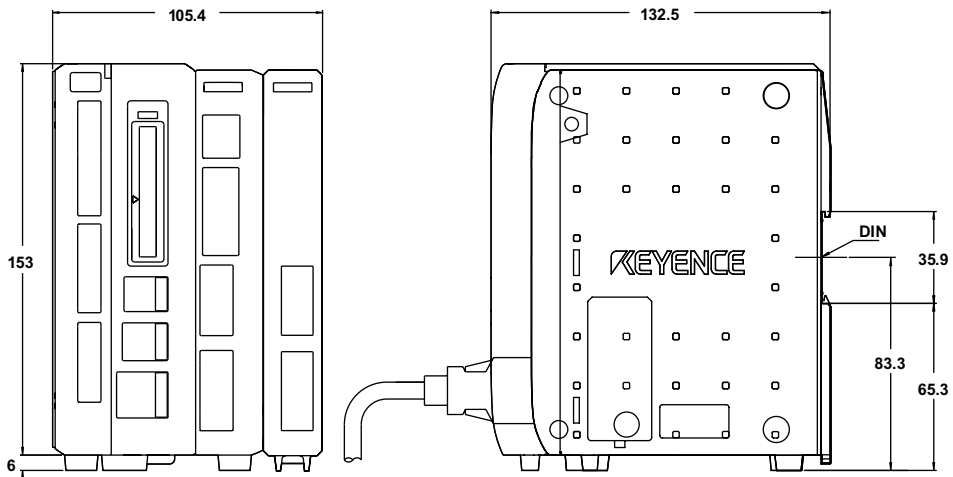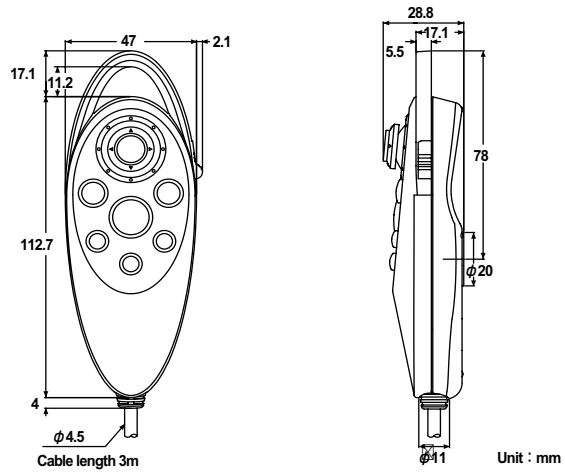
Camera (CV-200C/200M)

When plastic mount is attached (default state when shipped from factory)
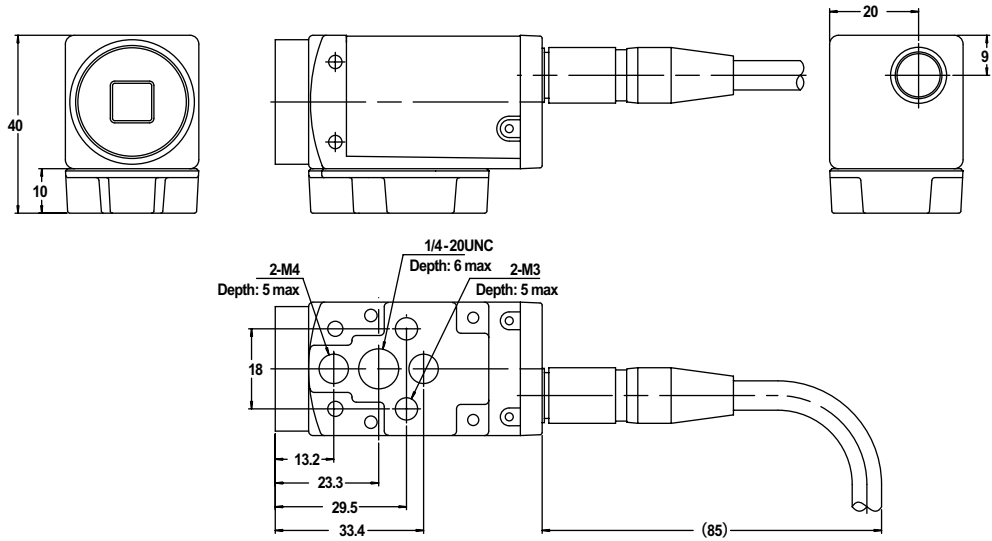
When plastic mount is not attached
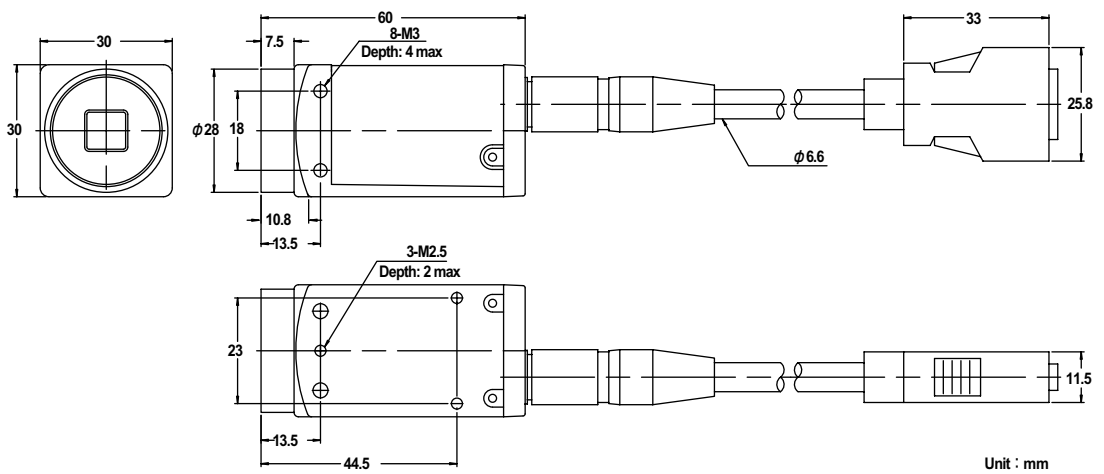
Unit：mm

Specifications

Camera (CV-035C/035M)

When plastic mount is attached (default state when shipped from factory)

20

9

40

10

2-M4
Depth: 5 max

1/4-20UNC
Depth: 6 max

2-M3
Depth: 5 max

18

13.2

23.3

29.5

33.4

(85)

When plastic mount is not attached

30

30

48.3

7.5

8-M3
Depth: 4 max

33

25.8

φ28 18

φ6.6

10.8

13.5

3-M2.5
Depth: 2.5 max

43

42

24

11.5

13.5

21.5

φ12.5
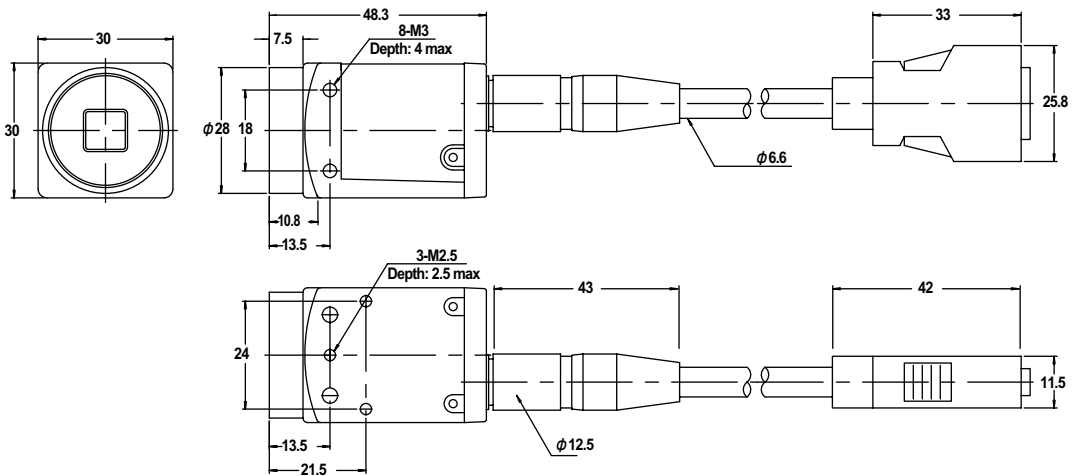
Unit：mm

Camera (CV-S035C/S035M/S200C/S200M)

Camera CV-S035CH / CV-S035MH

12
12.5
46.8
35
6.25

CCD imaging area distance
to lens 4.0mm

When mount is attached

12
17.5
5
46.8
35
5.5
29.1
11.25

Special mount（M10.5 P0.5）

54
φ12.6
φ6.0
Cord length: 2m

2-M3
Depth: 4max
12.5
22.1
(46)
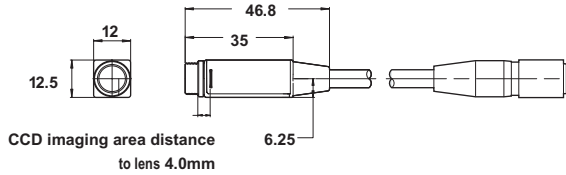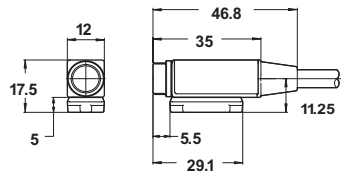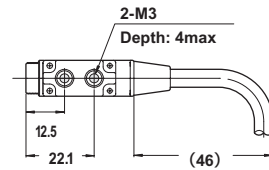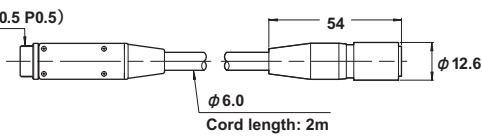
Camera CV-S200CH / CV-S200MH

17
17.5
42.7
30.7
9

CCD imaging area distance
to lens 6.0mm

When mount is attached

17
22.5
5
42.7
30.7
7.5
25.3
14

Special mount（M15.5 P0.5）

54
φ12.6
φ7.0
Cord length: 2m

2-M3
Depth: 4max
11.6
21.2
(47)
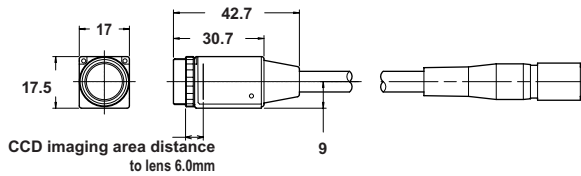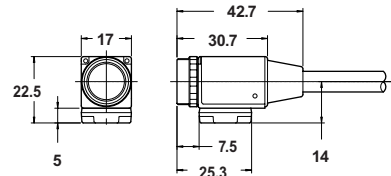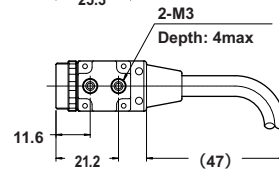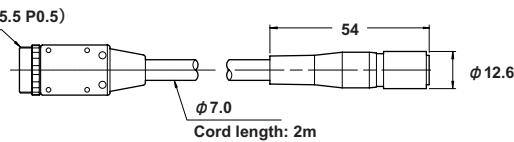
**Camera control unit
CV-S200CU/S200MU/S035CU/S035MU**

112.6
105
98
3.5
19
26
3.5
2-φ3.6 thru hole

6
11
6
21
11.5

When cable is attached

33
25.8
φ6.6
Controller side
(202)
Camera side
2-φ3.6 thru hole

(76)
(86)
11.5

Unit：mm

Specifications
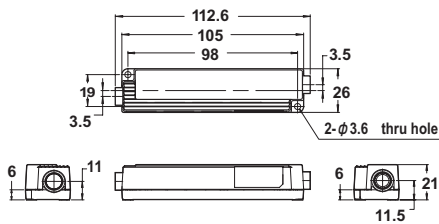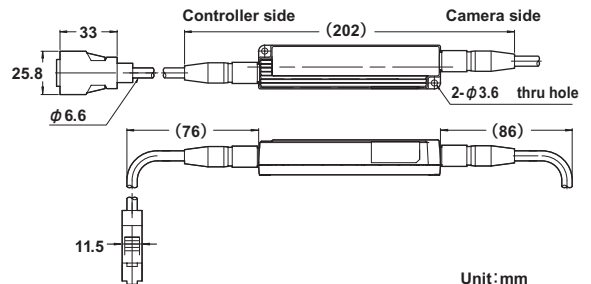
Camera Cable

Straight type

Unit : mm
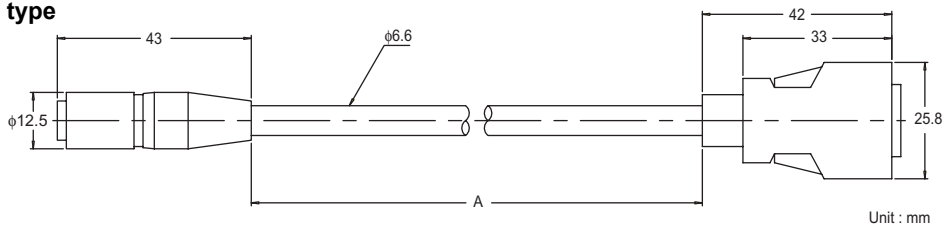
Model name	Cable length (A)	Weight	CV-035C/ 035M	CV-200C/ 200M	CV-S035C/ S035M	CV-S200C/ S200M
OP-51499	1 m	100 g	○	○	○	○
CV-C3	3 m	220 g	○	○	○	○
CV-C10	10 m	660 g	○	○	○	○
CV-C17	17 m	1100 g	○	–	–	–
CV-C3R	3 m	220 g	○	○	○	○
CV-C7R	7 m	450 g	○	○	○	○
CV-C12R	12 m	740 g	○	–	–	–

○: Connectable, –: Not connectable

Bent type

Unit : mm
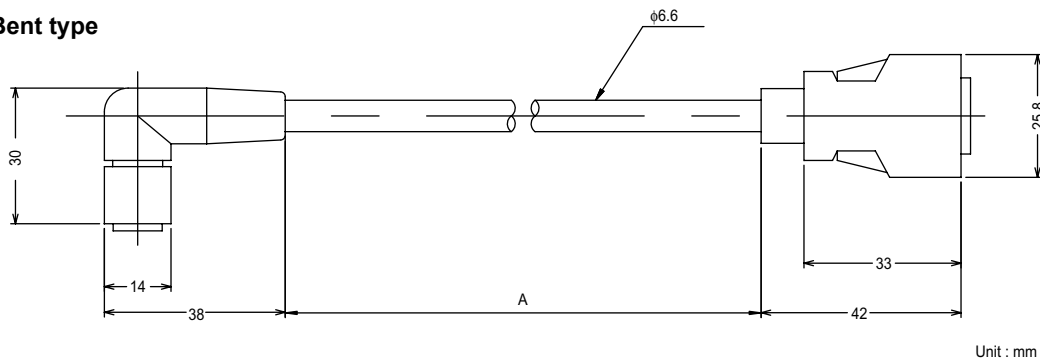
Model name	Cable length (A)	Weight	CV-035C/ 035M	CV-200C/ 200M	CV-S035C/ S035M	CV-S200C/ S200M
CV-C3L	3m	220 g	○	○	○	○
CV-C10L	10m	660 g	○	○	○	○
CV-C17L	17m	1100 g	○	–	–	–

