

Panasonic®

Image Processor for FA
IMAGECHECKER

PV500

[Basic course] Training Text



May 2008

Matsushita Electric Works, Ltd.
Automation Controls Business Unit
Automation Controls Device Division

Preface

Thank you for selecting or evaluating our Imagechecker PV500 (hereafter "PV500").

PV500 is an image-processing device built on our image processing technology accumulated for many years. PV500 simultaneously achieves ease of use, high speed, and high performance, by complete pursuit of functions and performance based on our customers' needs and our hands-on experience and expertise.

This text is for trainings, such as our FA Seminars, where participants can learn about the functions and basic usage of PV500. It is also useful after introduction for installing and using of PV500.

In addition to this text, the following manual is available on PV500:

- User's Manual

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Chapter 1

What is Imagechecker?

1.1 Why We Use Imagechecker

"Imagechecker" is the product name of image processing devices produced by Matsushita Electric Works, Ltd.

Imagechecker is device for automating and simplifying visual inspections, which had relied on the human eyes. Replacing the human eyes, the devices can inspect the products by processing images taken by **cameras**. Using cameras provides:

Complicated inspections with multiple conditions

without touch, those were impossible by optical sensors, proximity switches, or applications of actuators. Imagechecker also provides

Stability of inspections

because Imagechecker have no obsceneness of the standards, unevenness, instability or carelessness that visual inspections might have. In addition, the device accomplishes

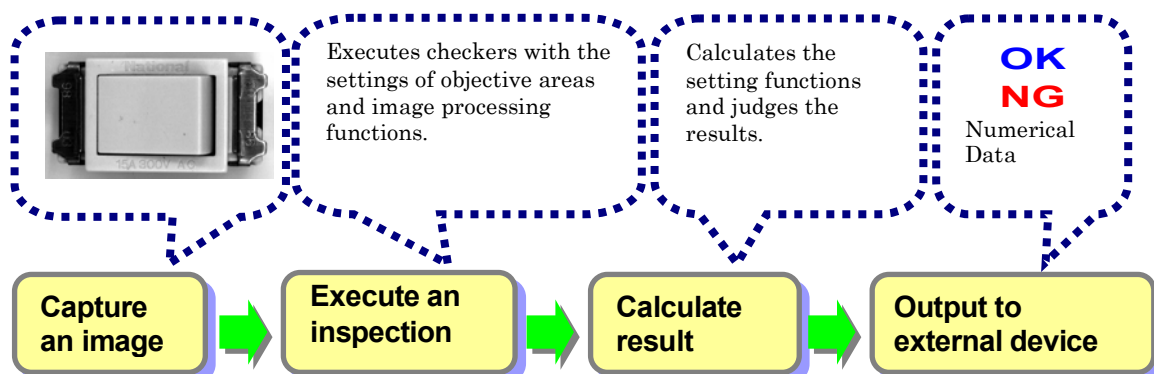
High-speed and high-precision inspection that is difficult or even impossible for human eyes

Imagechecker at your production facilities will solve your problems with visual inspections such as:

- **Cutting down the inspection costs**
- **Reducing oversights and mistakes**
- **Expediting the operations**
- **Improving precision**

1.2 Imagechecker Operation Sequence

Imagechecker processes “inspections” set in advance when the external device signals to start. The operation sequence of “inspections” is shown below.



1. Capture an image

Capturing a contrasty image is important to allow camera distinguishing the area to inspect. To inspect an image appropriately, you must carefully select not only cameras and lens but also lighting equipment and the way of illumination. It is the hardest but the most important to capture an appropriate image in image processing.

2. Execute checkers

A checker is a basic unit for image processing in Imagechecker. PV500 has several types of checkers such as the following: Binary Window counts the number of white or black pixels to measure the black area of the object, and Gray Edge detects coordinates of the edge to measure the length of the object. Each checker outputs individual results.

3. Calculate

Most inspections use the results of more than one checker to calculate and judge. Using them, numeric calculations and logical operations lead a final result.

4. Output to external devices

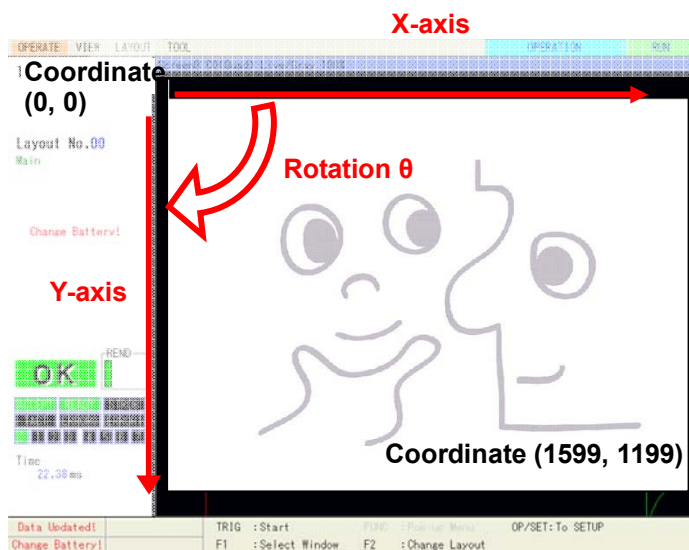
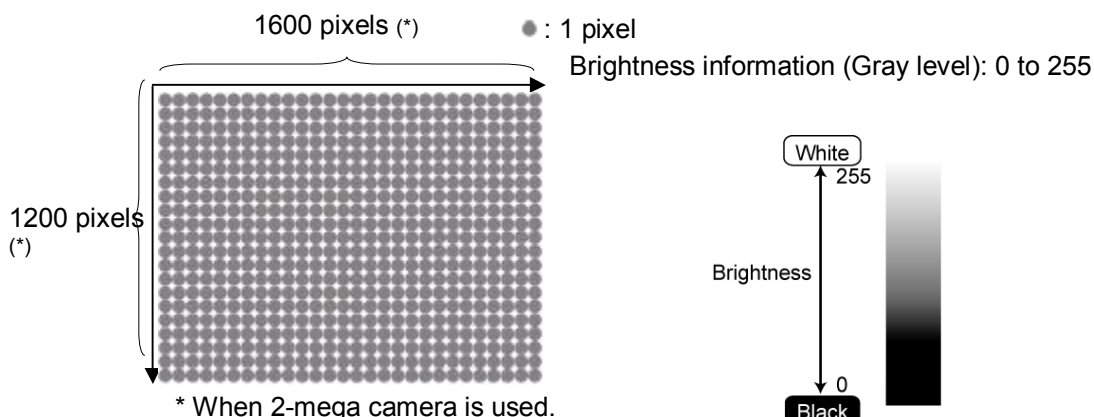
Numeric calculation results and judgments can be output to external device through specified interfaces. The PV500 supports the following communications: maximum of 16-bit parallel output, RS-232C serial output, Ethernet, and SD memory card.

1.3 Inspection Images for PV500

■ About Image Data

A camera-captured image consists of pixels or the smallest units of an image. PV500 captures an image in 1600 pixels horizontally and 1200 pixels or 640 pixels horizontally and 480 pixels vertically. The number of pixels varies depending on using camera.

PV500 uses monochrome cameras and each pixel has 8-bit grayscale value from 0 to 255. Using an image with 256 gradation levels and differences of grayscale levels to contrast each pixel, the gray image processing is strong for brightness changes and allows stable inspections. The example below describes 2-mega-pixel digital camera we will use in this training.



PV500 has a coordinate system as the left image.

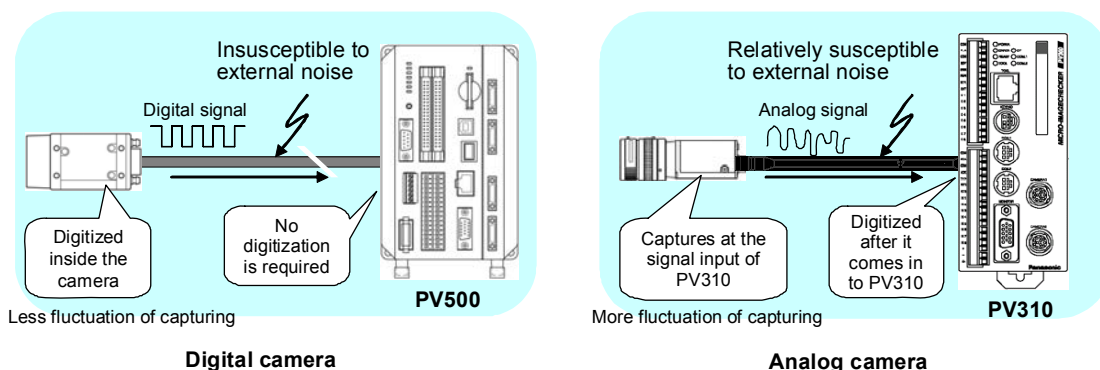
X axis is in the horizontal direction and Y axis is in the vertical direction. Rotation angle, theta is clockwise. The coordinate at the upper left of the screen is (0, 0) and the bottom right is (1599, 1199) for 2-mega camera and (639, 479) for ultra compact camera.

"X-coordinate" or "Y-coordinate" described in the setting of checkers and inspection results are based on this coordinate system.

You can change the positive direction and the original point of axes as necessary.

■ Digital Cameras for PV500

PV500 uses digital cameras instead of analog cameras used by the earlier models. Compared with analog cameras, digital cameras have the features shown below:



Thanks to these features, digital cameras allow higher precision inspection with its unsusceptibility to noise and less fluctuation in capturing quality.