○: Connectable, –: Not connectable

Options

Option List

For C-mount camera

Model name	Description	Reference page
CV-L3	Standard lens (focal distance 3 mm)	Page 2-12, 12-18
CV-L6	Standard lens (focal distance 6 mm)	Page 2-12, 12-18
CV-L16	Standard lens (focal distance 16 mm)	Page 2-12, 12-19
CA-LC16	Standard lens (focal distance 16 mm)	Page 2-12, 12-19
CV-L50	Standard lens (focal distance 50 mm)	Page 2-12, 12-20
CA-LH8	High-resolution lens (focal distance 8 mm)	Page 2-12, 12-20
CA-LH16	High-resolution lens (focal distance 16 mm)	Page 2-12, 12-20
CA-LH25	High-resolution lens (focal distance 25 mm)	Page 2-12, 12-21
CA-LH50	High-resolution lens (focal distance 50 mm)	Page 2-12, 12-21
OP-51612	Close-up ring	Page 2-13, 12-22
CA-LM2	Macro (straight) lens with optical magnification (reference magnification) x2	
CA-LM4	Macro (straight) lens with optical magnification (reference magnification) x4	Page 2-12, 12-22
CA-LM6	Macro (straight) lens with optical magnification (reference magnification) x6	
CA-LM8	Macro (straight) lens with optical magnification (reference magnification) x8	
CA-LM0510	Telecentric macro zoom lens (straight) with optical magnification (reference magnification) x0.5 to x1.0	Page 2-12, 12-22
OP-66852	Plastic parts for mounting cameras	Page 12-11, 12-22

For the miniature camera (CV-S200C/S200M)

Model name	Description	Reference page
CA-LHS8	High-resolution lens (focal distance 8 mm)	
CA-LHS16	High-resolution lens (focal distance 16 mm)	Page 12-24
CA-LHS25	High-resolution lens (focal distance 25 mm)	
CA-LHS50	High-resolution lens (focal distance 50 mm)	
OP-66830	Close-up ring (5 mm)	
OP-66831	Close-up ring (10 mm)	Page 12-24
OP-66832	Polarizing filter	
OP-66833	Side view attachment	

Specifications

For the microminiature camera (CV-S035C/S035M)

Model name	Description	Reference page
CA-LS4	Standard lens (focal distance 4 mm)	Page 2-13, 12-24
CA-LS6	Standard lens (focal distance 6 mm)	
CA-LS16	Standard lens (focal distance 16 mm)	
CA-LS30	Standard lens (focal distance 30 mm)	
OP-51500	Close-up ring (5 mm)	Page 12-24
OP-51501	Close-up ring (10 mm)	
OP-51502	Polarizing filter	
OP-51503	Side view attachment	

Illumination lights

Model name	Description	Reference page
CA-DRR4F	LED light (direct ring light, red)	Page 2-20, 12-25
CA-DRW4F	LED light (direct ring light, white)	
CA-DRB4F	LED light (direct ring light, blue)	
CA-DRR10F	LED light (direct ring light, red)	
CA-DRW10F	LED light (direct ring light, white)	
CA-DRB10F	LED light (direct ring light, blue)	
CA-DLR7	LED light (low angle light, red)	Page 2-21, 12-25
CA-DLR12	LED light (low angle light, red)	
CA-DBR5	LED light (bar light, red)	Page 2-20, 12-25
CA-DBW5	LED light (bar light, white)	
CA-DBB5	LED light (bar light, blue)	
CA-DBR13	LED light (bar light, red)	
CA-DBW13	LED light (bar light, white)	
CA-DBB13	LED light (bar light, blue)	
CA-DDR15	LED light (dome light, red)	Page 2-21, 12-26
CA-DDW15	LED light (dome light, white)	
CA-DDB15	LED light (dome light, blue)	
CA-DSR3	LED light (back light, red)	Page 2-20, 12-26
CA-DSW3	LED light (back light, white)	
CA-DSB3	LED light (back light, blue)	
CA-DSR9	LED light (back light, red)	
CA-DSW7	LED light (back light, white)	
CA-DSB7	LED light (back light, blue)	

Model name	Description	Reference page
CA-DXR5	LED light (coaxial light, red)	Page2-21, 12-26
CA-DXW5	LED light (coaxial light, white)	
CA-DXB5	LED light (coaxial light, blue)	
CA-DXR7	LED light (coaxial light, red)	
CA-DXW7	LED light (coaxial light, white)	
CA-DXB7	LED light (coaxial light, blue)	
CA-DC100	LED light controller	Page 12-27
CV-R11	Ring light	Page 12-28
CA-R20	Large-diameter ring light	

Cables

Model name	Description	Reference page
OP-51499	Camera cable (1 m)	Page 12-14
CV-C3	Camera cable (3 m)	
CV-C10	Camera cable (10 m)	
CV-C17	Camera cable (17 m)	
CV-C3R	High Flex camera cable (3 m)	
CV-C7R	High Flex camera cable (7 m)	
CV-C12R	High Flex camera cable (12 m)	
OP-26487	Serial connection cable (2.5 m, straight)	Page 9-3, 10-4 to 10-6
OP-26486	D-sub 9-pin connector (female)	Page 9-3, 10-4 to 10-6
OP-26485	D-sub 25-pin connector (female)	Page 9-3
OP-66843	Ethernet cable (3 m, cross cable)	Page 9-4
OP-51657	Parallel port connection cable (3 m)	Page 11-1
OP-66844	USB2.0 cable (2 m)	Page 9-8
OP-66842	Monitor cable (3 m)	

Specifications

Other

Model name	Description	Reference page
CA-U2	24 V DC power supply	Page 12-32
CA-MP80	RGB LCD color monitor	Page 12-34
NR-M32	Memory card (32 MB)	
GR-M256	Memory card (256 MB)	Page 8-2
CV-M1G	Memory card (1 GB)	
CV-A1	PCMC1A adaptor (for memory card)	Page 8-10
OP-42342	Remote control console	Page 1-3, Page 12-10

Lens

3.5-mm lens (CV-L3)
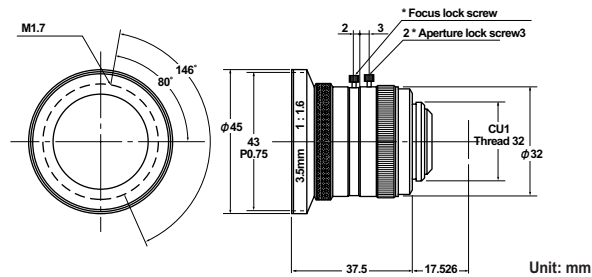
6-mm lens (CV-L6)
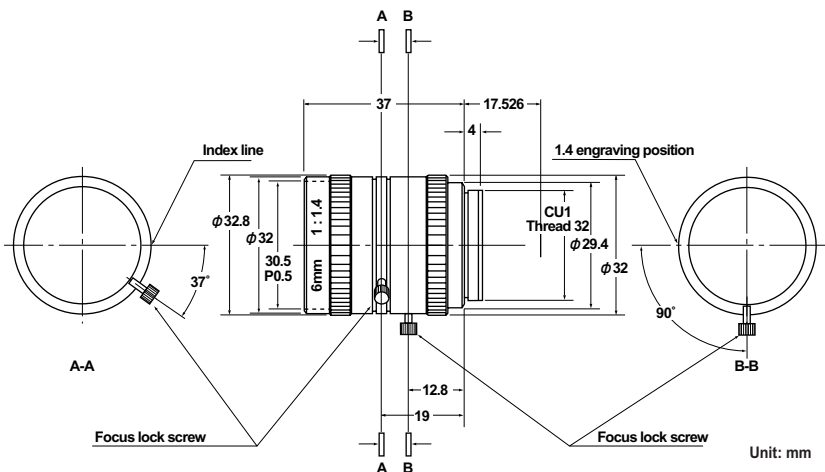
16-mm lens (CV-L16)

Index line

1.6 engraving position

φ30 φ30

A B

φ29.3
27P0.5

16mm 1:1.6

φ16
CU1
Thread 32

24.5 17.526

4 4.4

37°

90°

A-A B-B

Focus lock screw **Focus lock screw**

7.5
12.1

A B

Unit: mm

16-mm lens (CA-LC16)

A B

24.5 17.526

φ30

4 1.2

φ29.3
27 P0.5

φ16
CU1
Thread 32

37°

90°

A-A B-B

Focus lock screw **Focus lock screw**

5.5
12.3

A B

Unit: mm

50-mm lens (CV-L50)

Focus lock screw

Aperture lock screw

1.8 engraving position

3-M1.7

120°

120°

95°

105°

A-A

Index line

B-B

3-M1.7

A B

12.4

5.5

ϕ 32

30.5
P0.5

50mm 1 : 1.8

CU1
Thread 32

4

37

17.526

Unit: mm

A B

80-mm lens (CA-LH8)

(*)41

25

16.5

17.526

8.55(max.)

20

ϕ 34

ϕ 28.5

M27 P0.5

ϕ 22.9

Thread 32

* Variable depending on the focal distance. 41.0mm (infinity focus) to 42.2mm (shortest focus)

Unit: mm

16-mm lens (CA-LH16)

(*)36.5

21.8

11

17.526

4.4(max.)

20

ϕ 33.5

ϕ 27

M25.5 P0.5

ϕ 22.5

CU1 Thread 32
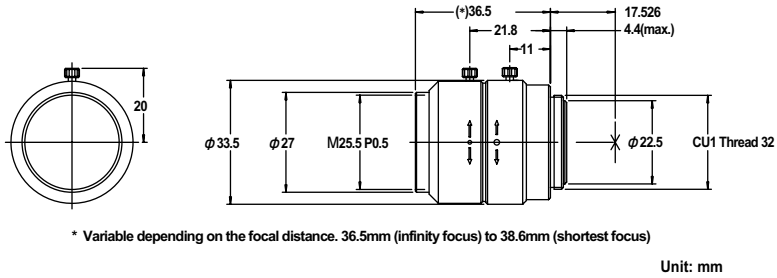
* Variable depending on the focal distance. 36.5mm (infinity focus) to 38.6mm (shortest focus)

Unit: mm
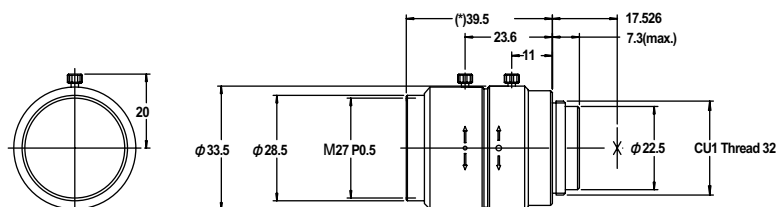
25-mm lens (CA-LH25)

* Variable depending on the focal distance. 39.5mm (infinity focus) to 44.0mm (shortest focus)   Unit：mm

50-mm lens (CA-LH50)
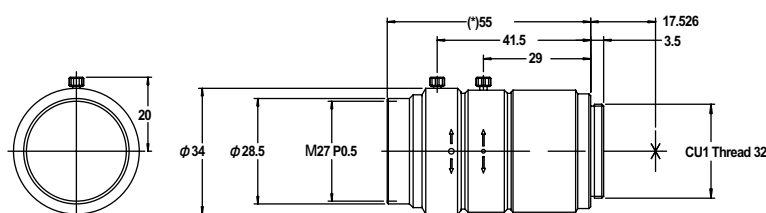
* Variable depending on the focal distance. 55.0mm (infinity focus) to 73.5mm (shortest focus)   Unit: mm

Specifications

Model name	CV-L3	CV-L6	CV-L16	CA-LC16	CV-L50
Focal distance	3.5 mm	6 mm	16 mm	16 mm	50 mm
Aperture	F1.6 to CLOSE	F1.4 to CLOSE	F1.6 to CLOSE	F1.4 to CLOSE	F1.8 to CLOSE
Minimum object distance	0.1 m	0.2 m	0.4 m	0.4 m	1.0 m
Mount	C-mount	C-mount	C-mount	C-mount	C-mount
Filter thread diameter	43.0 mm P0.75	30.5 mm P0.5	27.0 mm P0.5	27.0 mm P0.5	30.5 mm P0.5
Weight	Approx. 90 g	Approx. 70 g	Approx. 44 g	Approx. 44 g	Approx. 55 g

Model name	CA-LH8	CA-LH16	CA-LH25	CA-LH50
Focal distance	8 mm	16 mm	25 mm	50 mm
Aperture	F1.4 to F16	F1.4 to F16	F1.4 to F16	F2.8 to F22
Minimum object distance	0.1 m	0.2 m	0.2 m	0.2 m
Mount	C-mount	C-mount	C-mount	C-mount
Filter thread diameter	27.0 mm P0.5	25.5 mm P0.5	27.0 mm P0.5	27.0 mm P0.5
Maximum CCD size	2/3 inch	2/3 inch	2/3 inch	2/3 inch
TV distortion*	-0.6% (-2.8%) or less	-0.05% (-0.1%) or less	-0.04% (-0.02%) or less	-0.03% (-0.01%) or less
Operating temperature/ humidity range	0 to +50°C, 35 to 80% RH (no condensation)			
Weight	Approx. 83 g	Approx. 81 g	Approx. 89 g	Approx. 92 g

* The indicated values are for 2/3 inch CCD. The values for 1/3 inch are indicated in brackets ( ).

Close-up Rings (OP-51612)
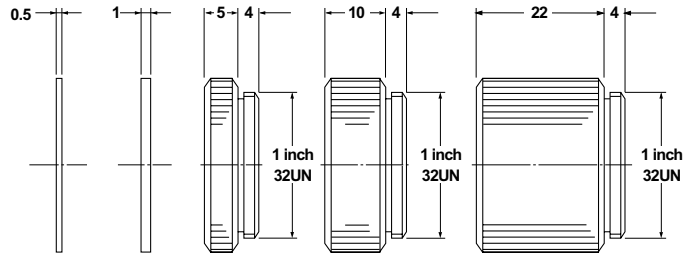
Unit：mm

Macro Lens

Straight type
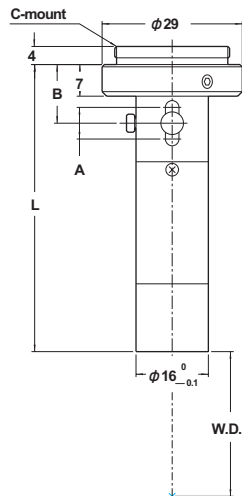
Unit：mm

Model name	CA-LM2	CA-LM4	CA-LM6	CA-LM8
L (length)	63.5 mm	69.3 mm	80.6 mm	95.0 mm
A (adjustment range)	7.0 mm	9.3 mm	7.7 mm	7.6 mm
B (adjustment position)	13.0 mm	15.1 mm	20.5 mm	34.9 mm
C (coaxial position)	30.7 mm	31.8 mm	—	—

CA-LM0510

Unit: mm
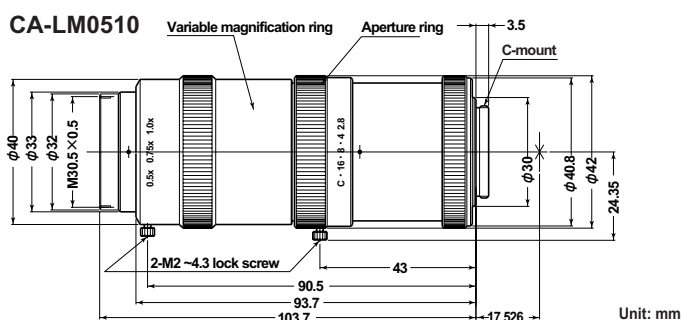
► **Note**

All the values in the specifications below are based on the optical design value. Individual differences can occur depending on the installation accuracy.

Model name		CA-LM2	CA-LM4	CA-LM6	CA-LM8	CA-LMA2	CA-LMA4	CA-LM0510
Shape		Straight	Straight	Straight	Straight	Coaxial	Coaxial	Straight
Optical magnification (reference magnification)		x2	x4	x6	x8	x2	x4	x0.5 to x1
Magnification range		Approx. ±5% relative to the reference magnification						—
WD [1](mm, in reference magnification)		66.9	70.3	64.4	64.5	66.9	70.3	111 (x0.5) 78 (x1.0)
Maximum CCD size		1/2 inch						2/3 inch
Image capturing field of view [2] (mm, in reference magnification)	1/3 inch	1.8 x 2.4	0.9 x 1.2	0.6 x 0.8	0.45 x 0.6	1.8 x 2.4	0.9 x 1.2	3.6 x 4.8 to 7.2 x 9.6
	1/2 inch	2.4 x 3.2	1.2 x 1.6	0.8 x 1.07	0.6 x 0.8	2.4 x 3.2	1.2 x 1.6	4.8 x 6.4 to 9.6 x 12.8
Valid F value		15.4	26.5	39.3	52.4	15.4	26.5	2.8~CLOSE
Depth of field [3] [4] (μm)		400	172	111	79	400	172	2560 (x0.5) 1280 (x1.0)
TV distortion (Max)		-0.04%	-0.22%	-0.10%	-0.04%	-0.04%	-0.22%	-0.4% (x0.5) -0.1% (x1.0)
Resolution [5] (μm)		5.1	4.5	4.4	4.4	5.1	4.5	3.8 (x0.5) 3.4 (x1.0)
Mount		C-mount						
Operating temperature and humidity		0 to +50°C, 80% RH (no condensation)						
Weight		Approx. 57 g	Approx. 58 g	Approx. 64 g	Approx. 67 g	Approx. 62 g	Approx. 66 g	Approx. 220 g

[1] WD indicates the working distance when each lens is used in the standard magnification. It changes when the magnification is adjusted.

[2] Image capturing field of view means the standard field of view for each CCD size. It can be changed by ±5% by adjusting the magnification (except for CA-LM0510).

[3] Depth of field is a simulation value assuming the 320 TV lines of horizontal resolution using a 1/2" CCD (circle of least confusion on the image: plane 40 μm).

[4] Depth of field of CA-LM0510 is when the effective F value is 32. Depth of field varies depending on the F value.

[5] Resolution indicates the simulation value in 550 nm.

Specifications

Option for Megapixel Miniature Camera (CV-S200C/S200M)

Lens CA-LHS☐
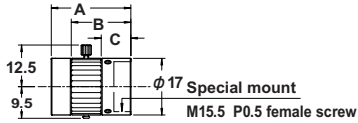
	CA-LHS8	CA-LHS16	CA-LHS25	CA-LHS50
A	40.4	23.9	24.9	40.4
B	28.6	17.9	18.6	27.1
C	19.6	8.9	9.6	18.1

12.5
9.5
φ17 **Special mount**
M15.5 P0.5 female screw

Close-up ring OP-66830（5mm）/OP-66831（10mm）
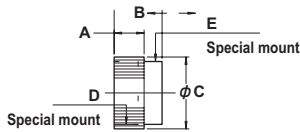
	OP-66830	OP-66831
A	5	10
B	8	13
C	17	17
D	M15.5 P=0.5 female screw	
E	M15.5 P=0.5 male screw	

Polarizing filter OP-66832

φ17
8
4.2
3
φ25
lens Insertion slot
Object
3-M1.6
Lens fixing screw
3.1

Side-view attachment OP-66833

24.9   2.6
27.4
Object
Beam axis
（internal light path length=25.8mm）
15
φ17
Lens insertion depth
5mm
23.3
4-M1.6
Lens fixing screw
9.5
31.8
3
15   30
2-M2
Depth: 8mm
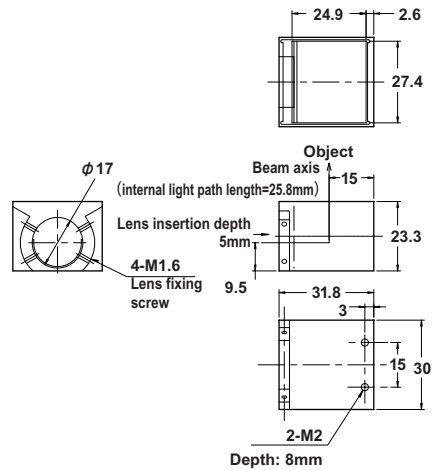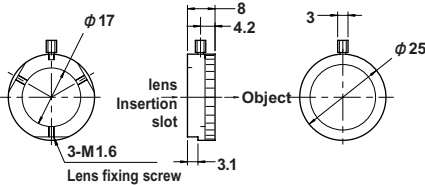
Option for Standard Miniature Camera (CV-S035C/S035M)

Lens CA-LS☐
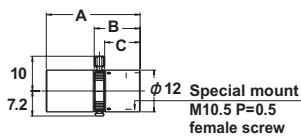
	CA-LS4	CA-LS6	CA-LS16	CA-LS30
A	16.7	21.3	20.4	27
B	11.5	15.9	10.2	13.2
C	8.5	12.9	7.2	10.2

10
7.2
φ12 **Special mount**
M10.5 P=0.5 female screw

Close-up ring OP-51500（5mm）/OP-51501（10mm）
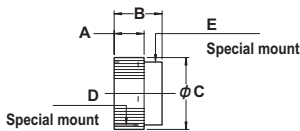
	OP-51500	OP-51501
A	5	10
B	8	13
C	12	12
D	M10.5 P=0.5 female screw	
E	M10.5 P=0.5 male screw	

Polarizing filter OP-51502

φ12
8
4.2
3
φ20
lens Insertion slot
Object
3-M1.6
Lens fixing screw
3

Side-view attachment OP-51503

13.7   2.8
14.9
Beam axis
（internal light path length =15.3mm）
Object
φ12
Lens insertion depth
4.5mm
9.7
14.7
4-M1.6
Lens fixing screw
6.25
21
3
10
17.5
2-M2
Depth: 5mm
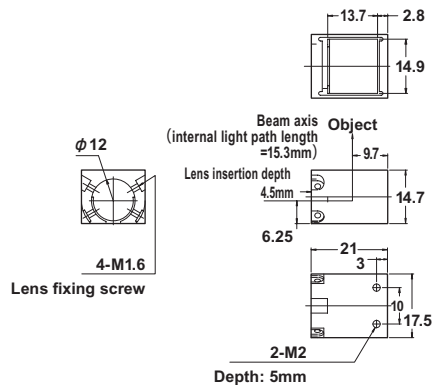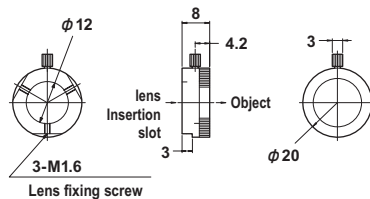
LED Lights

Direct-ring light (CA-DR)

Model name	LED color	Weight	Power consumption
CA-DRR4F	Red	Approx. 20 g	1.5 W
CA-DRW4F	White	Approx. 20 g	2.9 W
CA-DRB4F	Blue	Approx. 20 g	2.9 W
CA-DRR10F	Red	Approx. 90 g	8.3 W
CA-DRW10F	White	Approx. 80 g	7.9 W
CA-DRB10F	Blue	Approx. 80 g	7.9 W

CA-DR□4F

CA-DR□10F

* When mounting bracket is attached

Camera mounting slot
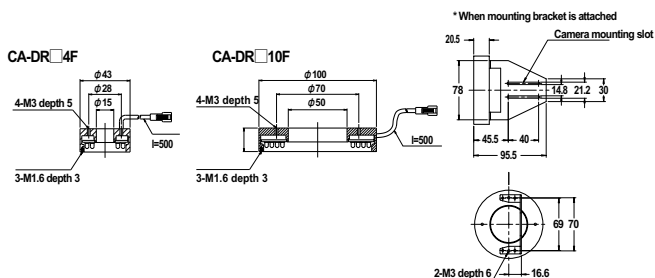
Unit：mm

Low-angle light (CA-DL)

Model name	LED color	Weight	Power consumption
CA-DLR7	Red	Approx. 40 g	2 W
CA-DLR12	Red	Approx. 85 g	3.3 W

CA-DLR7

4-M3 depth 3

l=500

2-P SM connector

Model	Size		
	A	B	C
CA-DLR7	φ75	φ56	φ46
CA-DLR12	φ125	φ110	φ95
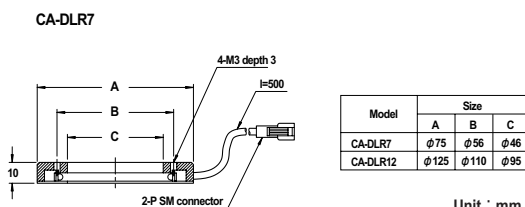
Unit：mm

Bar light (CA-DB)

Model name	LED color	Weight	Power consumption
CA-DBR5	Red	Approx. 35 g	1.7 W
CA-DBW5	White	Approx. 40 g	2.9 W
CA-DBB5	Blue	Approx. 40 g	2.9 W
CA-DBR13	Red	Approx. 80 g	4.2 W
CA-DBW13	White	Approx. 90 g	7.3 W
CA-DBB13	Blue	Approx. 90 g	7.3 W

CA-DB□□□

l=500

2-P SM connector

2-M2 depth 4

2-M3 depth 3
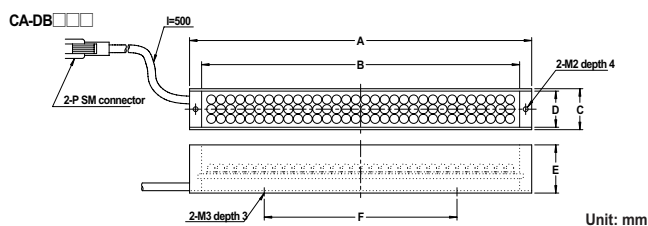
Unit: mm

Model	Size					
	A	B	C	D	E	F
CA-DB□5	60	50	17	15	20	30

Model	Size					
	A	B	C	D	E	F
CA-DB□13	142	132	17	15	20	80

Dome light (CA-DD)

Model name	LED color	Weight	Power consumption
CA-DDR15	Red	Approx. 130 g	11 W
CA-DDW15	White	Approx. 170 g	18.8 W
CA-DDB15	Blue	Approx. 170 g	18.8 W

CA-DDR15
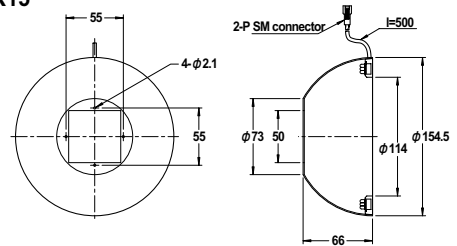
Back light (CA-DS)

Model name	LED color	Weight	Power consumption
CA-DSR3	Red	Approx. 40 g	3.6 W
CA-DSW3	White	Approx. 40 g	5.8 W
CA-DSB3	Blue	Approx. 40 g	5.8 W
CA-DSR9	Red	Approx. 110 g	14 W
CA-DSW7	White	Approx. 90 g	18 W
CA-DSB7	Blue	Approx. 90 g	18 W

CA-DS□3
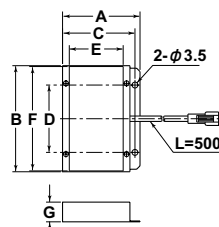
Model	Size						
	A	B	C	D	E	F	G
CA-DSR3	46	63	43	40	32	62	8.2
CA-DSW3	46	63	43	40	32	62	11.7
CA-DSB3	46	63	43	40	32	62	11.7

CA-DS□7/9
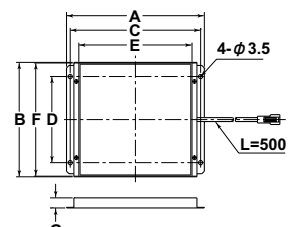
Model	Size						
	A	B	C	D	E	F	G
CA-DSR9	112	93	106	70	92	92	8.2
CA-DSW7	97	78	91	60	77	77	11.7
CA-DSB7	97	78	91	60	77	77	11.7

The sizes of the illuminating surface are E and F.