■ Camera Type

PV500 connects three types of cameras shown in the table below. You can select one of the cameras according to the conditions including size of inspection object, required accuracy, and inspection time. To make setting of connecting camera, select "ENVIRONMENT" > "Camera" and "TYPE" > "Type Setting" > "Camera Setting".

	2-mega-pixel Digital Camera (ANPVC1210)	Quad-speed Digital Camera (ANPVC1040)	Ultra Compact Double Speed Digital Camera (ANPVC1021)
Number of Pixels	2 million pixels (1600 x 1200)	300 thousand pixels (640 x 480)	
Image transferring Time	Approximately 34 ms	Approximately 9 ms	Approximately 17 ms

* This manual describes the cameras as follows.

2-mega-pixel Digital Camera = 2 Mega camera

Quad-speed Digital Camera = Quad-speed camera

■ Processing Captured Images

PV500 connects up to four cameras (for four-camera type product). And you can use three types of cameras at the same time as necessary. Connecting cameras are Camera 0, Camera 1, Camera 2, and Camera 3, as indicated next to each camera connector of PV500. PV500 has inspection image memories for each camera inside and captured images are stored in the each designated memory (Memory 1 for Camera 1, Memory 2 for Camera 2, Memory 3 for Camera 3).

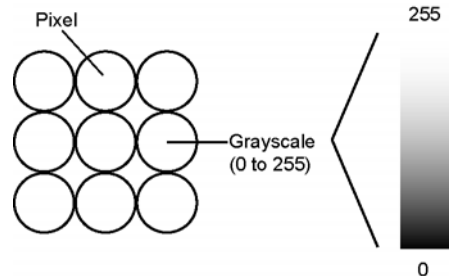
■ Displayed Image Type

PV500 is an image processor for gray scale processing.

The device displays camera-capturing images in two types of method, “Gray Scale Image” and “Binary Image”. You can change the type by operating the <F1> key menu, “Memory/Live” > “Gray/Binary”. (When you set checkers, an image on the screen switches between gray and binary; to a gray image in the checkers perform gray processing and to a binary image in the checkers perform binary processing.)

What is Gray Scale Image?

Captured signals of image data have various level of brightness. PV500 divides the signals in 256 levels of brightness and stores them as an image to display. This image is “gray scale image”. and just like a photo taken with monochrome camera.



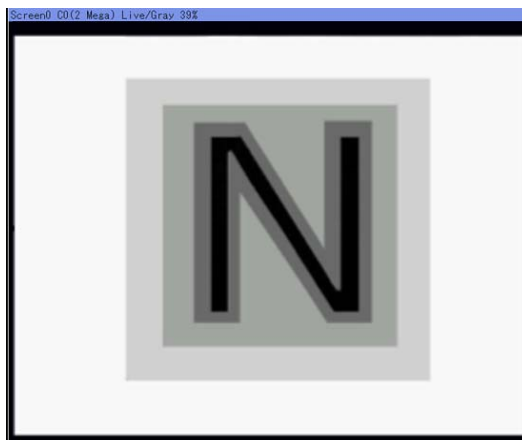
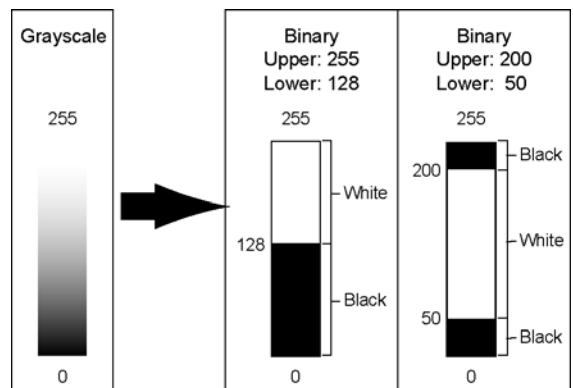
What is Binary Image?

Binary Image is a gray scale image that whitens all pixels within the certain range of gray scale and blackens the rest of pixels. Gray area, which a gray scale image has, does not exist.

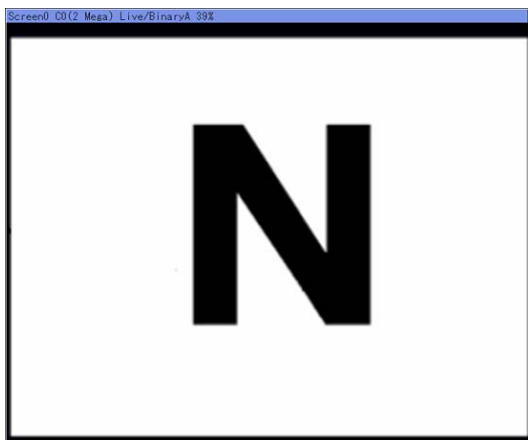
The gray scale, which divides white and black range, is a slice level.

The smaller color information of a binary image that is binary (white and black) information speeds the process of checkers comparing to inspections with a gray scale image.

Note that if the brightness of the image or an inspection object changes during inspection, a pixel may change from white to black or black to white.



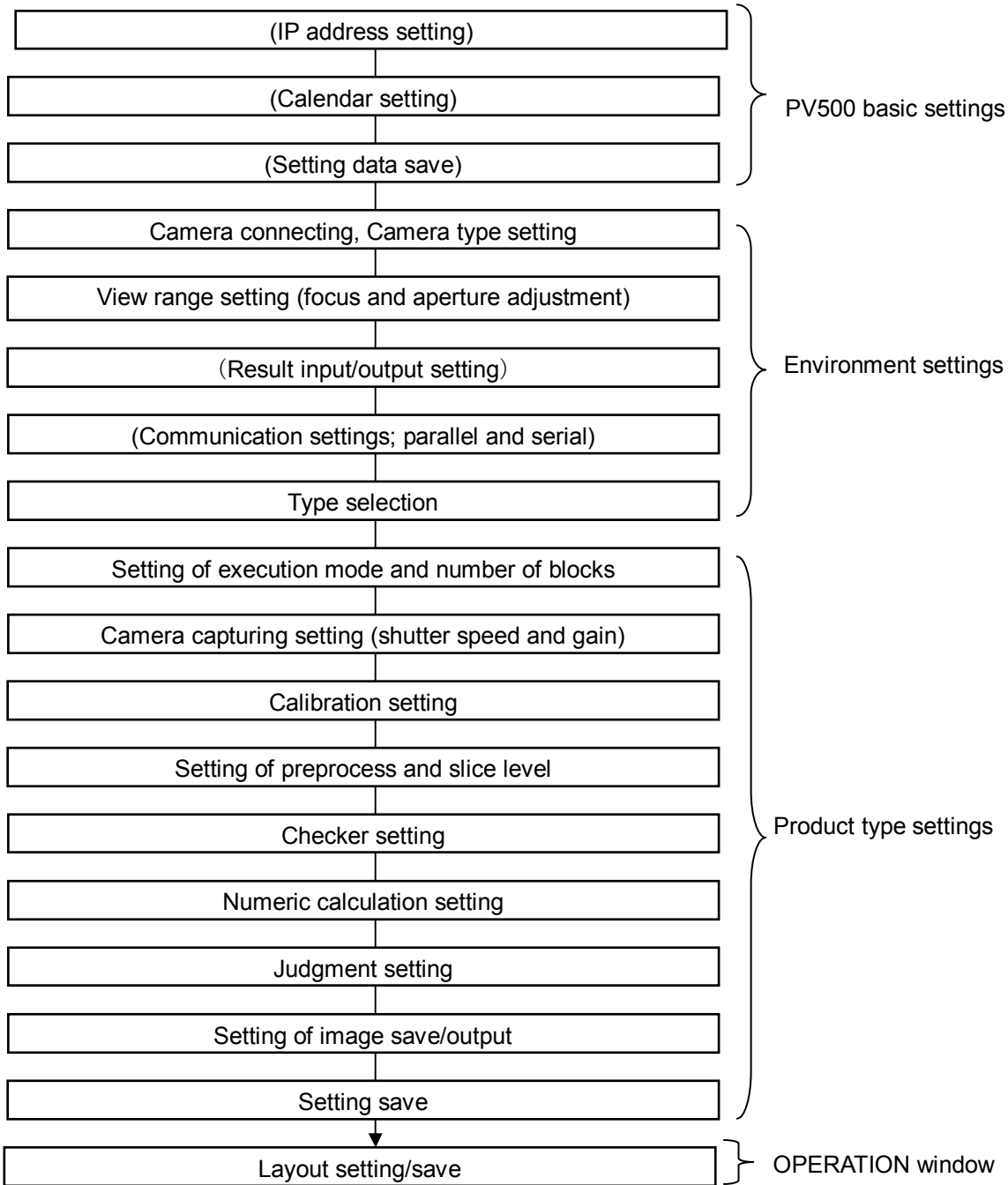
Gray scale image



Binary image

1.4 PV500 Inspection Procedure

The general setting procedure for inspection with the PV500 is as described below. Every step is not always needed and you can skip some steps depending on the condition.