Coaxial light (CA-DX)

Model name	LED color	Weight	Power consumption
CA-DXR5	Red	Approx. 230 g	5 W
CA-DXW5	White	Approx. 230 g	4.9 W
CA-DXB5	Blue	Approx. 230 g	4.9 W
CA-DXR7	Red	Approx. 380 g	6.7 W
CA-DXW7	White	Approx. 380 g	10.1 W
CA-DXB7	Blue	Approx. 380 g	10.1 W

Model	Size						
	A	B	C	D	E	F	G
CA-DX□5	97	60	36	32	16	59	40
CA-DX□7	120	82	50	50	17	79	60

Model	Size					
	H	I	J	K	L	M	N
CA-DX□5	32	10	15	80	40		
CA-DX□7	50	11	14			50	55

CA-DX□□
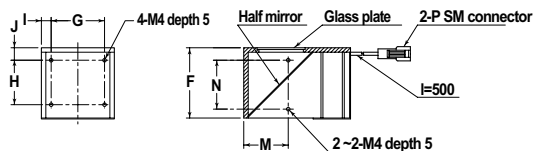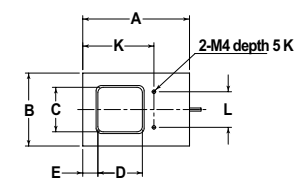
LED Light Controller (CA-DC100)

Dimensions

CA-DC100

15 | 85

110

11

5

45

81.2

Mounting screw hole
2-M3: Screw inserting depth 6 max

39 | 16

11.2

(40)

Mounting on the front（OP-42168）

135

8

20 | 2-φ5

45

t= 2

98.5

Mounting on the side（OP-42170）

130

φ5

t= 2

47.5

8

10 | 40.5

61 | 5

5×6 slot
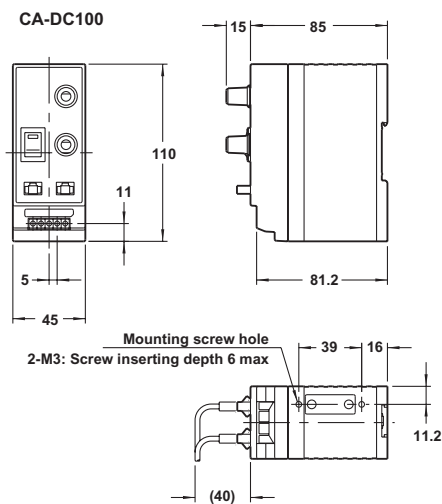
Mounting on the bottom (OP-42169)

116.6

t= 1.6

24

20 | 45

125

135

4-φ5
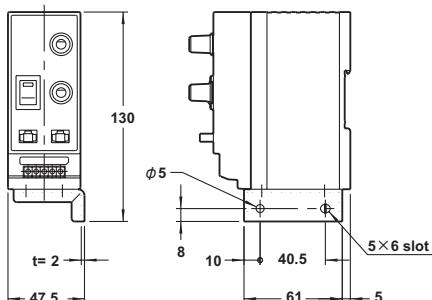
Specifications

Output	Dimmer method: emission frequency 100 kHz, pulse-duration modulation method
	Number of connection points: 2 channels
	Voltage: 12 V
	Capacity: Maximum 30 W (but 20 W/1 CH)
Input	2 points of external control input (EXT), non-voltage contact input
Rating	Power supply voltage: 24 V DC ± 10%
	Power consumption: 1.8 A (at maximum load)
Environmental resistance [1]	Operating ambient temperature: 0 to +45°C
	Operating ambient humidity: 35 to 85% RH (no condensation)
Weight	Approx. 220 g

[1] The environmental resistance characteristics of the LED light section include ambient operating temperature of 0 to +40°C, and ambient operating humidity of 35 to 65% RH (no condensation).

Ring Light (CV-R11/CA-R20)

CV-R11

Light section (When mounting bracket (large) is attached)

Camera mounting slot

41.5
23
ϕ92
14.8 21.2 30 74 ϕ90
48 40
98

33 4-M2.5×R4
ϕ48
36 55 69 ϕ90
16
15
42.5

Amplifier section

140

110

40

8

15 110 15

15 80 15

CA-R20

Light section

236
230
130
11
90
90
45 55
ϕ200
ϕ176
ϕ149
ϕ12
15 15 15

3 5 18
ϕ212

Amplifier section

145

50

8

10 120 10
140

15 80 15
110
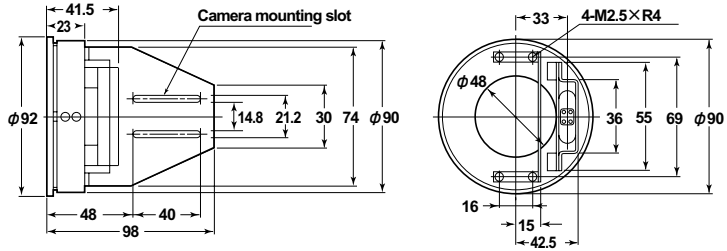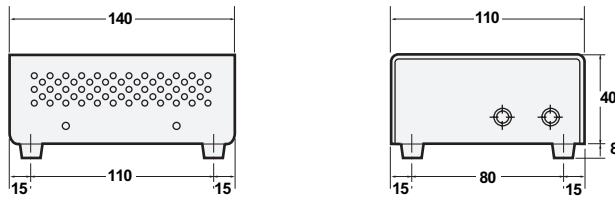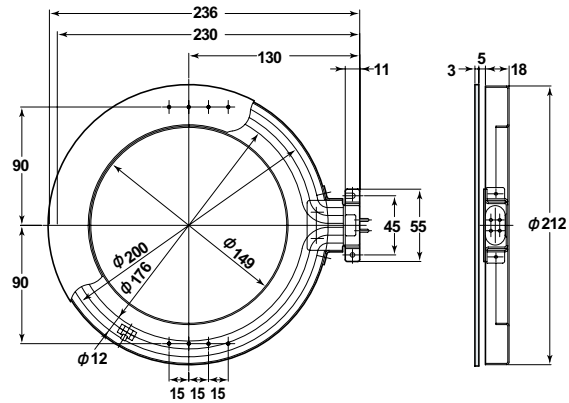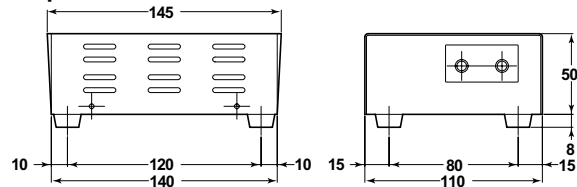
Specifications

Model name		CV-R11	CA-R20
Lighting method		High-frequency inverted power supply (25 to 35 kHz)	
Light color		N-EX (neutral white color)	
Lamp shape		Outer diameter : 80 mm, internal diameter : 56 mm	Outer diameter : 200 mm, internal diameter : 176 mm
Lamp life [1]		Approx. 2,000 hours	Approx. 1500 hours
Rating	Power supply voltage	24 V DC ±10% (50/60 Hz common)	24 V DC ±10%
	Current consumption	0.7 A max.	1.5 A
Environmental resistance	Ambient operating temperature	+5 to +50°C	+5 to +40°C
	Ambient operating humidity	35 to 90% RH (no condensation)	
Weight	Lamp unit	Approx. 150 g	Approx. 300 g
	Amplifier	Approx. 900 g (including the cable)	Approx. 950 g (including the cable)
Replacement lamp type		OP-25526	OP-51495

[1] Lamp life indicates the average time it takes for the initial luminance [2] to drop to 70% when the lamp is lit continuously under the environment with no vibration at about 25°C of ambient temperature.The lamp life may be shorter depending on the operating condition.

[2] Initial luminance is the luminance when a new, unused lamp is lit for the first time.

24-VDC Power Supply (CA-U2)

Mounting on the front using OP-42174)
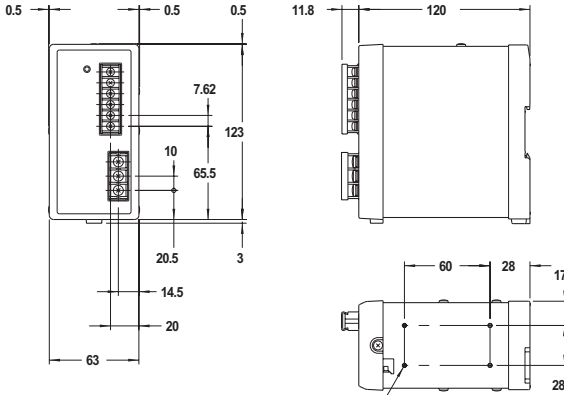
Mounting screw hole
4-M3 Screw inserting depth 6 max.
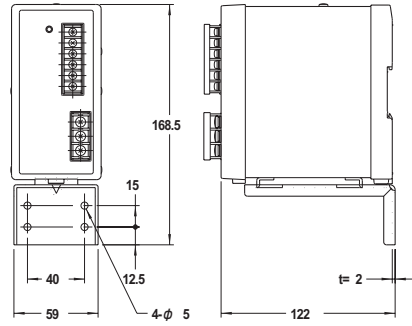
Mounting on the bottom(using OP-42175)
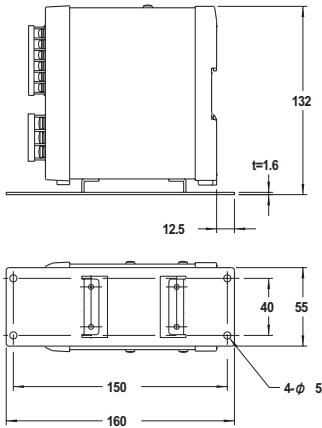
Mounting on the side (using OP-42176)
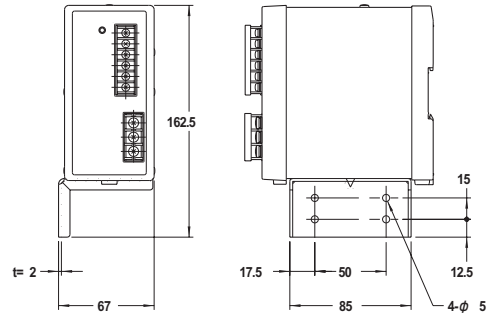
Specifications

Input condition	Rated input voltage	100 to 240 V DC (±10%), 50/60 Hz
	Efficiency	78 to 80% typ.
	Rated input current	1.2 A or less
	Power factor (100/200 V AC)	0.99/0.95 typ. at max. load
	Leak current (100/200 V AC)	0.4/0.75 mA or less
	Rush current (100/200 V AC)	18/36 A or less (25°C cold start)
	Overvoltage category	II
Output condition	Rated output voltage	24 V, Class2
	Rated output current	3.5 A (total of three output terminals)
	Ripple noise voltage	1% (P-P) or less
	Input fluctuation	0.4% or less
	Load fluctuation	0.7% or less
	Startup time (100/200 V AC) [1]	1500/1000 ms or less
	Output holding time	20 ms or more (100 to 240 V AC)
Protection	Overcurrent protection [2]	3.6 to 4.2 A or more, fixed current drop or output block
	Overvoltage protection [3]	Available
Environmental resistance	Ambient operating temperature	-10 to 55°C (No freezing) (See derating characteristics.)
	Ambient operating humidity	25 to 85% RH (no condensation)
	Ambient storage temperature	-20 to 70°C (No freezing)
	Pollution degree	2
	Withstanding voltage	3.0K V AC 50/60 Hz, 1 min (between input and output) 2.0K V AC 50/60 Hz, 1 min (between input and GND) 500 V DC, 1 min (between output and GND)
	Impact resistance	300 m/s2, twice each in the 3 axis directions
	Vibration resistance	10 to 55 Hz Double amplitude of 1.5 mm or less 2 hours in X, Y, and Z direction respectively (9.8 m/s2 or less in DIN rail installation)
	Insulating resistance	100 MΩ or more in 500 V DC (between input and output) (between input and GND) (between output and GND)
Safety standard		UL60950, UL508, CAN/CSA C-22.2 60950-00, EN60950, EN50178
Noise terminal voltage		FCC part15B class A, EN55011 class A
Radiated susceptible electrolytic strength		FCC part15B class A, EN55011 class A
High-frequency current regulation		Complying to EN61000-3-2
Weight		Approx. 700 g

[1] Rating input voltage (100 or 200 V AC) is defined as 100% load.

[2] The system automatically recovers when a current drop occurs. When the output is shut down, the system recovers when the input is turned on more than a minute after the input is turned off.

[3] The output is shut down using the oscillation stop method. When the output is shut down, the system recovers when the input is turned on more than a minute after the input is turned off.

Specifications

Monitor (CA-MP81)
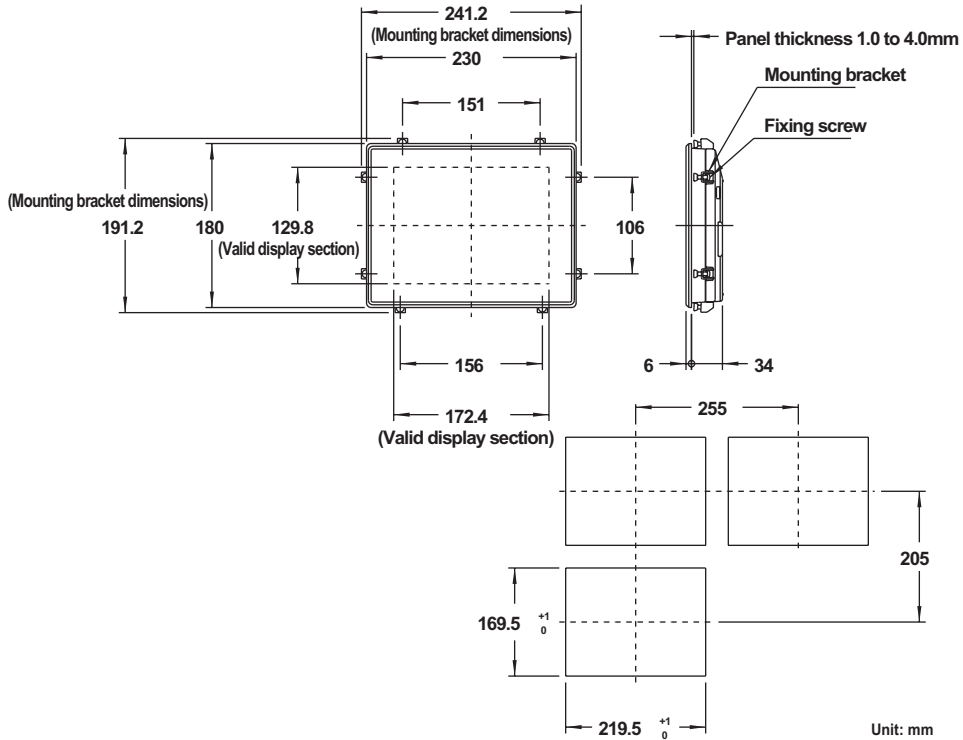
Specifications

Liquid crystal panel	Display element	Low-temperature p-Si TFT Active Matrix
	Valid display area	172.4 (W) x 129.8 (H) mm
	Number of display dots	800 (W) x 600 (H) dots
	Display color	262,144 colors
Backlight	Method	Two-way cold-cathode fluorescent lamp
	Life	Average life: approx. 50,000 hours (25 °C vertical installation)
Input/output	Input signal	Analog RGB signal (0.7 Vp-p, 75 Ω), horizontal, vertical period signal
	Input signal mode	800 (W) x 600 (H) vertical frequency 60 Hz
	Connector	D-sub 15 pin, female (3WAY, inch screw), input only
Rating	Power supply voltage	24 V DC ±10%
	Current consumption	1 A or less
	Ambient operating temperature	0 to +40 °C
	Ambient operating humidity	35 to 85% RH
Structure		Panel embedded type, dust-proof, drop-proof structure equivalent to IP65f at front only
Weight		Approx. 1200 g

Processing a Color Image [Color]

What is a Color Extraction?