NOTE

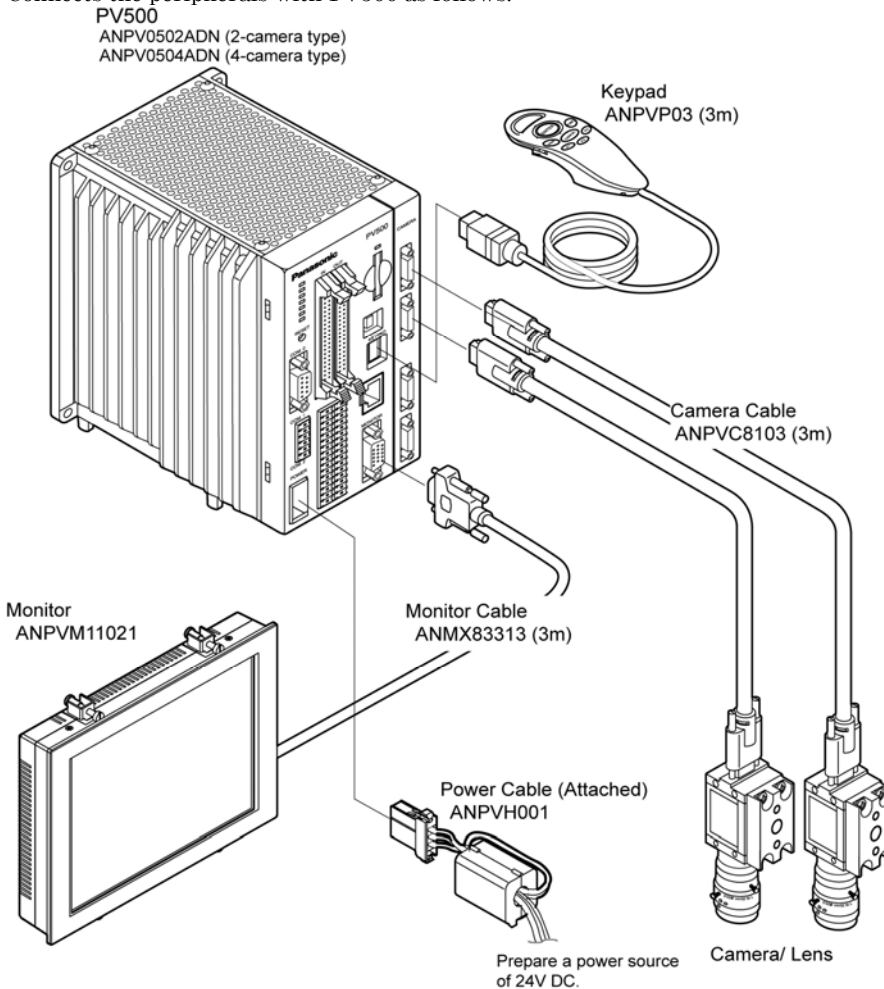
- PV500 requires basic settings, such as the setting of calendar and IP address, only once when you install it. Be sure to save them after you modify the settings of [Configuration].

Chapter 2

Settings and Basic Operations

2.1 Connecting Peripherals

Connects the peripherals with PV500 as follows.



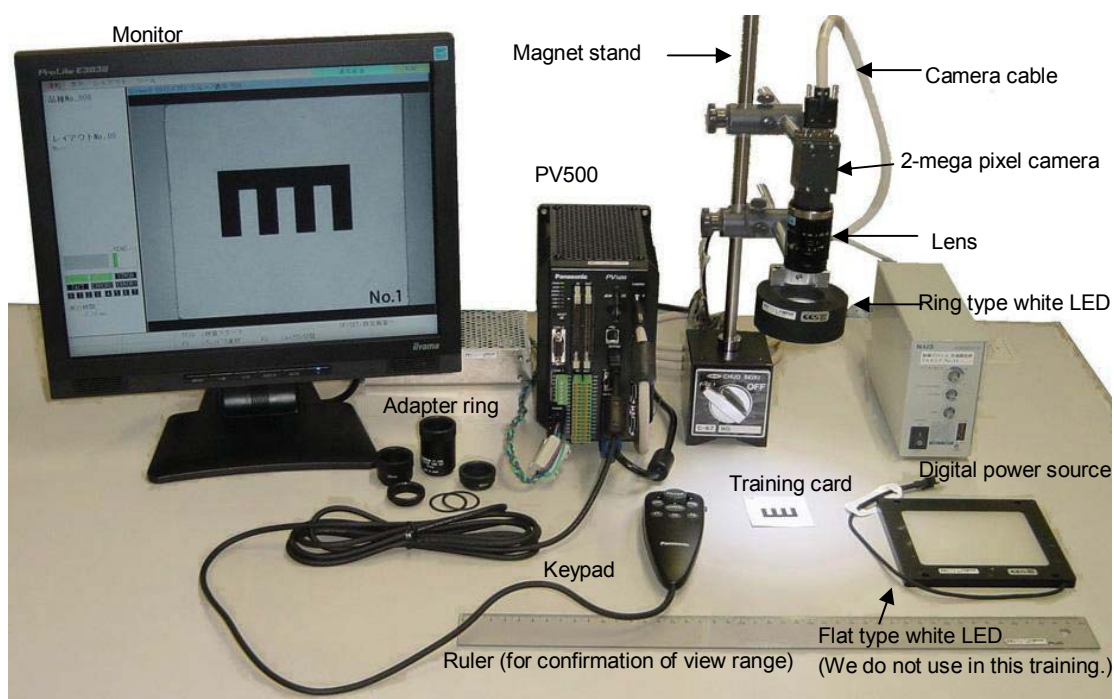
In this training, we have the following conditions;

- Although we will connect PV500 with a PC in the last half, we will not use designated tool software, AXTOOL Ver.3.
- We will not use a memory card (SD card).



- Make sure to turn the power OFF for PV500 before connecting. Otherwise, damage might cause.

Here is the aspect of setting.



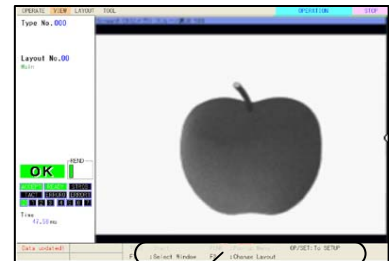
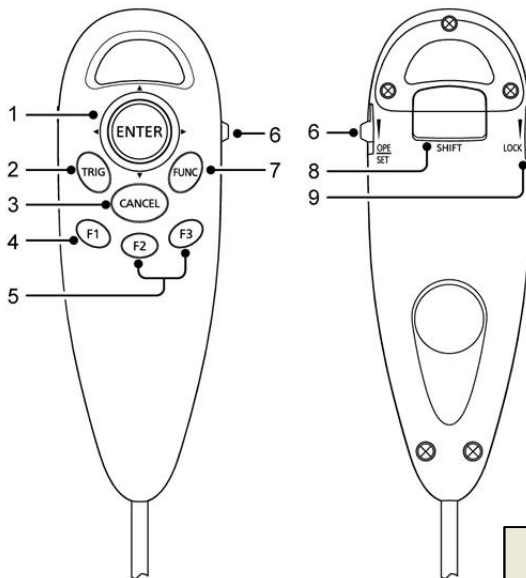
We use training cards for the exercises instead of practical works. (Training cards are in the appendix at the end of this training manual.) To inspect certainly, the objects printed on the training cards are clear and contrasty. However, because the ceiling lighting is generally unstable for adjusting focus or aperture of a camera, we have the special lightings for the training.

We have two types of lightings, ring-type white LED illumination and flat-type white LED illumination. We will use the ring-type lighting in the training. (The above picture shows also flat-type lighting for your guidance.) Mount the ring-type lighting between a camera and a work (training card) as the picture. The vertical position of the lighting should not be so strict thanks to the contrast of the training cards; about the lighting position in the picture is appropriate.

- If the lighting is too far from the work, it results in less illumination.
(You can adjust the light intensity with the designated digital light controlling power.)
- If the lighting is too close to the work, the camera captures the lighting itself.

For trainings, this is enough consideration of lightings. However, in actual inspections, you need more consideration of lighting types and capturing way to capture various works.

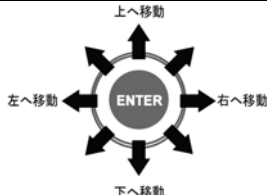
2.2 Keypad



Key operation guide

TRIG : Start	FUNC : Pop-up Menu	OPE/SET : To SETUP
F1 : Select Window	F2 : Change Layout	

Names and Descriptions

1	ENTER key	Cursor Operation To select the menu, input letters and move the start and end points of areas. 
		Determination Operation To determine the settings or select menu. 
2	TRIG Key (TRIGGER)	To start an inspection or run a test.
3	CANCEL Key	To return to the previous window or operation while setting.
4	F1 Key	Mainly to display the image menu.
5	F2, F3 Key	Use these keys when key guide is displayed in the bottom of the window.
6	OPE/SET Switch	To switch windows between SETUP and OPERATION. This is a snap type switch and the window switches every time you snap it.
7	FUNC Key (FUNCTION)	To display pop-up menu. Pressing it 2 seconds or more takes a printscreen (screen display copying).
8	SHIFT Key	Use when "SHIFT" sign is shown on the screen. Mainly, to make the cursor move faster combining with cursor operation. "SHIFT" sign is shown when you select a Product type or a checker and set an inspection area.
9	LOCK Switch	To lock or disable the 1 - 8 keys by setting in "LOCK" side. The switch prevents undesired operation of the keys by mistake.

In the key operation guide field on the screen, the information whether the following keys can be used and their operations; TRIG key, F1 key, F2key, F3 key, OPE/SET switch, FUNC key, and SHIFT key.

2.3 Initializing Environment Settings

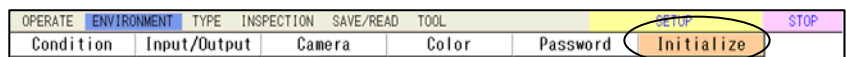
We will configure the initial settings of PV500 environment for this training.

Environment is the common setting for all product types to make a suitable environment for inspections such as setting of camera or communication.

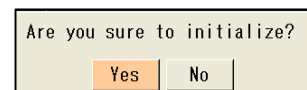
1. Press the “OPE/SET” key in OPERATION window to display the menu bar. Next, use the right/left arrow keys (← and →) to move the cursor onto "ENVIRONMENT", and then press the ENTER key.



2. Use the right/left arrow keys (← and →) to move the cursor onto "Initialize", and then press the ENTER key.



3. The message below appears. Select "YES" and press the ENTER key.



Now, initializing Environment is completed.

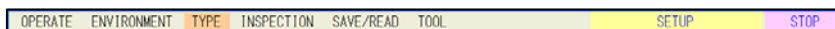
2.4 Initialization of Product Type

Product Type is a group of settings which are necessary to execute an inspection such as image capturing setting of camera, inspection area, and conditions of inspection method.

Multiple types can be registered. You can continue inspections simply by switching to the registered type even if you need to inspect on the object with different conditions.

The PV500 allows you to save 25600 sets of inspection conditions. You can set a title for each product type. In this chapter, we will initialize and set a product type of PV500 to use in the training.

1. Press the "OPE/SET" key in OPERATION window to switch to SETUP window. Next, use the right/left arrow keys (← and →) to move the cursor onto "TYPE", then press the ENTER key.



2. Use the right/left arrow keys (← and →) to move the cursor onto "Select Type", and then press the ENTER key.

The list of set Product Types appears on the screen.

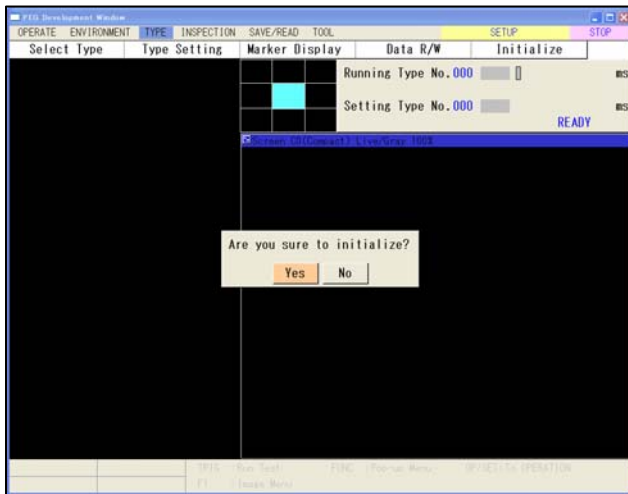
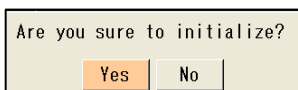
For this training, initialize the all types firstly.



3. Press the CANCEL key to move the cursor onto "Select Type". Press the right arrow key (→) to select "Initialize", and then press the ENTER key.



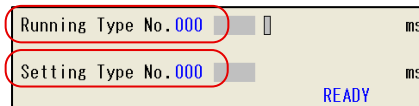
4. The message below appears. Select "YES" and press the ENTER key.



Initialization of all product types completed.

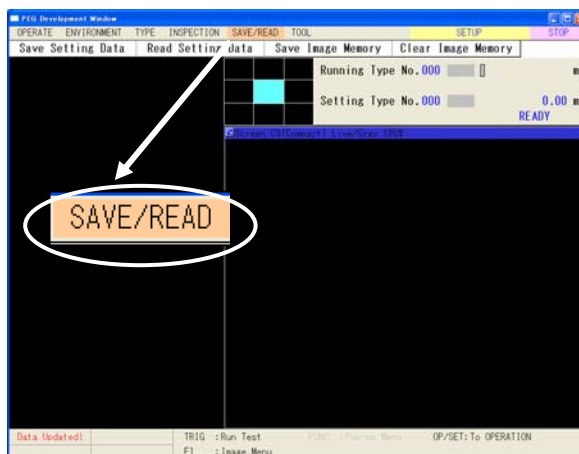
Be sure to save the new settings, otherwise the PV500 clear unsaved settings when the device turns off.

Right after initialization, PV500 creates a new type in No.000. Confirm that "000" is shown for Running Type and Setting Type in the information display area.



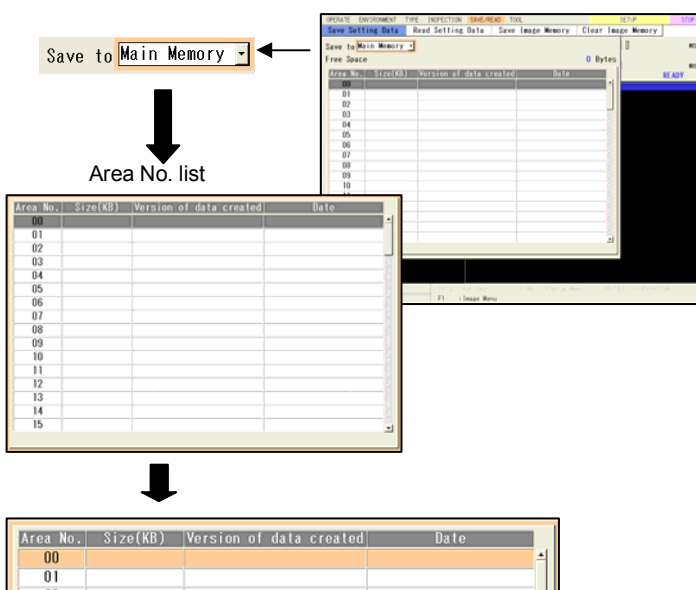
5. Store the setting data in PV500.

Move the cursor to **“SAVE/READ”** and press the ENTER key. Move the cursor to **“Save Setting Data”** and press the ENTER key.



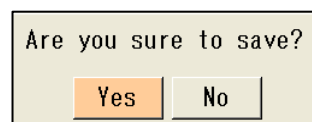
6. The cursor moves to “Save to”. Confirm that “Main Memory” is selected.

Use the up/down arrow keys (↑ and ↓) to the cursor onto the Area No. list and press the ENTER key.

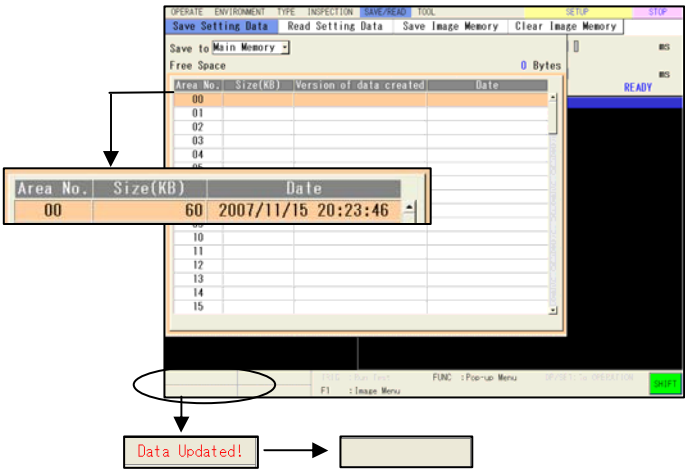


7. The cursor moves to “00”. Save the current information in the area of No.000. Press the ENTER key on “00”.

The message appears as the right figure. Confirm that the cursor is on **“Yes”** and press the ENTER key. The settings we set have been saved in PV500, excluding lens aperture and focus.



8. Observe the size and date of the saved data in the field of “Size” and “Date” of Area No.00.



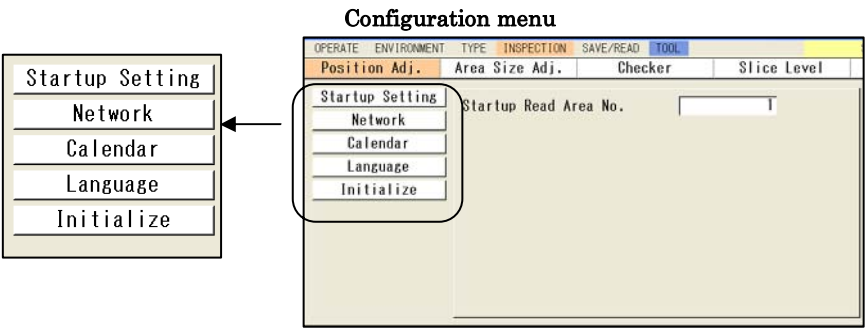
Plus, confirm that the sign saying “Data updated!” which was shown in the message area disappears.

Now, saving the setting data in PV500 is completed.

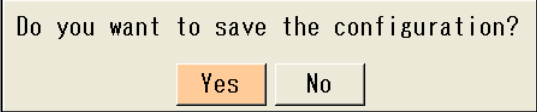


NOTE

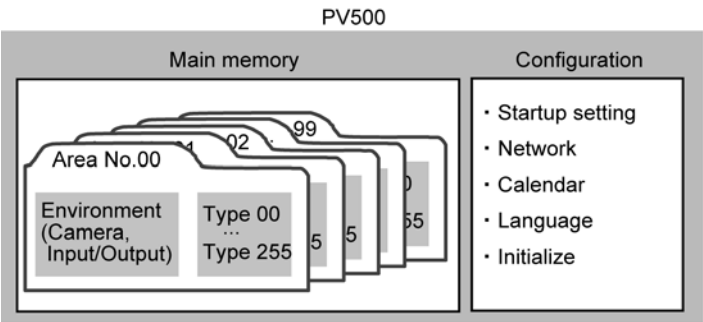
The settings saved in “Save Setting Data” in this chapter are conditions which you set in SETUP and OPERATION windows. Note that these conditions exclude the settings of “TOOL” > “Configuration” in SETUP window.



When you change or set the items of Configuration (“Startup Setting”, “Network”, “Calendar”, “Language”, and “Initialize”), the message appears as right figure.



To use the changed setting, select “Yes” and press the ENTER key and complete saving.



2.5 Initial Settings of Environment

1. Configure initial settings. Move the cursor onto "ENVIRONMENT" and press the ENTER key. Next, use the up/down arrow keys (↑ and ↓) to move the cursor onto "Camera" and press the ENTER key.