The color extraction process in this system converts the captured raw color image to a monochrome (grayscale or binary) image. All the image processing (excluding HSB and RGB measurement) is performed on this monochrome image.
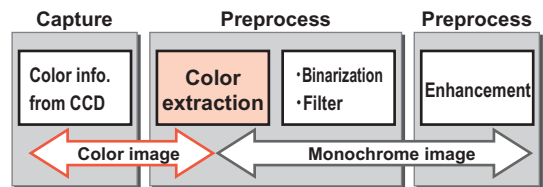
Color extraction is performed in Program mode for each inspection window.
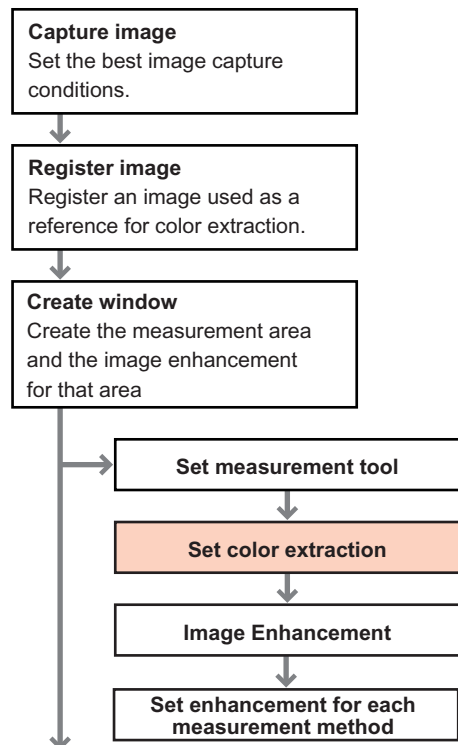
► **Note**

Color extraction cannot be performed when a monochrome camera is selected in the inspection window setting.

Methods of Color Extraction

The following three processes are available in the system for extraction or conversion of color information.
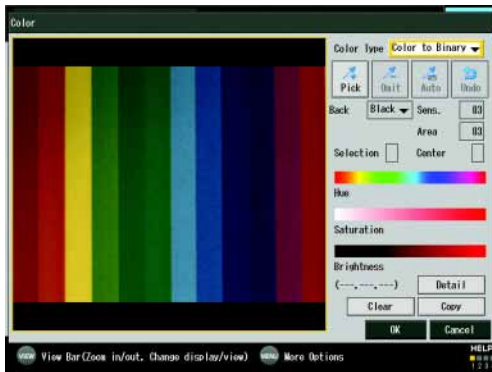
(Example of an image before color extraction)

- **Converting to a binary image by specifying the color range (Color to Binary)**: This process creates a binary image by setting the pixels that fall within the selected color range to be a level of 255 (white). All pixels that fall out of the selected color range will be set at a level of 0 (black). This binary image is useful for counting pixels of a specified color (Area tool) or measuring the various properties of a blob (Blob tool).
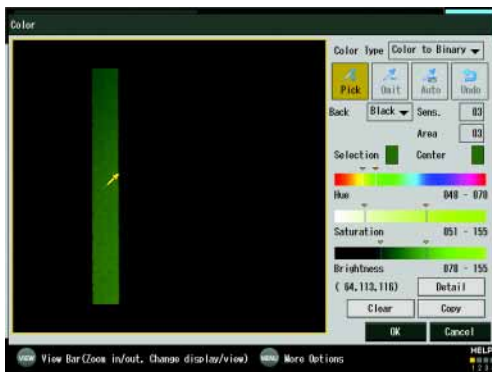
Reference

The Area and Blob tools require the binary image for inspection, which is set in the [Color to Binary] process. Thus, no further Image Enhancement is necessary in the window setting.

- **Converting to a grayscale image by specifying a color as the maximum intensity (Color to Gray)**: This process creates a grayscale image that focuses specifically on the selected color range (Adaptive Grayscale). The pixels that fall within the selected color range become the maximum intensity level of 255 (white). All other pixels outside the specified color region are assigned a gray level from 254 to 0. the closer the shade of color is to the selected region, the higher the gray level.A level of 0(black) represents colors that do not closely match the selected color range.This type of image processing is very useful for inspections that require high accuracy such as position measurement to the sub-pixel level or stain detection.

- **Converting to a grayscale image (Gray)**: This process creates a traditional grayscale image by extracting only the brightness from the color image. All pixels are assigned a level of gray from 255 (white) to 0 (black). This option can be used when one would like to treat the color camera as a monochrome (grayscale) camera.
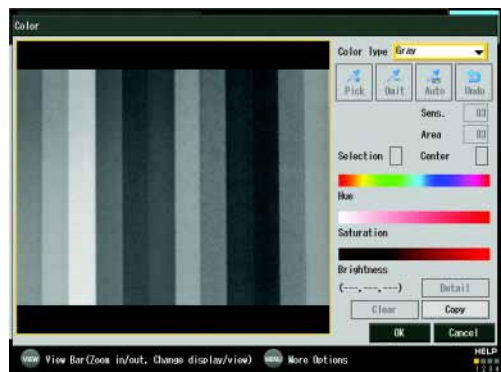
Converting to a Binary Image by Specifying a Color Range [Color to Binary]

1 **Select [Color to Binary] from the [Color Type] field of the [Color] menu.**

The default image displayed on the screen is a registered image that is used in the inspection window, which you can change to the live captured image.

2 **Select [Pick].**

3 **Select a color which you want to be white (255) after binary processing on the screen by moving the [ENTER] button.**
Only the part of the color that has been selected and extracted is displayed in color.

4 **Enlarge the range of extracted color as required.**
- If the [ENTER] button is pressed consecutively, the neighboring colors of the first selected color can be incrementally selected.
- If [Auto] is selected, a range of extraction color can be automatically enlarged, depending on the value specified in [Sens.].

To exclude color from the extraction
Press the [ESCAPE] button to exit the color extraction state and select [Omit]. In this state, you can colors that you want to exclude by using the [ENTER] button.

5 **When you have completed selecting the color to be excluded, press the [ESCAPE] button.**

6 **Select [OK].**
The window setting menu appears.

Reference

- During setup, you can also change the zoom ratio using the VIEW bar (Page 3-9) and then set the extraction color.
- While in the color selection /omit state (eyedropper icon on screen), you can press the FNC key to toggle back and forth between the Pick and Omit state as necessary to obtain the best color setting.

Viewing the extracted color

Press the [SCREEN] button.
Each time you press the button, the screen changes from Raw screen display → Color on a Grayscale background → Color on a black/white background → Raw screen → … in this order.

► **Note**

While the system is running, all the extracted colors are displayed in white on the process screen.

Checking the extracted color by using the live captured image

This is helpful when you want to check whether the current color extraction setting is appropriate for the actual target.

1 **Press the [VIEW] button.**
The [VIEW] bar appears.

2 **Select [icon].**
You can change the screen that is displayed during color extraction to the captured screen or the registered image.

Clearing all the settings on color extraction

Select [Clear] from the [Color] screen.

Appendix

Changing the color extraction settings

Changing the background color
Background color for the image after color extraction can be selected from either white or black (default) in [Back] from the [Color] menu. It is useful to select black if bright colors are extracted, and white if dark colors are extracted.

Background color is [Black]
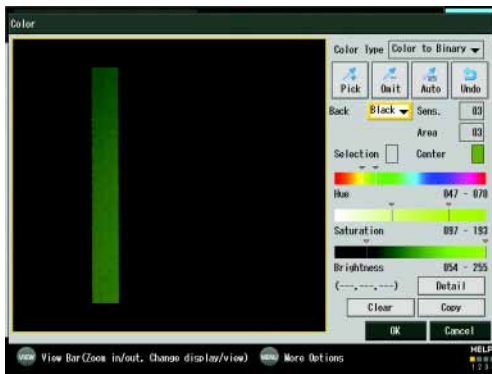
Background color is [White]
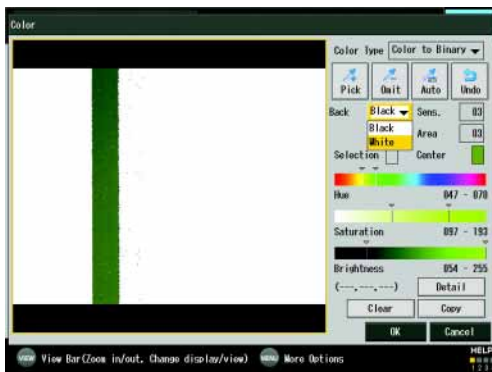
Adjusting the extraction sensitivity of neighboring colors
The range of the extracted color can be adjusted by clicking [Sens.] from the [Color] menu. Use a lower setting for a more precise color extraction of a specific color (default is 3).

Adjusting the size of the color extraction selection box
The size of the reference area (square box) for the color extraction can be set in [Area] from the [Color] menu. All colors that fall within this selection box will be extracted. (Default is 3, can be set from 1 to 32).

Specifying the color range to be extracted with numeric values

You can set or change the extracted color range by entering actual value ranges for the Hue, Saturation, and Brightness.

1 Select [Detail] from the [Color] menu.
The right side of [Color] menu changes to the detail setup screen.
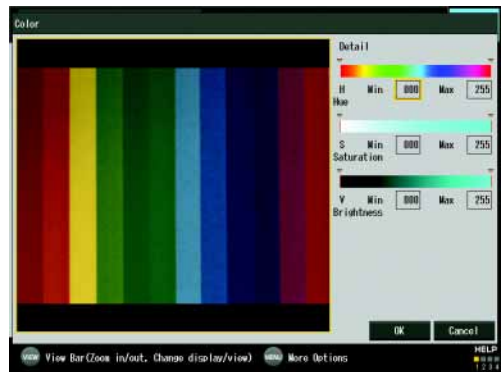
2 Specify the color range by specifying upper limit values and lower limit values for H, S, and B, respectively.
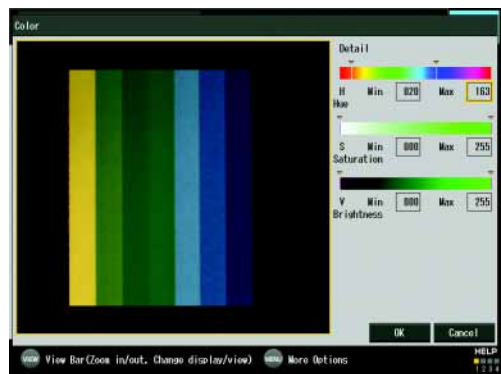
The color information is controlled by the following three elements:
- H (Hue): Indicates hue.
- S (Saturation): Indicates the white level of the color.
- B (Brightness): Indicates the black level of the color.

If an upper limit or a lower limit is specified, the color extraction range on the screen changes, and the position of the ▼ mark shifts on the color bar.

Reference
H (Hue) is a clockwise hue circle starting from red, that may cause the lower limit value to exceed the upper limit value.

3 Select [OK].
The right side of [Color] menu returns to the normal screen.

Converting to a Grayscale Image with a Specified Color as the Maximum Contrast [Color to Gray]

1 Select [Color to Gray] from the [Color Type] field of the [Color] menu.

2 Select Pick .

3 Select a color which you want to be white (255) in the grayscale image by moving the [ENTER] button.
The displayed image is converted to grayscale with the selected color as white (255). The pixels that represent the level of 255 are displayed in yellow.

4 Enlarge the range of extraction color as required.
- If the [ENTER] button is pressed consecutively, the neighboring colors of the first selected color will gradually be converted to a color approaching full white (255).
- If Auto is selected, a range of extraction color can be automatically enlarged, depending on the value specified in [Sens.].

▶ **Note**
The best color settings are usually obtained by extracting only once (Pressing [ENTER] one time). Enlarging the extraction range reduces image contrast.

To exclude a color from the extraction:
Press the [ESCAPE] button to exit the color extraction state and select Omit . In this state, you can select colors that you want to exclude by using the [ENTER] button.

▶ **Note**
If too many exclusions are applied, the contrast information of the image will be lost, resulting in an image that is similar to the binary image. In this case, accuracy of measurements (edge or pattern search) that reference to the contrast information may decrease.

5 When you have completed selecting the color to be excluded, press the [ESCAPE] button.

6 Select [OK].
The window setting menu appears.

Reference
- During setup, you can also change the zoom ratio using the VIEW bar (Page 3-9) and then set the extraction color.
- While in the color selection/omit state (eyedropper ican on screen), you can press the FNC key to toggle back and forth between the Pick and Omit state as necessary to obtain the best color setting.

Viewing the extracted color

Press the [SCREEN] button.
Each time you press the button, the screen changes from Raw screen display → Grayscale image after conversion with white (255) displayed in yellow → Grayscale image after conversion → Raw screen → … in this order.

Checking the extracted color by using the live captured image

This is helpful when you want to check whether the current color extraction setting is appropriate for the actual target.

1 Press the [VIEW] button.
The [VIEW] bar appears.

2 Select .
You can change the screen that is displayed during color extraction to the captured screen or the registered image.

Appendix

Clearing all the settings of color extraction

Select [Clear] from the [Color] screen.

Changing the settings of color extraction

Adjusting the extraction sensitivity of neighboring colors
The range of the extracted color can be adjusted by clicking [Sens.] from the [Color] menu. Use a lower setting for a more precise color extraction of a specific color (default is 3).

Adjusting the size of the color extraction selection box
The size of the reference area (square box) for the color extraction can be set in [Area] from the [Color] menu. All colors that fall within this selection box will be extracted. (Default is 3, can be set from 1 to 32).

Specifying the color range to be extracted with numeric values

You can set or change the extracted color range and contrast level by entering actual value ranges for the Hue,Saturation, and Brightness.

1 Select [Detail] from the [Color] menu.

The right side of [Color] menu changes to the detail setup screen.
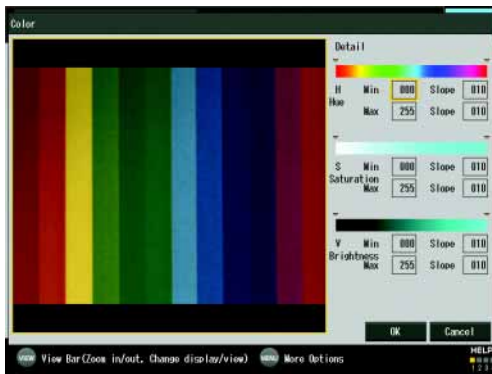
2 Specify the color range by setting upper limit values and lower limit values for H, S, and B, respectively.
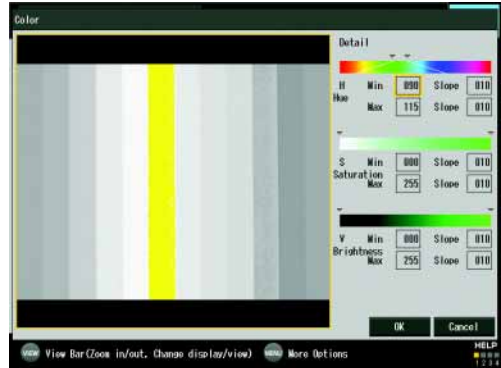
The color information is controlled by the following three elements:

• H (Hue): Indicates hue.
• S (Saturation): Indicates the white level of the color.
• B (Brightness): Indicates the black level of the color.