OPERATE	ENVIRONMENT	TYPE	INSPECTION	SAVE/READ	TOOL	SETUP	STOP
Condition	Input/Output	Camera	Color	Password	Initialize		

2. Move the cursor onto the "Camera" in the dialogue.

Confirm that "Connected Camera" of Camera No.0 is displayed as "2 Mega" which is currently connected.

OPERATE	ENVIRONMENT	TYPE	INSPECTION	SAVE/READ	TOOL	SET
Condition	Input/Output	Camera	Color	Password	In	
Camera	FLASH Polarity	Camera	Connected Camera	Camera Type		
Camera No.0	2 Mega	2 Mega				
Camera No.1	2 Mega	2 Mega				
Camera No.2	2 Mega	2 Mega				
Camera No.3	None	Unused				

3. Set "2 Mega" for "Camera Type" of Camera No.0. Press the Enter key. In the pulldown menu of Camera No.0, use up/down arrow keys (↑ and ↓) to move the cursor onto "2 Mega" and press the ENTER key.

Camera	Connected Camera	Camera Type
Camera No.0	2 Mega	2 Mega
Camera No.1	2 Mega	Ultra Compact
Camera No.2	2 Mega	Quad-speed
Camera No.3	None	Unused



NOTE

If the types for "Connected Camera" and "Camera Type" are different, PV500 cannot capture an image correctly.

Changing camera type initializes capturing conditions of cameras*. It is advisable to set the correct camera types before setting capturing conditions.

PV500 makes camera settings at its startup. When you changed the camera mode, you have to save the setting and then reboot PV500. This operation allows capturing an image correctly.

*Capturing condition of cameras: the following items can be set from "TYPE" > "Type Setting" > "Camera Setting";

- Shutter Speed
- Gain, Capture Delay
- Flash Delay (ms)
- Flash Span (ms)
- Partial Imaging
- Calibration

As you switch the camera mode, the message appears as the figure below.

If you change the camera type, the camera settings of all types using this camera will be initialized. Do you want to continue?
Yes No

2.6 Mounting the Camera, Lens, and Adapter Rings

2.6.1 View Range Table - Selection of Lens, Adaptor Rings, and Installation Distance of Camera

First, you need to decide range of capturing images (view range). Adjusting the distances between a camera and a lens, and a lens and an object gives you desired view range. Insert adapter rings between a camera and a lens to adjust the distance between them.

The View range table lists types of camera and lens, thickness of adapter rings, and distance to object.

2.6.1.1 2-mega-pixel Digital Camera (ANPVC1210)

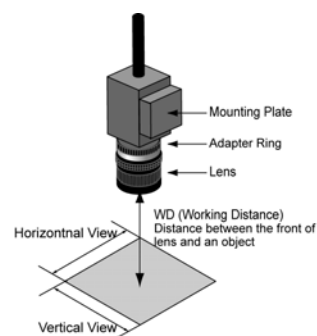
Select the appropriate lens and adapter rings from the table below to match the resolution and view range. Moreover, confirm the distance between the camera and the object. (The values in the table are around the focal point of ∞ , except as otherwise noted.)

Lens		ANPVL502 f=50 mm		ANPVL252 f=25 mm		ANPVL162 f=16 mm		Resolution $\mu\text{m}/\text{pixel}$	
View range (mm)		WD	Adapter ring	WD	Adapter ring	WD	Adapter ring	Ver.	Hor.
1	1.3	30	264					0.8	0.8
2	2.7	40	132					1.7	1.7
3	4.0	49	88					2.5	2.5
4	5.3	59	66					3.3	3.3
5	6.7	68	53					4.2	4.2
7.5	10.0	92	35					6.3	6.3
10	13.3	115	26	30	13			8.3	8.3
12.5	16.7	139	21	41	11			10.4	10.4
15	20.0	163	18	53	9			12.5	12.5
20	26.7	210	13	77	7			16.7	16.7
30	40.0	305	9	124	2(*2)	74	2(*5)	25.0	25.0
40	53.3	399	7	172	2(*3)	104	2	33.3	33.3
50	66.7	494	5	219	2(*4)	135	1.5	41.7	41.7
75	100.0	731	2(*1)	337	2	210	1	62.5	62.5
100	133.3	968	2	456	2	286	1	83.3	83.3
150	200.0	1441	2	693	1	438	0.5	125.0	125.0
200	266.7	1915	1.5	929	1	589	0.5	166.7	166.7
250	333.3	2388	1	1166	1	741	0.5	208.3	208.3
300	400.0	2862	1	1403	0.5	892	0.5	250.0	250.0
350	466.7	3335	1	1639	0.5	1044	0	291.7	291.7
400	533.3	3809	0.5	1876	0.5	1195	0	333.3	333.3
450	600.0	4282	0.5	2113	0.5	1347	0	375.0	375.0
500	666.7	4756	0.5	2350	0.5	1498	0	416.7	416.7
600	800.0	5703	0.5	2823	0	1801	0	500.0	500.0
700	933.3	6649	0.5	3297	0	2104	0	583.3	583.3
800	1066.7	7596	0.5	3770	0	2407	0	666.7	666.7
900	1200.0	8543	0.5	4244	0	2710	0	750.0	750.0
1000	1333.3	9490	0	4717	0	3013	0	833.3	833.3

variety of thickness: 0.5mm, 1.0mm, 5mm, 10mm, 20 mm, and 40mm.
Make the thickness of "Adapter ring" in the table by combining them.

Lens focal point differs from the others.

- *1: Around 2
- *2: Around the closest position
- *3: Around 0.5
- *4: Around 1
- *5: Around 0.3



WD: The distance from the front of the lens to the object
f: Focal length

The adapter rings come in a

2.6.1.2 Quad-speed Digital Camera (ANPVC1040)

(The values in the table are around the focal point of ∞ , except as otherwise noted.)

View Range (mm)		Lens		ANM8850 ANM88501 f=50 mm		ANB847L f=50 mm		ANB846NL ANM88251 f=25 mm		ANB845NL ANM88161(*1) f=16 mm		ANB 843L f=8.5 mm		ANB 842NL f=6 mm		Resolution $\mu\text{m}/\text{pixel}$	
		Ver.	Hor.	WD	Adapter ring	WD	Adapter ring	WD	Adapter ring	WD	Adapter ring	WD	Adapter ring	WD	Adapter ring	Ver.	Hor.
1	1.3	59	178	48	178											2.1	2.1
2	2.7	73	89	62	89											4.2	4.2
3	4.0	87	59	76	59											6.3	6.3
4	5.3	101	44	90	44											8.3	8.3
5	6.7	115	36	104	36	31	18									10.4	10.4
7.5	10.0	150	24	139	24	49	12									15.6	15.6
10	13.3	186	18	175	18	66	9	31	6							20.8	20.8
12.5	16.7	221	14	210	14	84	7	42	4.5							26.0	26.0
15	20.0	256	12	245	12	101	6	53	2(*2)							31.3	31.3
20	26.7	326	9	315	9	137	2(*2)	76	2(*3)	30	1.5					41.7	41.7
30	40.0	467	6	456	6	207	2(*3)	121	2	54	1	32	1			62.5	62.5
40	53.3	608	2(*2)	597	2(*2)	277	2	166	1.5	78	1	49	1			83.3	83.3
50	66.7	749	2(*3)	738	2(*3)	348	2	211	1	102	0.5	66	0.5			104.2	104.2
75	100.0	1101	2	1090	2	524	1	323	1	162	0.5	108	0.5			156.3	156.3
100	133.3	1452	2	1441	2	700	1	436	0.5	221	0.5	150	0.0			208.3	208.3
150	200.0	2156	1	2145	1	1052	0.5	661	0.5	341	0	235	0			312.5	312.5
200	266.7	2860	1	2849	1	1403	0.5	886	0.5	461	0	319	0			416.7	416.7
250	333.3	3564	0.5	3553	0.5	1755	0.5	1112	0	580	0	404	0			520.8	520.8
300	400.0	4268	0.5	4257	0.5	2107	0.5	1337	0	700	0	488	0			625.0	625.0
350	466.7	4972	0.5	4961	0.5	2459	0.5	1562	0	820	0	573	0			729.2	729.2
400	533.3	5675	0.5	5664	0.5	2811	0	1787	0	939	0	657	0			833.3	833.3
450	600.0	6379	0.5	6368	0.5	3163	0	2013	0	1059	0	741	0			937.5	937.5
500	666.7	7083	0.5	7072	0.5	3515	0	2238	0	1179	0	826	0			1041.7	1041.7
600	800.0	8491	0.5	8480	0.5	4219	0	2688	0	1418	0	995	0			1250.0	1250.0
700	933.3	9898	0.5	9887	0.5	4923	0	3139	0	1657	0	1164	0			1458.3	1458.3
800	1066.7	11306	0	11295	0	5626	0	3589	0	1897	0	1333	0			1666.7	1666.7
900	1200.0	12714	0	12703	0	6330	0	4040	0	2136	0	1502	0			1875.0	1875.0
1000	1333.3	14121	0	14110	0	7034	0	4490	0	2375	0	1671	0			2083.3	2083.3

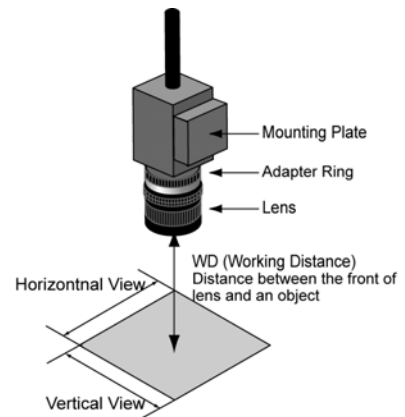
WD: The distance from the front of the lens to the object

f: Focal length

*1: WD= +4 mm

*2: Lens focal point is around the closest position

*3: Lens focal point is around the middle position

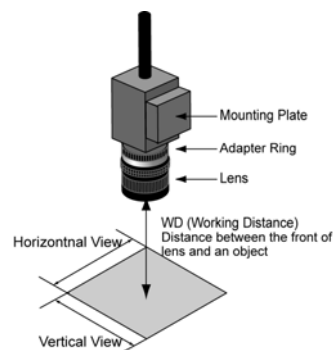


2.7 View Range Setting

For this training, we use the lens of $f=25\text{mm}$ and set the vertical view range to 50mm. Now, make a setting of view range.