If an upper limit or a lower limit is specified, the color extraction range on the screen changes, and the position of the ▼ mark shifts on the color bar.

Reference

H (Hue) is a clockwise hue circle starting from red, that may cause the lower limit value to exceed the upper limit value.
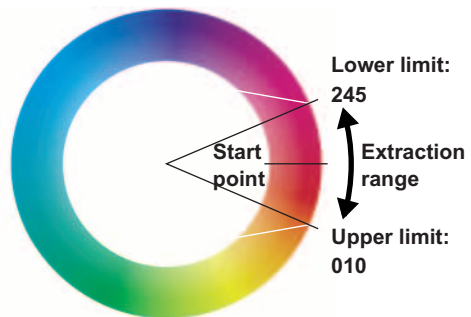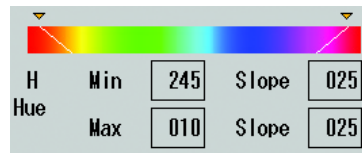
3 **Specify the slope of the contrast value for H, S, and B, on the grayscale image.**
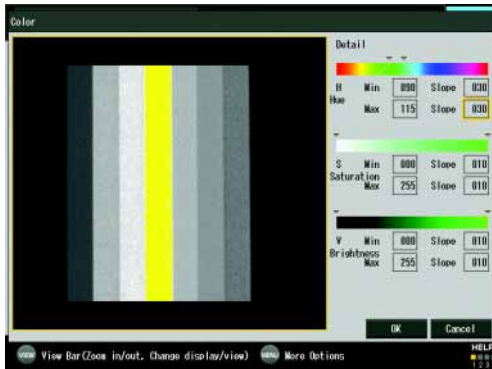
The slope can be individually set for upper and lower limit values. The contrast levels are updated on the image as the slope setting is changed so you can obtain the desired effect.

- **When the slope increases (up to 100)**: The difference in contrast between the selected color range and non-color range increases, resulting in an image that is more focused on the exact color range (approaching a binary type image).
- **When the slope decreases (min. 10)**: Setting the slope to the minimum value allows for the maximum image versatility.The image will remain more stable in regards to lighting or color changes.

► **Note**

As with the case of exclusion, if the slope increases, the contrast information outside the selected area decreases. Therefore, excessive slope may impact the accuracy of measurements that reference the contrast information.

4 **Select [OK].**

The right side of [Color] menu returns to the normal screen.

Converting to a Grayscale Image [Gray]

1 **Select [Gray] from the [Color Type] field of the [Color] menu.**

The image is converted to a grayscale image which contains only the brightness information of the color image.
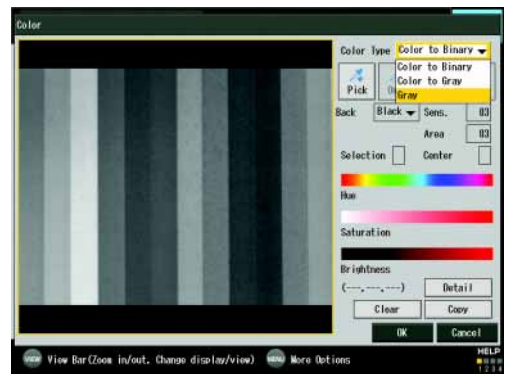
2 **Select [OK].**

The window setting menu appears.

Comparing with a previous registered image

The screen can be switched between the raw screen (color) and the filtered screen by pressing the [SCREEN] button.

Appendix

HSB Color System Used in the System

The HSB color system is used to process RGB signals from CCD in the system. HSB color system is a color representation using H (hue), S (saturation), and B (brightness).
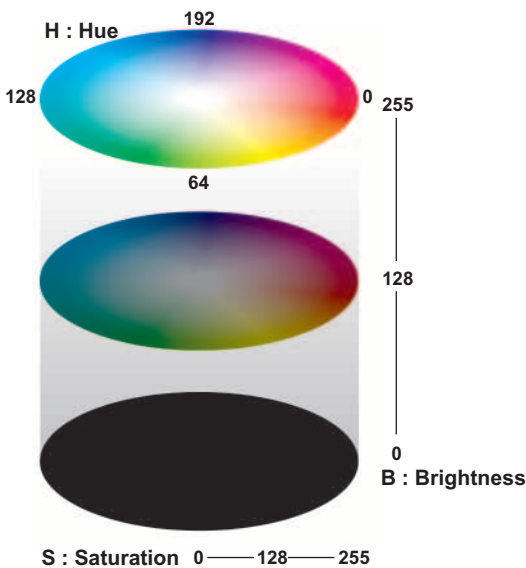
In this system, the ranges for the H, S, and B values are automatically determined when selecting the color in the color menu. By specifying the actual numeric values for the H, S, and B ranges in the [Detail] menu, a more precise color extraction can be done.

Tips on specifying with numeric values

The following points must be considered when specifying the color range to be extracted with numeric values.

- H: (hue): The most important parameter to determine the color to be extracted. Other parameters of S and B are applied to the same area specified for H. Be sure to specify the H value accurately.
- S (saturation): This is essentially the level of white contained in the color. Changing this value can be useful when trying to eliminate glare from the detection. By excluding the portion with low saturation from the selected area, the white portion of the color caused by glare can also be excluded from the extraction range.
- B (Brightness): This sets the level of black contained in the selected color. If the selection area is enlarged, stable extraction can be performed despite changes caused by light deterioration.

Reference

You can get a guideline for specifying color range in numeric values by measuring the HSB values of the extraction with the [Color] measurement tool (Page 4-210).

Filter List

The details of the image enhancements are listed below.

None

Image enhancement will not be executed.
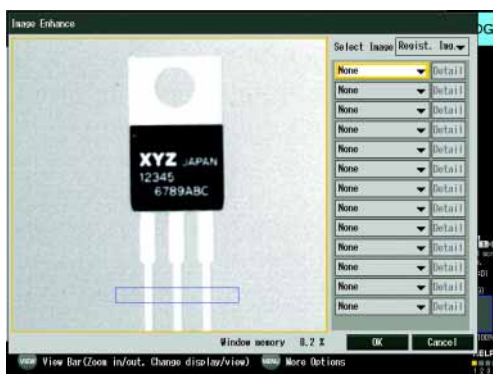
Binary

The image is converted to a binary image.
The binary level can be adjusted by selecting [Detail].
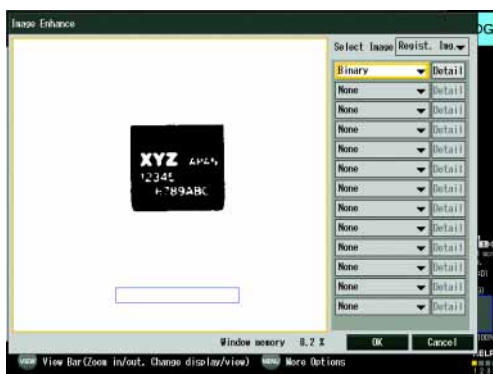
Expand

The white pixels are expanded and the black pixel noise is removed.
Filter size (3 x 3: default, 5 x 5: for larger expansion), Count (number of times to apply the filter, up to 9 times), and Border (see below) can be set by selecting [Detail].
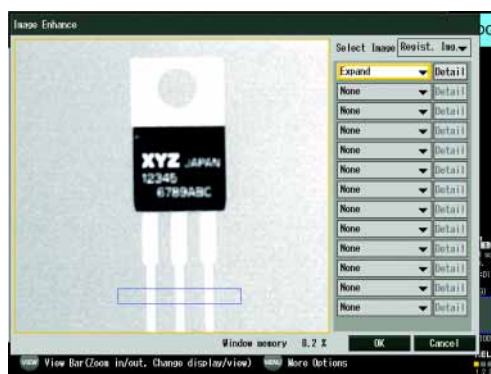
Outside reference using an expand filter (Border)

You can specify how to process edges of areas when referencing to surrounding pixels (default: ON).

- ON: Processes by referencing gradation of outside areas.
- OFF: Processes the gradation of outside areas the same as the gradation of the edges.

Reference

The Border state of ON is displayed on the process screen of the image enhancement configuration menu, regardless of the setting.

Appendix

Shrink

The white pixels are shrunk and the white pixel noise is removed.
Filter size (3 x 3: default, 5 x 5: for larger expansion),
Count (number of times to apply the filter, up to 9 times),
and Border (see below) can be set by selecting [Detail].
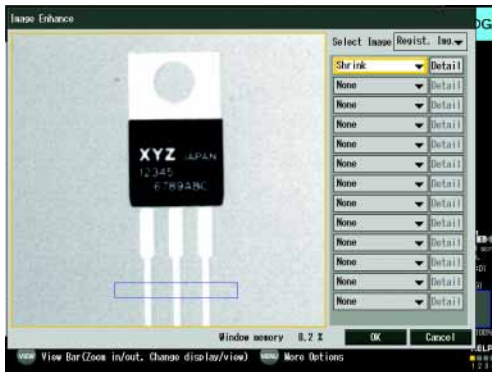
Outside reference using a shrink filter (Border)

You can specify how to process edges of areas when referencing to surrounding pixels (default: ON).

• ON: Processes by referencing gradation of outside areas.
• OFF: Processes the contrast of outside areas as the same contrast as the edges.

Reference

The Border state of ON is displayed on the process screen of the image enhancement configuration menu, regardless of the setting.

Average

Intensity is averaged to remove noise.
Number of times for application (1 to 9) can be set by selecting [Detail].
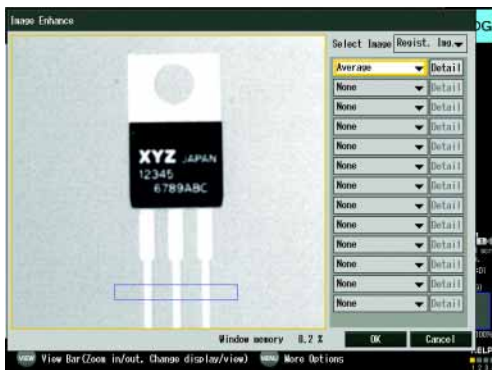
Median

Noise is removed while the outline is maintained.
Number of times to apply (1 to 9) can be set by selecting [Detail].
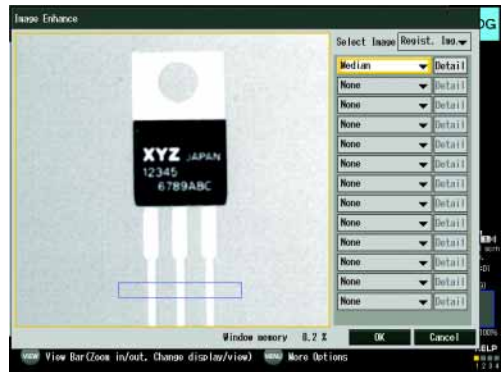
Sharpen

Regions where there is a change in intensity are enhanced. Number of times to apply (1 to 9) can be set by selecting [Detail].
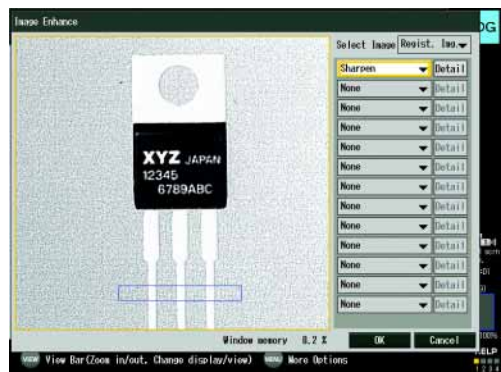
Sobel X

Regions where there is a change in intensity in the horizontal (X) direction are extracted.Number of times to apply (1 to 9) can be set by selecting [Detail].

Sobel Y

Regions where there is a change in intensity in the vertical (Y) direction are extracted. Number of times to apply (1 to 9) can be set by selecting [Detail].

Sobel

Edges in both directions are extracted.Number of times to apply (1 to 9) can be set by selecting [Detail].

Prewitt

Extracts edges in the X and Y direction (like Sobel). However, the Prewitt filter will emphasize high contrast edges and not low contrast edges. Number of times to apply (1 to 9) can be set by selecting [Detail].

Appendix
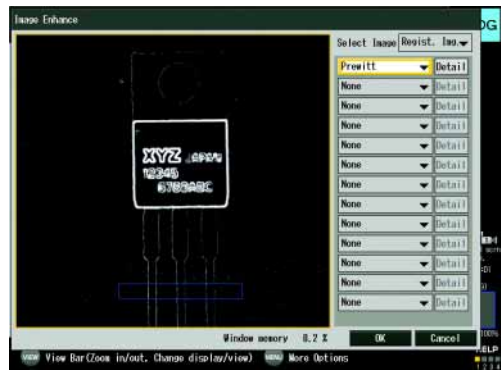
Roberts

Used to emphasize edges that appear diagonally on the screen. For X and Y extraction, use Prewitt or Sobel. Number of times to apply (1 to 9) can be set by selecting [Detail].

Laplacian

Uniformly extracts edges in all directions. However, the edge contrast will become lower than Prewitt, Sobel, or Roberts. Number of times to apply (1 to 9) can be set by selecting [Detail].
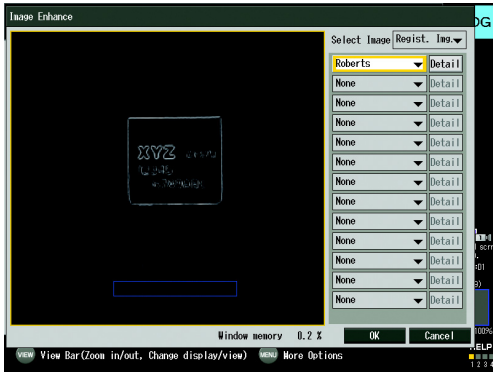
Subtract

See "Extracting Flows using a Subtract Filter" (Page 4-14).

Preserve Intensity

See "Reducing the Impact of Intensity Change Using the Preserve Intersity Filter" (Page 13-13).

Contrast conversion

See "Adjusting the image brightness balance (Gain adjustment)" (Page 4-10) for details.

Image Extraction

See "Deleting the Background Information with the Image Subtraction Filter" (Page 13-14) for details.
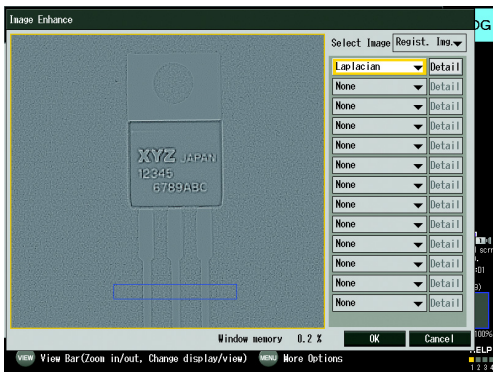
Reducing the Impact of Intensity Change Using the Preserve Intersity Filter

The impact of lighting fluctuations can be reduced by using the Preserve Intensity filter to correct the intensity of the input image based on a registered image. It is especially useful for measurement windows of a monochrome camera where only contrast information is processed.