■ Excerpton of the view range table for 2-mega-pixel digital camera

Lens		ANPVL502 f=50mm		ANPVL252 f=25mm		ANPVL162 f=16mm		Resolution $\mu\text{m}/\text{pixel}$	
View range (mm)		WD	Adapter ring	WD	Adapter ring	WD	Adapter ring	Ver.	Hor.
Ver.	Hor.								
10	13.3	115	26	30	13			8.3	8.3
12.5	16.7	139	21	41	11			10.4	10.4
15	20.0	163	18	53	9			12.5	12.5
20	26.7	210	13	77	7			16.7	16.7
30	40.0	305	9	124	2(*2)	74	2(*5)	25.0	25.0
40	53.3	399	7	172	2(*3)	104	2	33.3	33.3
50	66.7	494	5	219	2(*4)	135	1.5	41.7	41.7



*2: Lens focal point is around the closest position

*3: Lens focal point is around 0.5

*4: Lens focal point is around 1

*5: Lens focal point is around 3

WD: The distance from the front of the lens to the object

*: Lens focal point differs from the others.

■ Exercise 1

Set a vertical view range to **10mm** by referring to the values of “WD” and “Adapter ring” in the view range table to capture an image.

The view range table lists WD = 30mm and Adapter ring = 13mm for the 10mm vertical view range with an $f = 25\text{mm}$ lens. A set of adapter rings consists of the rings of the following thickness: 40mm, 20mm, 10mm, 5mm, 1mm, and 0.5mm. Combine them to make 13mm-thickness.

The camera or the lens and a 10mm-ring can be screwed each other to fix. However, you cannot screw them if rings of over 2mm are between them.

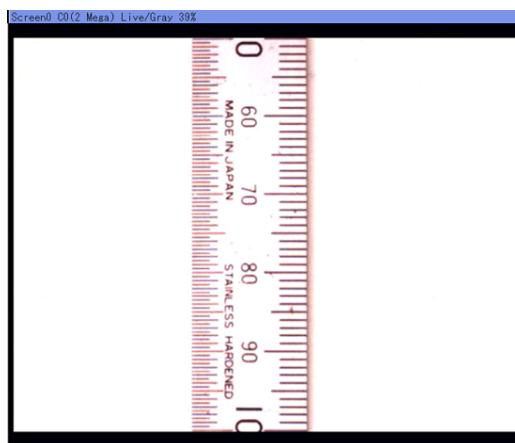
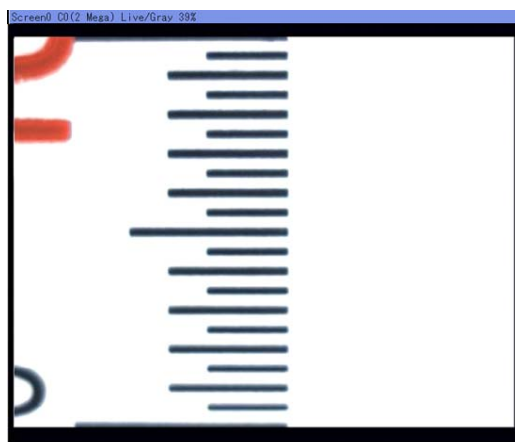
Therefore, insert rings of 1mm between the camera and a 10mm-ring, and another ring of 2mm between the 10mm-ring and the lens, to make the total thickness of 13mm.

■ Exercise 2

Set a vertical view range to **50mm** by referring to the values of “WD” and “Adapter ring” in the view range table to capture an image.

The view range table lists WD = 219mm and Adapter ring = 2mm for the 50mm vertical view range with an $f = 25\text{mm}$ lens.

(The focal point is around 1.)



2.7.1 Capturing Suitable Images for Inspection

To have accurate and stable inspection results, you must capture the desired area of the object appropriately. Images out of focus and wholly extremely light or dark images will not achieve accurate inspection results.



Image with suitable exposure and focus



Out-of-focus image



Underexposed image



Overexposed image

■ Adjusting Aperture and Focus

Generally, a lens has two rings for adjusting. The ring with marks such as 1.4, 2, 2.8, 4, 5.6, 8 ... is the "aperture" ring. The ring with marks such as 0.3, 0.5, 0.7, 1... ∞ is the "focus" ring.

1. Adjust focus first.

To capture suitable images for inspection, adjust the focus of the lens appropriately. Because you can focus more sharply with open aperture, dim the lights before adjustment. Open the aperture so that the captured image has sufficient brightness.

Adjust the focus to the point where the camera captures the edge of the object most sharply.

2. Next, adjust the aperture.

After adjusting the focus, turn on the lighting device. Then, adjust the aperture so that the entire image is neither too bright nor too dark to capture the target clearly.

Adjust the aperture and the focus before all settings including a checker setting.

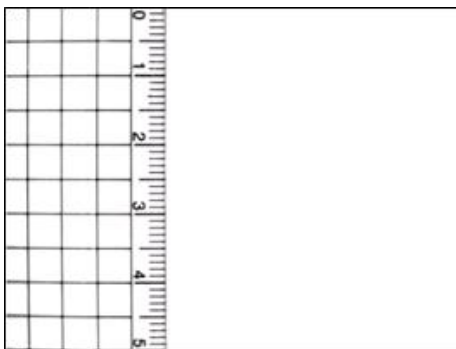


NOTE

About Image Display

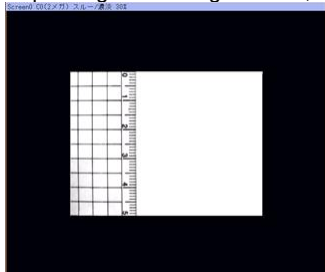
PV500 displays camera-capturing images in Screen window. Screen window allows displaying the images zoomed in/out. Thus, the sizes of the displayed image and the captured image are not always the same. Before setting the view range, display the entire captured image on the screen. Note that displaying no scroll bar on the screen. Displaying the scroll bar indicates that the displayed image is a part of the captured image. Be sure to set the view range when you can see the entire image. Refer to page 30 on how to set it.

[Captured image]

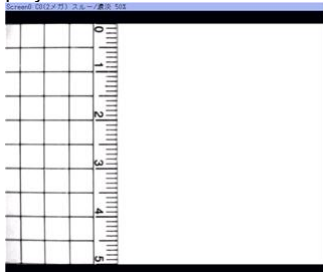


[Screen display]

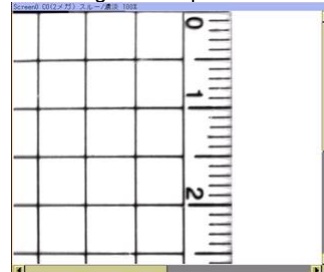
Depending on the magnification, the area displayed on the screen varies even if the same image was captured.



Magnification: 30%



Magnification: 50%



Magnification: 100%

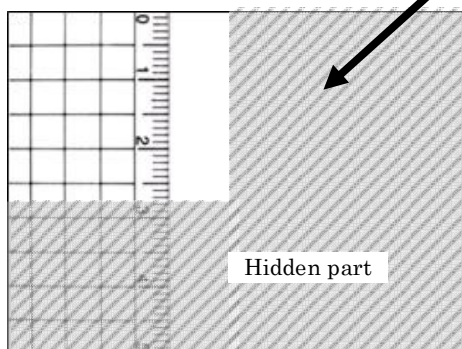
The entire window cannot be displayed and scroll bar is displayed.



Although magnification changes the display size of an image on the screen, the actual image size does not depend on it; 1600 x 1200 or 640 x 480.

Larger magnification may not be able to display an entire captured image on the screen. Only a part of the image is displayed and the scroll bar appears. Moving the scroll bar allows you to observe the hidden part of the image.

This part hidden on the screen is also captured by camera.



Be sure to be aware that hidden part exists if the scroll bar is displayed when setting view range.

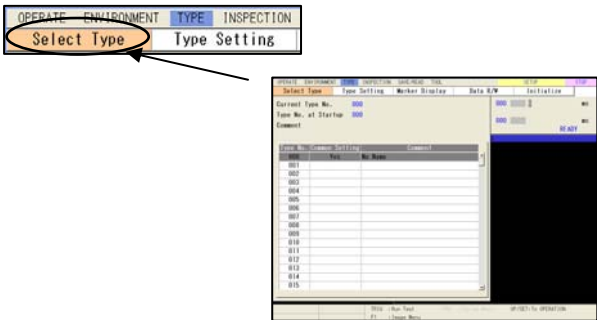
2.8 Selecting Type

1. Create a new product type.

Right after initializing all types, PV500 creates a new type in No.000.

Press the ENTER key on "TYPE".

Use the right/left arrow keys (← and →) to move the cursor onto "Select Type", and then press the ENTER key.