► **Note**

It cannot be used for a color measurement window.

Enhanced image

Registered image	Current image	Enhanced image
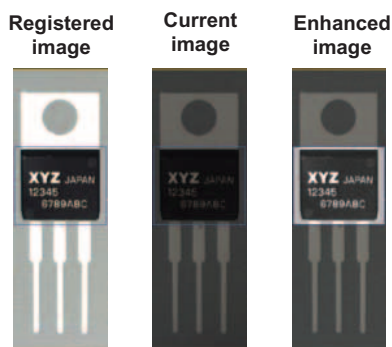
Process of preserve intensity
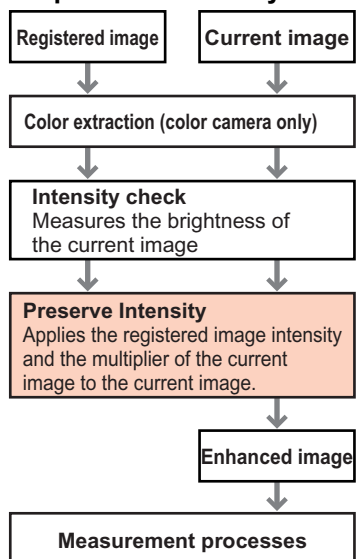
► **Note**

The intensity inspection of the registered image is performed only once to generate reference values at registration or recalculation of reference values.

Flow of operations

1 **Measure the intensity to set as a reference.**
To measure the brightness of the image, set the Intensity tool on any window.

See Intensity Inspection (Page 4-202) for how to set inspection windows.

Reference

The window number in which the intensity tool is set can be selected independently from the window number in which the preserve intensity filter is performed.

► **Note**
- Register an image beforehand to use for the reference intensity.
- Set the measurement window in a location with moderate brightness (around the average intensity of 128). If this window is set in a location that is too bright or too dark, adjustment cannot be performed properly. In particular, adjustment may be unstable for images with high contrast through color extraction.

Appendix

2 **Set [Preserve Int.] enhancement in the measurement window that you want to stabalize.**
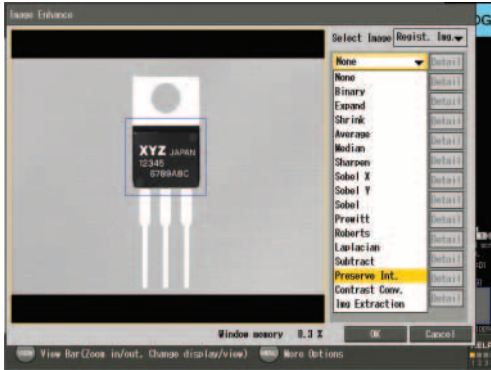
Select [Image Enhance] to display the [Image Enhance] menu, and select [Preserve Int.].

3 **Select [Detail]**

[Select Windows] menu appears. Specify the intensity inspection window which the Preserve Intensity filter refers to.
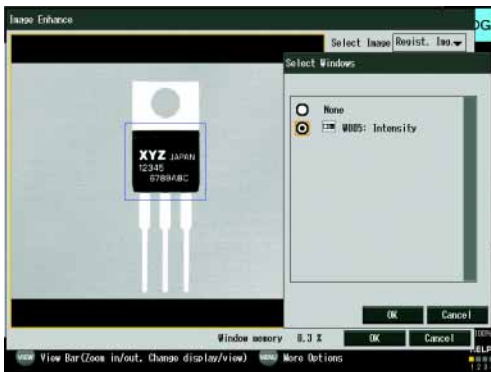
4 **After completing the settings, select [OK].**

► Note

Adjustment is not performed if following conditions apply.

• If an inspection tool other than the intensity tool is specified as reference
• If the referenced intensity inspection window has an error
• If the execute condition of the referenced intensity inspection window is not executed

Deleting the Background Information with the Image Subtraction Filter

The background information of the target can be deleted by performing a subtraction between the current image and an internal processed image that is obtained from the current image. This filter is very useful for extracting small points or thin lines from a fluctuating background.

Advanced settings can be configured by selecting "Details". The extraction color can be set to "Dark" (default) or "Light", while the extraction size can be set in the range of 03 to 39 pixels (the pixels are counted in 2 pixel increments, with default: 5).

Reference

Unlike with the subtraction filter, the reference image is automatically generated by performing image processing on the current image. Thus, there is no need to register any additional images to account for background conditions.

► Note

Increasing the value for extraction size also lengthens the processing time.

Processed image

Current image

Processed image

Subtraction processing
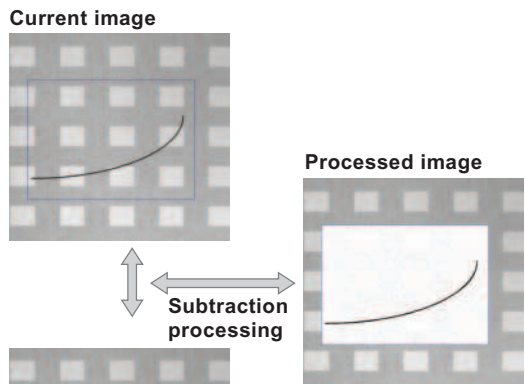
Internal processed image (not shown)
The internal processed image is created as a result of applying expand and shrink processing on the current image.

What is an Edge ?

The edge process of the system is used to detect edges within the desired measurement area. Edge detection is performed not according to the definitive value of intensity, but according to the amount of change in the average intensity. This amount of change is called edge intensity.

Edge sensitivity

The sensitivity of edge detection in percentage, with the maximum edge intensity (location with maximum intensity change within the set measurement window) as 100%, is called edge sensitivity. Edge sensitivity specifies the amount of edges that the system will detect. A higher sensitivity will only detect the largest changes in intensity, while a lower sensitivity will pick up the smaller changes as well.

Edge detecting direction

Project waveform
+255
0

Edge graph
+255
Edge sensitivity (%)
100%
This length is considered as 100%.
0
0%
(The image shown is not an actual edge graph.)
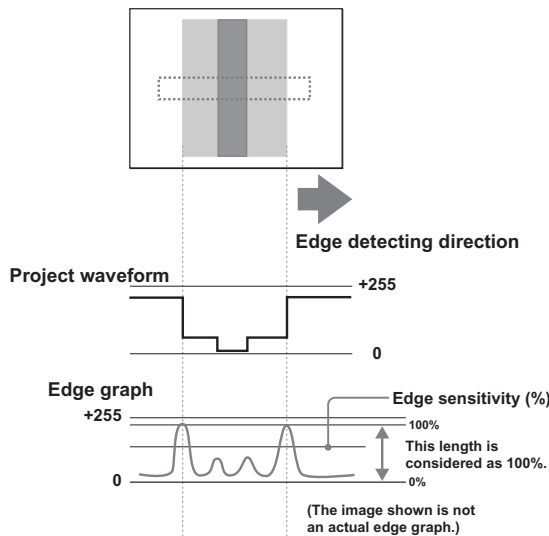
Edge sensitivity 50% (Two edges should be detected.)

50%
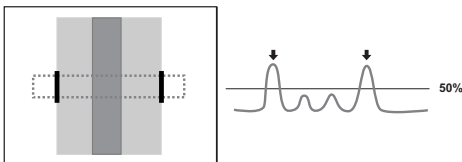
Edge sensitivity 30% (Four edges should be detected.)

30%
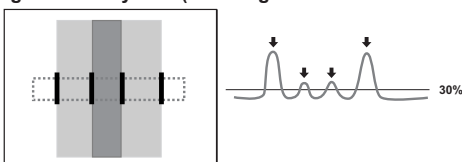
Edge intensity upper and lower limit

Sets the upper and lower limits for detecting edges. Only the edges that lie between the upper and lower limit will be detected. Any edge outside this range will not be processed.

Edge detecting direction

Edge graph
+255
Edge intensity upper limit
Edge sensitivity (%)
0
Edge intensity lower limit
((The image shown is not an actual edge graph.)
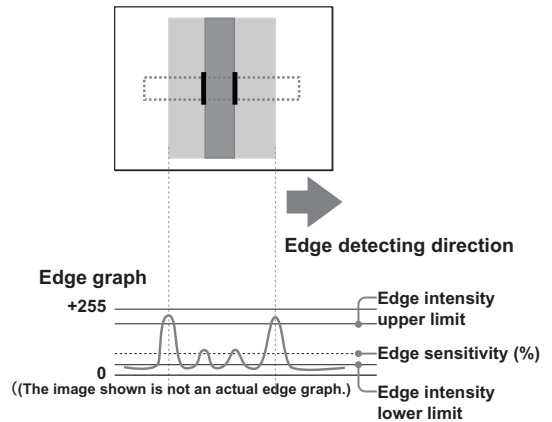
Difference between edge sensitivity and upper/lower limits of edge intensity

While the edge sensitivity is specified using a relative value with a maximum edge intensity as 100%, the upper limit and lower limit of edge intensity is specified using an absolute value of the edge intensity.

■ **Reference**

Edges excluded from detection by the upper limit of edge intensity are also excluded from the maximum edge intensity in edge sensitivity. Thus, if the upper limit of edge intensity is changed, the edge detection result may change.

Checking the edge intensity

The maximum edge intensity within a measurement window can be adjusted with the numeric values displayed next to the edge graph on the [Select Detection Conditions of Edges] menu.

Appendix

Filter width

By selecting a filter width, the edge graph can be averaged. If a false edge is detected as result of a noise component, increasing the filter width averages the noise component, reducing erroneous detections.
In addition, when you want to detect a gradual change in contrast such as that produced when a measurement target is tilted, increasing the filter width allows a wider range of intensity change to be detected as an edge.

Filter width default setting (filter width = 5)

Edge detecting direction
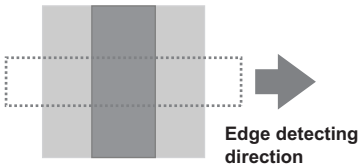
After the filter width setting is changed (filter width = 30)

Edge detecting direction
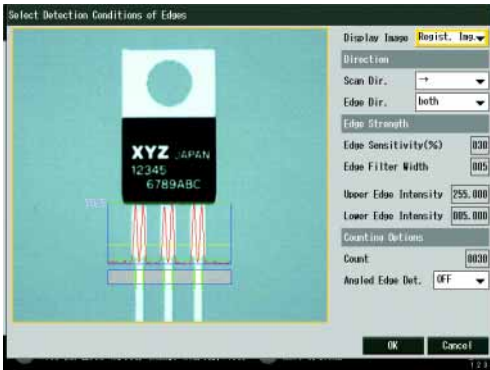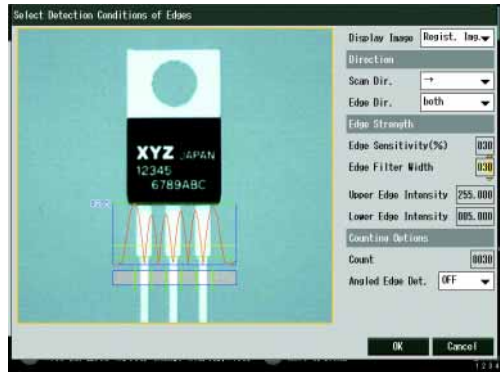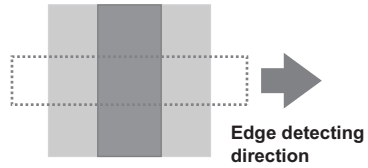
What is the Stain Grouping Function ?

Stain grouping function in the stain tool (Page 4-144) allows the successive small areas that have been detected as a stain segment to be measured as a group.

A normal stain detection detects the segment with the maximum intensity difference (stain level) among a multiple number of segments (this number represents total amount of stains) that exceeded the threshold values of stain level within a measurement area. The stain grouping function treats successive segments that exceeds the stain level threshold value as a group to be processed. This function is useful when trying to count the total number of flaws detected and obtaining positional information for each flaw.

When detecting a position

Stain grouping function [OFF]
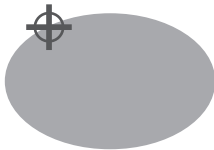
The position of the segment that has the maximum intensity difference is detected.

Stain grouping function [ON]
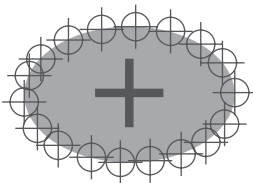
Several segments can be grouped and its center of gravity can be output in coordinates.

Reference

The detection segment in the illustration is a conceptual image and different from an actual representation. Check the segment distribution in the contrast view of the filtered image.

When detecting a large flaw such as smear

Stain grouping function [OFF]
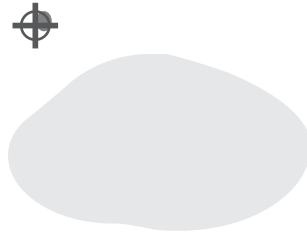
The position of the segment that has the maximum intensity difference is detected.

Stain grouping function [ON]
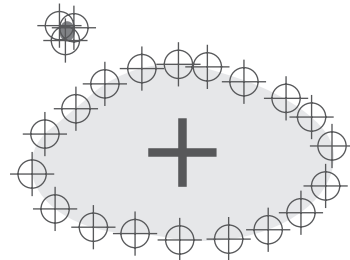
The group that has the larger number of segments (amount of stains) that exceeding the stain level (a subtle smear, in the example above) can be detected.

Reference

The detection segment in the illustration is a conceptual image and different from an actual representation. Check the segment distribution in the contrast view of the filtered pattern.

► Note

When [Ring] is selected for measurement window and [Ring direction] or [Radial direction] is selected for scan direction, the stain grouping function is disabled.

Appendix

ASCII Code Chart (Hexadecimal/Decimal Notation)

Characters that are recognized in OCR measurement mode can be converted from ASCII code (hexadecimal) into decimal values and output for calculation or terminal output processing. The following chart show the ASCII code (hexadecimal) and converted decimal values for written characters.

Symbols		-	.	/	:								
	Hexa-decimal	2D	2E	2F	3A								
	Decimal	45	46	47	58								

Numbers		0	1	2	3	4	5	6	7	8	9		
	Hexa-decimal	30	31	32	33	34	35	36	37	38	39		
	Decimal	48	49	50	51	52	53	54	55	56	57		

Letters		A	B	C	D	E	F	G	H	I	J	K	L	M
	Hexa-decimal	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D
	Decimal	65	66	67	68	69	70	71	72	73	74	75	76	77
		N	O	P	Q	R	S	T	U	V	W	X	Y	Z
	Hexa-decimal	4E	4F	50	51	52	53	54	55	56	57	58	59	5A
	Decimal	78	79	80	81	82	83	84	85	86	87	88	89	90

Custom characters		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
	Hexa-decimal	61	62	63	64	65	66	67	68	69	6A
	Decimal	97	98	99	100	101	102	103	104	105	106
		11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
	Hexa-decimal	6B	6C	6D	6E	6F	70	71	72	73	74
	Decimal	107	108	109	110	111	112	113	114	115	116

The custom characters use the ASCII code for a to t (lowercase letters).