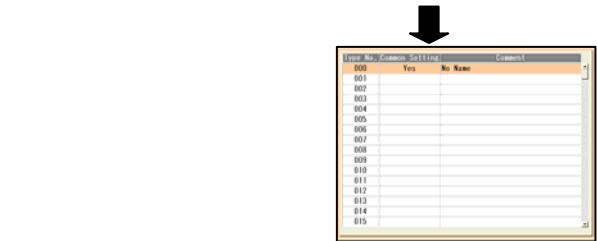
2. The cursor moves to the type list.

In the window of "Select Type", the type list is displayed.

In this window, you can create a new type, switch types and enter a comment.

To select the type No. you want to create, use the up/down arrow key (↑ and ↓) to move the cursor.

For now, move the cursor onto product type No.001 and press the ENTER key. "Current Type No. 001" is shown above the list. Now, the type is switched to the new one.



Type No.	Common Setting	Comment
000	Yes	No Name
001		

Type No.	Common Setting	Comment
000	Yes	No Name
001		

OPERATE ENVIRONMENT TYPE INSPECTION

Select Type Type Setting

Current Type No. 001

Type No. at Startup 000

Comment

Type No.	Common Setting	Comment
000	Yes	No Name
001	Yes	No Name
002		

- Copy
- Paste
- Delete
- Enter Comment
- Type No. at Startup

3. Name this product type.

Choose Type No.001 and press the FUNC key. A menu appears in the top left of the screen. Use the up/down arrow keys (↑ and ↓) to move the cursor onto "Enter Comment" and press the ENTER key.

4. The "Enter Comment" box appears.

Enter a product type title using the arrow keys and ENTER key.

A Product Type title consists of up to 64 characters. In the right example, "Test_1" is being set.

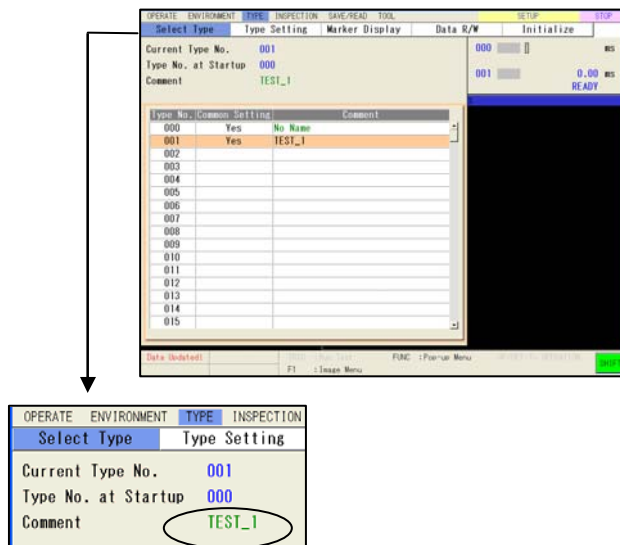
Enter Comment

TEST_1

1	2	3	4	5	6	7	8	9	0	.	_	=	+	BS
A	B	C	D	E	F	G	H	I	J	K	L	M	-	DEL
N	O	P	Q	R	S	T	U	V	W	X	Y	Z	*	
a	b	c	d	e	f	g	h	i	j	k	l	m	/	
n	o	p	q	r	s	t	u	v	w	x	y	z	:	
,	;	'	&	%	\$	!	#	@	(	)	<	>	\	Enter

<- ->

5. After entering it, select **"Enter"** and press the ENTER key. The title is registered. You can see that the product type list shows the title you have entered. (In the right figure "TEST_1")

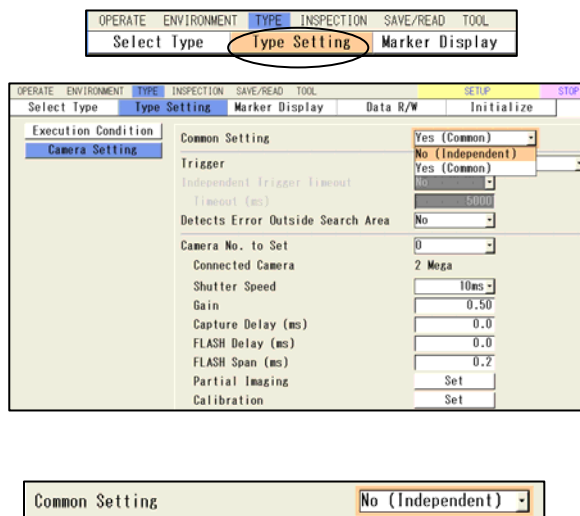


6. Next, we will change the shutter speed. Select "TYPE" > "Type Setting". Move the cursor onto "Camera Setting" and press the ENTER key.

7. Press the ENTER key in "Common Setting" and select "No (Independent)".

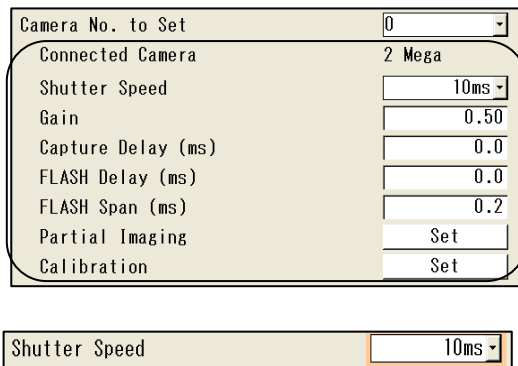
About items of "Common Setting"

In PV500, you can set the items of Camera Setting, including a trigger which commands an inspection start and shutter speed of a camera, for each product type. Additionally, you can commonly use them in different types. "Common Setting" decides whether you make setting for each type or use common setting. "Common Setting" applies to the items beneath it in the "Camera Setting" window.



8. Next, change the shutter speed. Make setting for Camera No.0 (Camera No. to Set: 0). Confirm that "2 Mega" is shown in "Connected Camera".

"Shutter Speed", "Gain", "Capture Delay (ms)", "FLASH delay (ms)", "FLASH Span (ms)", "Partial Imaging", and "Calibration" are setting items per camera.

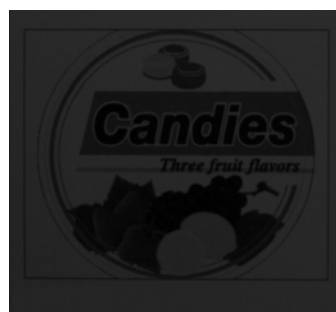


Press the ENTER key on “Shutter Speed”.

9. The menu shown on the right appears to select shutter speed. Switch the speed which is currently set to “10ms” to “5ms”, “1ms”, “500us”, “250us”.... Pressing the ENTER key at the higher speed setting shows the darker image. On the contrary, pressing the ENTER key at the lower speed such as “50ms”, “100ms”, “500ms”, ...shows the lighter image.

30us
100us
250us
500us
1ms
5ms
10ms
50ms
100ms
500ms
1000ms

The higher shutter speed darkens a captured image, and the lower speed lightens it up.



Slow speed (Light)

Fast speed (Dark)



NOTE

About Setting Numbers

As you can see in the type list, Type number begins from 000 in PV500. In the same way, the rest of the setting items begin from 0, including Connected Camera number, Screen number, and Checker number.

ENVIRONMENT > Camera

OPERATE	ENVIRONMENT	TYPE	INSPECTION	SAVE/READ	TOOL	SET
Condition	Input/Output	Camera	Color	Password	In	
Camera						
FLASH Polarity						
Camera	Connected Camera	Camera Type				
Camera No.0	2 Mega	2 Mega				
Camera No.1	2 Mega	2 Mega				
Camera No.2	2 Mega	2 Mega				
Camera No.3	None	Unused				

The number begins from “0”.

OPERATION > Layout

No.	Comment
00	Main
01	Title
02	Main+3Subs(Hor.)
03	Main+3Subs(Ver.)
04	
05	
06	
07	
08	
09	
10	
11	
12	
13	
14	
15	

Layout Image

\$0	\$1
\$2	\$3

Symbols
 \$n: Screen
 Dn: Data R/W
 n: Window No.

The number begins from “0”.

INSPECTION > Checker

OPERATE	ENVIRONMENT	TYPE	INSPECTION	SAVE/READ	TOOL					
Position Adj.	Area Size Adj.	Checker								
Checker										
Checker Type										
Line										
Block No. 0										
Checker No. 0										
<table border="1" style="width: 100%;"> <tr><td>000</td></tr> <tr><td>001</td></tr> <tr><td>002</td></tr> <tr><td>003</td></tr> <tr><td>004</td></tr> </table>						000	001	002	003	004
000										
001										
002										
003										
004										

Note that all the setting numbers in the earlier models (PV310, AX40, A series, etc.) begin from 1.