Other		SPACE
	Hexa-decimal	20
	Decimal	32

Reference

When text is referenced with calculation, ASCII code for the first character is converted and output in decimal form.
EX: When the recognized text is "ABCD"
The ASCII code "41" for the first character "A" is converted into decimal form as "65". Therefore, when the text is referenced in calculation, "65" is used.

Troubleshooting

Symptom	Cause	Remedy
The system does not power-up.	The power cable is not connected properly.	Connect the power cable properly (Page 2-16).
The monitor screen is blank.	The power used is outside of the specified range.	Use power that is within the specified range (Page 2-16).
	The monitor cable is not connected.	Connect the monitor cable properly (Page 2-16).
	The power is not on.	Turn on the power. Use power that is within the specified range (Page 2-16).
	The monitor is not adjusted properly.	Adjust the brightness and the color of the monitor.
The menu is visible, but the camera image is abnormal or blank.	The lens focus or aperture is not adjusted.	Adjust the focus or the aperture (Page 2-19) of the lens.
	The shutter speed is not appropriate.	Set the shutter speed properly (Page 4-8).
	The lens or part of the CCD sensor is dirty.	Clean with an air duster.
	The camera cable is not connected properly.	Turn off the power, and then connect the camera cable (Page 2-15).
	The lens cap is on.	Remove the lens cap.
	The lens aperture is closed too much.	Adjust the aperture to the appropriate width (Page 2-19).
Cannot operate on the console.	The console is not connected properly.	Connect the console properly (Page 2-15).
	The console operation is locked by the communication command LK (Page 9-31).	Release the lock using the communication command.
Cannot communicate over RS-232C.	The communication cable is not connected properly.	Check the wiring, and connect the power cable properly (Page 2-16, Page 10-6).
	An appropriate communication cable is not used.	Verify that the correct cable is being used (Page 9-2).
	The communication condition of the personal computer is not set properly.	Change the communication settings of the personal computer.
	The RS-232C port is locked by the communication command LK (Page 9-31).	Release the lock using the communication command.
	Even if the flow control is set in the communication settings, it is not controlled properly.	Check the wiring and the setting of the communication destination.
	A voltage potential difference has been generated between the system and the SG (signal - ground) of the communication destination.	If the power supply unit of the system is different from that of the communication destination, check whether the frame ground of both units is grounded properly.

Appendix

Symptom	Cause	Remedy
The OK/NG value and the measured value are not transmitted.	The output circuit is not connected properly.	Connect the output circuit properly referring to the output circuit diagram (Page 11-12).
	The outputs have not been configured.	Configure the output settings to send the desired data in the OUTPUT menu (Page 4-278).
	The system is not in RUN mode.	Use the switch on the console to switch to the run mode (Page 5-1).
	The tolerance is not set properly.	Confirm the tolerance settings.
	The position of the window has deviated.	Perform the Image Registration setting (Page 4-18) again. If the position of the target is continually deviating, use the Position Correction function (Page 4-249).
	The intensity of the light is not stable.	Use a stable light designed for image processing (Page 2-21).
	TEST pin is ON.	Set the TEST pin to OFF.
	Failed to open the USB communication port.	Restart the communication software on the personal computer.
The personal computer freezes during USB communication.	An operating system before Windows XP SP1 is used.	If you use Windows XP, use the version of SP2 or later.
	The version of the USB driver is old.	Install the latest driver in the personal computer.
The duration of measurement is prolonged after running for a while.	The output buffer overflows.	• Reduce the number of output items. • Shorten the output cycle time for the port.
Cannot input the trigger.	EXT port is ON.	Set the EXT port to OFF.
	Trigger input is not enabled in the trigger setting of image input settings.	Put the tick mark in the check box of the equipment with which you want to input the trigger (Page 4-14).
	The device input is disabled by the LK command.	Enable the desired device to input the trigger by using LK command (Page 9-31).
	The trigger 1 and trigger 2 are mixed up.	Confirm the trigger to input.
	A trigger is input using Trigger 1 while Trigger 2 is set to be used.	Use the correct trigger to input.
The screen cannot be updated.	The NG screen is set in the Display template setting.	Set it to current image update.
The result display is not updated.	A screen is highlighted which has been set to trigger delay in the Display template.	Move the highlight to a screen that has been set to the result display.

Error Messages

Message	Cause	Remedy	Operates with ERR terminal output
A camera has been undetected. Please power down the unit.	Error occurred in the connection with the camera.	• Turn on the power and check whether the camera has been disconnected. • Check that the camera is properly connected. • Check if the camera cable is disconnected.	ON
	The camera is used in an environment outside the specification. (e.g. The ambient temperature of the camera is beyond the specification. The camera cable that is not supported is used.)	• Check the ambient temperature. • Use a camera cable that supports the camera.	
Window settings are referring to an unconnected camera. (Displayed when switching from Program to Run mode.)	A camera that is connected is different from what is set. (e.g. A 2-megapixel camera is connected, while a 320,000-pixel camera is set.)	• Confirm that the type of camera that is connected and the setting contents are the same. • Select [Auto] in the [Camera] - [Type] setting.	ON
	A camera is specified in the inspection window that is not connected. (e.g. While camera 2 is specified in the Window No. 000, camera 2 is not connected.)	Turn off the power and connect the specified camera.	
The camera is not supported.	A camera that is not supported for the system is connected. (e.g. The CV-200C is connected to a CV-3001.)	• Confirm the model of the camera that is connected. • Specify a camera that is connected to the system, in the camera settings on the inspection window.	ON
Failed to access internal memory.	Access to the internal memory has an error.	• Perform [Check] of the internal memory using the memory utility from the [Utility] - [View Files] menu. • If the error persists, initialize the internal memory. (Note that all the data in the system is deleted when initialization is performed.) • If the problem cannot be resolved by any of these remedies, a failure in the internal memory is suspected. Contact your local Keyence office.	ON

Appendix

Message	Cause	Remedy	Operates with ERR terminal output
Internal memory is full.	Inadequate capacity of the internal memory.	• Make space available by deleting program data and registered image data. • Insert the memory card and change the save destination to the memory card.	OFF
Unable to find previously selected program in the internal memory	The program file that has been used last time is broken or deleted.	Create a new program file or change to the program No. of the program file that is successfully created.	ON
Please insert the memory card.	The memory card is not inserted.	Insert the memory card properly.	ON/OFF* (See page 13-26)
	After performing [Eject card] and removing the memory card, it is not inserted again.	If the memory card is already inserted, remove it first, and then insert it again.	
	A memory card is used that is not supported.	Operations of the commercial compact flash memory card cannot be guaranteed in the system.	
Failed to access Memory card.	Access to the flash memory card has an error.	• Perform [Check] of the memory card using the memory utility from the [Utility] - [View Files] menu. • If the error persists, perform [Format]. (Note that all the data in the memory card is deleted when formatting is performed.) • If the problem cannot be resolved by any of these remedies, a failure in the memory card is suspected. Contact your local Keyence office.	ON/OFF* (See page 13-26)
	The format of the memory card is not supported by the CV	• Perform [Check] of the memory card using the memory utility from the [Utility] - [View Files] menu. • If the error persists, perform [Format]. (Note that all the data in the memory card is deleted when formatting is performed.) • If the problem cannot be resolved by any of these remedies, a failure in the memory card is suspected. Contact your local Keyence office.	
	The memory card is used that is not supported.	Operations of the commercial compact flash memory card cannot be guaranteed in the system.	

Message	Cause	Remedy	Operates with ERR terminal output
Failed to access Memory card. (continued)	The setup data of the second edition or later is loaded to the unit of the first edition.	Program data is not backwards compatible, and therefore data cannot be used if it was created with a version that is newer than the current controller version. Use program data that was created with a first edition controller.	ON/OFF* (See page 13-26)
Memory card is full.	Inadequate capacity of the memory card.	Make space available by deleting the data in the memory card.	ON/OFF* (See page 13-26)
Please execute "Eject card" before ejecting your card. Your card and files may be corrupted.	The memory card has been removed without performing [Eject card].	After performing [Eject card] in the [Utility] menu, remove the memory card. If a memory card is removed while it is in conduction, the memory card and the data contained may be damaged.	OFF
An RS-232C communication time out error has occurred.	Communication via the RS-232C port cannot be performed for more than 60 minutes although the data output to the RS-232C port is set in the output settings.	• Check whether the flow control is set to [Enable] in the RS-232C setting. • Check whether the flow control is performed by the hardware flow. • Check if the cable is disconnected.	ON
Ethernet cable is not connected.	The Ethernet cable has an error while the data output to the Ethernet port is set in the output setting.	• Check that the Ethernet cable is connected to the controller and the personal computer. • Check if the Ethernet cable is disconnected. • Check the type (cross, straight) of the Ethernet cable. • Check that the orange lamp of the Ethernet connector is lit.	ON
An Ethernet communication time out error has occurred.	Cannot perform Ethernet communication for more than 10 seconds while the data output to the Ethernet port is set in the output setting.	• Check whether the connected personal computer is able to transmit/receive data. • Check that the communication software for Ethernet is running on the personal computer and connection is established with the controller.	ON
Ethernet communication has failed.	The Ethernet communication has an error while the data output to the Ethernet port is set in the output setting.	• Check whether the connected personal computer is able to transmit/receive data. • Check that the communication software for Ethernet is running on the personal computer and connection is established with the controller.	ON

Appendix

Message	Cause	Remedy	Operates with ERR terminal output
USB cable is not connected.	The USB cable has an error while the data output to the USB port is set in the output setting.	• Check that the USB cable is connected to the controller and the personal computer. • Check if the USB cable is disconnected. • Check whether the cable that supports USB 2.0 is used. • Change the connection speed to low in the USB setting in the Global Settings. • Install the latest driver in the personal computer.	ON
A USB communication time out error has occurred.	Cannot perform USB communication for more than 10 seconds while the data output to the Ethernet port is set in the output setting.	• Check whether the connected personal computer is able to transmit/receive data. • Check that the communication software for USB is running on the personal computer and connection is established with the controller. • Check whether the cable that supports USB 2.0 is used. • Change the connection speed to low in the USB setting in the Global Settings. • Install the latest driver the personal computer.	ON
USB communication has failed.	The USB communication has an error while the data output to the USB port is set in the output setting.	• Remove the USB cable and restart the personal computer, and then reconnect the USB cable. • Check whether the connected personal computer is able to transmit/receive data. • Check that the communication software for USB is running on the personal computer and connection is established with the controller. • Check whether the cable that supports USB 2.0 is used. • Change the connection speed to low in the USB setting in the Global Settings. • Install the latest driver in the personal computer.	ON
PLC communication has failed.	The connection with the PLC has an error while the [PLC link] is set for the RS-232C communication mode in the Global Settings.	• Check the connection with the PLC and settings of the PLC. • If PLC link is not used, reset the RS-232C communication mode to [No protocol]. • If the data is displayed with the trigger input, check that the data memory in the destination is specified in the range that meets the PLC format.	ON
Window memory is full.	Inadequate capacity of the window memory.	• Window memory is consumed every time measurement area or mask area is added or pattern window is set. • Delete a measurement area or mask area, or reduce the size of these areas.	OFF

Message	Cause	Remedy	Operates with ERR terminal output
Too many output items.	Inadequate capacity of the memory to output the result.	• The memory to output results is consumed each time a setting is performed in the [Output settings]. • Decrease the number of results to be output. • If you set that all the results should be output on a window in which a lot of detected items are set, the memory consumption increases. In this case, delete the items from the output setting and reduce the number of detected items set in the window, and perform the setting again.	OFF
Lost link(s) were found,and were convered to [FILEXXX.CHK].	The check error was found by the memory utility, but it has been restored successfully.	You can continue to use it.	OFF
• Internal memory check failed. • Memory card check failed.	The check error was found by the memory utility, and the error has not been resolved.	• If the error persists even if check is performed repeatedly, contact your local Keyence office. • In some cases, error might be resolved when formatting the memory card (Page 6-21) and performing the check again. However all the data contained in the card is lost.	OFF
Result are not available. Number of segments must be less than ***. (*** varies depending on the conditions)	The total number of detected items for pattern search, edge position, edge width, edge pitch, pair edge, stain, or blob in a single program exceeds the memory (result area) size for saving the detection result data.	• Reduce the number of detection items for each inspection window to the minimum. • Set the Edge graph in the edge detection process to OFF. (The result memory area is also consumed by setting the edge graph in the edge detection process to ON, where the default is OFF.)	OFF
Result are not available. Number of segments must be less than ***. (*** varies depending on the conditions)	The setting for trend edge position and trend edge width exceeds the memory (result area) size for saving the detection result data.	Change the segment size or amount of shift to decrease the number of segments.	OFF
Loading global settings failed.	Inadequate capacity of the internal memory.	Reduce the number of files in the internal memory.	OFF
Load failed.	Available free space is insufficient in the device (internal memory or memory card) to which the data is saved.	Make space available by deleting files.	OFF
Save failed.	Available free space is insufficient in the device (internal memory or memory card) to which the data is saved.	Make space available by deleting files.	OFF

Appendix

Message	Cause	Remedy	Operates with ERR terminal output
Insufficient number of patterns.	The number of settings has reached the upper limit (256) for the number of pattern areas that can be set in one program No.	Delete measurement windows that are not needed in the search, or reduce the number of registered patterns in Pattern sort.	OFF
Insufficient number of items.	Either the number of settings has reached the upper limit (256) for the number of items that can be set for one program No. in active text display for the custom menu, or there are not enough open items when copying a table.	Delete unnecessary items.	OFF
Failed to change the program. Incompatible program file.	• The data in the specified program file is corrupted and cannot be used. • The data in the specified program file was created with an incompatible version.	Change the program file to another file. Create a program file with a compatible version.	ON
Failed to save the library.	The specified library file is read only and cannot be overwritten.	Remove the read only attribute from the file on the computer.	OFF
The data is exceeds the library file capacity. It cannot be registered.	Attempting to register more than 200 characters in the library.	A maximum of 200 characters can be registered in one library. Delete unnecessary characters.	OFF
Measurement area and color settings are required.	Attempting to open library settings without configuring the measurement area or color (when a color camera is connected).	Set the color and measurement area before opening.	OFF

*   The ERR terminal output operation can be turned on or off for error messages related to the memory card. (Default: ON (operates with the ERR terminal output).)
    See "Changing Error Messages and ERROR Output for Memory Cards (Memory Card ERROR Output)" (page 7-17) for more details.

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Revision History

Date of printing	Version	Revision contents
April, 2007	Official release	Second edition III compliant version
June, 2007	2nd edition	

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