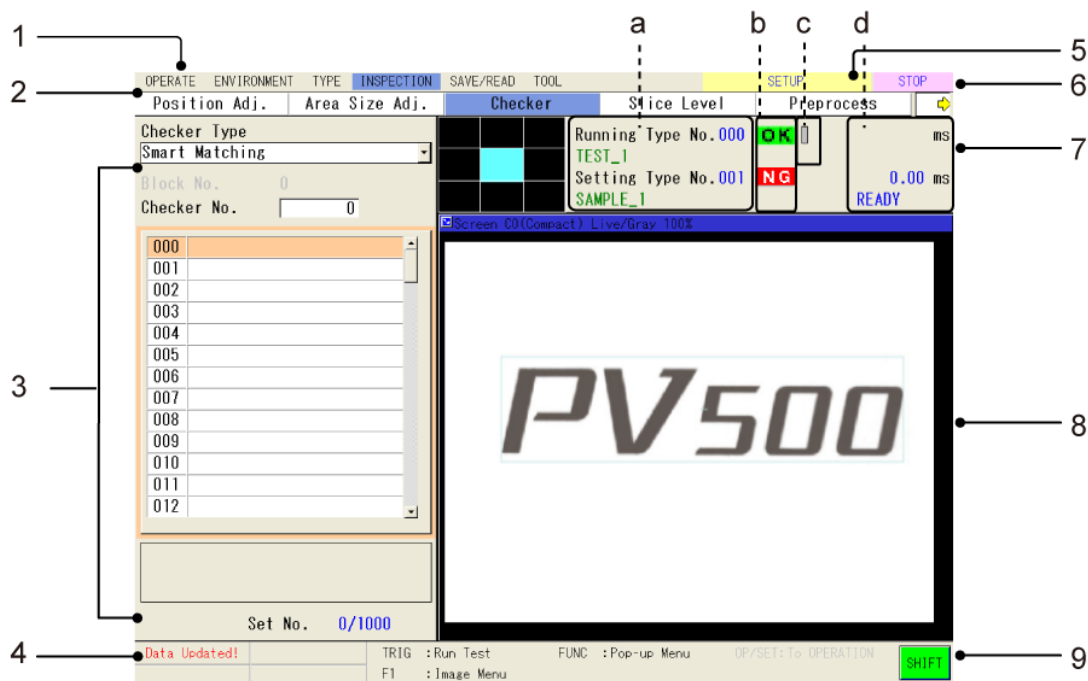
2.9 About Screen

■ OPERATION



- **1: Main Menu: Displays the menu to set in OPERATION.**
- **2: Information Display Area: Displays the information of PV.**
 - a) Displays the current type, layout No. and the status of the PV500.)
 - b) ReadEnd signal status (image capture completion signal)
 - c) Total judgment result
 - d) I/O terminal status
 - ACCEPT: Available for receiving signals
 - READY: Inspection start ready completion signal
 - STROB: Result read timing
 - TACT: Result read timing
 - ERROR0: Error in executing an inspection or outputting a result
 - ERROR1: Parallel signal command error
 - e) Displays inspection time and cycle in ms unit.
- **3: Message Area: Displays the message to inform.**
 - e.g.) The setting has been changed. > “Data updated!”
 - The voltage of the attached battery became lower > “Change Battery!”
- **4: Window Type: Displays "OPERATION".**
- **5: Operation Status: Displays the status operating (RUN) or pausing (STOP).**
- **6: Screen Window: This is a window to display an image. In addition, a data R/W window which shows data can be displayed in the area.**
- **7 : Key guide: Displays the operations of each key of the keypad.**

■ SETUP



- **1: Main Menu: Displays the menu to make setting in SETUP.**
- **2: Sub-menu: Displays a sub-menu of the menu selected in the main menu.**
- **3: Setting Windows: Displayed in the upper left of the screen.**
The above image is an example of screen displaying the checker setting window.
- **4: Message Area: Displays the message to inform.**
e.g.) The setting has been changed. > “Data updated!”
The voltage of the attached battery became lower > “Change Battery!”
- **5: Window Type: Displays "SETUP". (Indicates the current window is SETUP window.)**
- **6: Operation Status: Displays the status operating (RUN) or pausing (STOP).**
- **7: Information display area:**
 - a) Running Type No., Type name, Setting Type No., Type name
 - b) Total judgment of Running Type/ Total judgment of Setting Type
 - c) ReadEnd signal status (image capture completion signal)
 - d) Displays inspection time and test time in ms unit.
- **8: Screen Window: Displays a camera image.**
- **9: Key Guide: Guide for the keypad**

2.10 OPERATION window and SETUP window

PV500 has two windows: OPERATION window for performing inspections and SETUP window for making settings such as inspection conditions. Operate the device switching between them.

■ OPERATION window

This is a window for performing inspection. The PV500 starts in this mode when you turn it on.

In OPERATION window, the following items can be operated other than inspections; selecting type, resetting statistics, setting screen layout, saving setting data, viewing PV500 information, and modifying data from Data R/W Window. Regardless of the operation status, RUN or STOP, you can operate these menus.

■ SETUP window

In this mode, you can configure or change the settings for all the options in the menu bar (ENVIRONMENT, TYPE, INSPECTION, SAVE/READ, and TOOL).

As a default setting, switching to SETUP window stops operation. You can change the setting to operate in SETUP window as well.

■ About Operation Status: RUN and STOP

In both of OPERATION and SETUP windows, the monitor shows a sign of “RUN” or “STOP” in the upper right. The operating status is displayed in the field.

STOP

When PV500 in “STOP” status where it stops operation, you can only set up regardless of OPERATION window or SETUP window. All signals from external device including the inspection start signal (START) are denied. Although pressing the TRIG key on the keypad performs a test, results will not be output to the external device.

Run

When PV500 in “RUN”, you can execute inspections and output the results to the external device. Only in RUN mode, the PV500 outputs READY signal and accepts signals from the external device including inspection start signal (START). In addition, the inspection results can be output to the external device according to the conditions of communication and output.

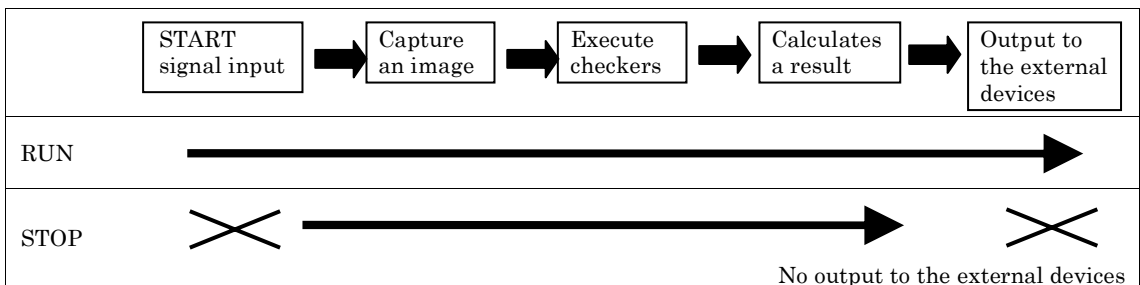
■ Switching between OPERATION and SETUP

Pressing the OPE/SET key switches between the two windows.

(Switching from the SETUP to OPERATION is available only when the screen shows no setting windows).

Note that you cannot switch the screen from SETUP to OPERATION if the type of the actually connecting camera and the settings of “Connected Camera” and “Camera Type” in Camera menu of ENVIRONMENT are not the same.

Differences between operations in RUN and STOP



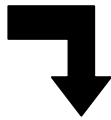
NOTE

- As the default setting, product number is 000 at startup. To specify a type number at startup or change it to the type number you have selected right before you turned off PV500, make setting from “ENVIRONMENT” menu.
“ENVIRONMENT” > “Condition” > “Startup Setting” > “Type No.”

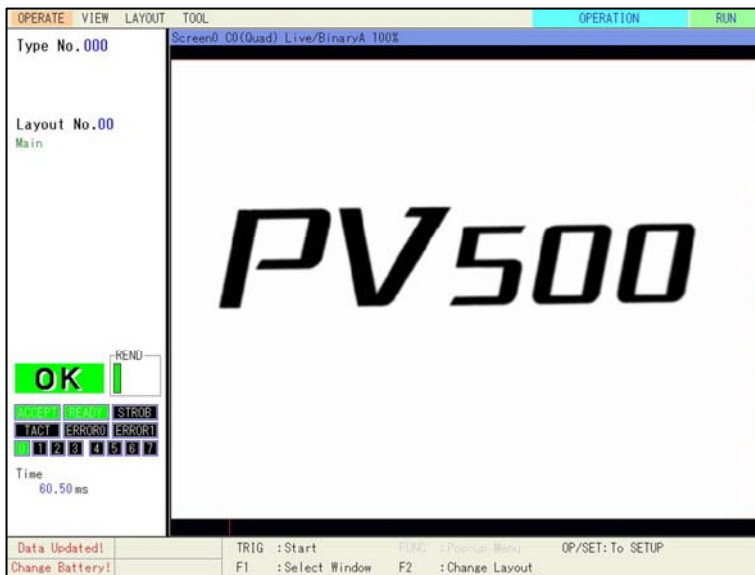
2.11 Menus and Functions



Screen at startup



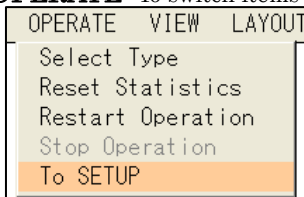
OPERATION window



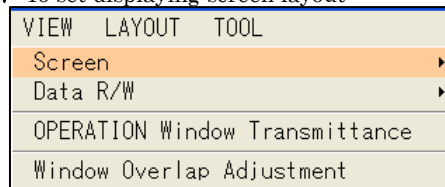
Switch with
OPE/SET switch



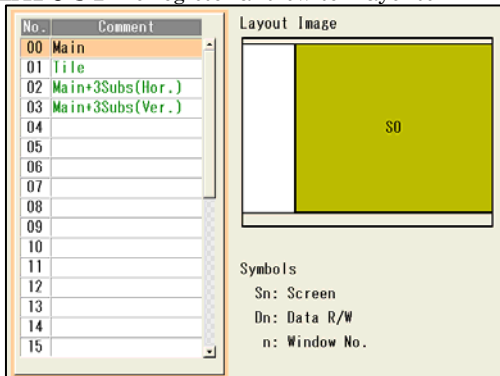
OPERATE: To switch items on operation



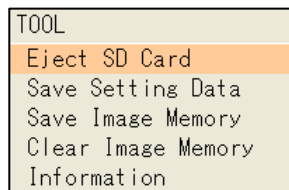
VIEW: To set displaying screen layout



LAYOUT: To register and switch layouts



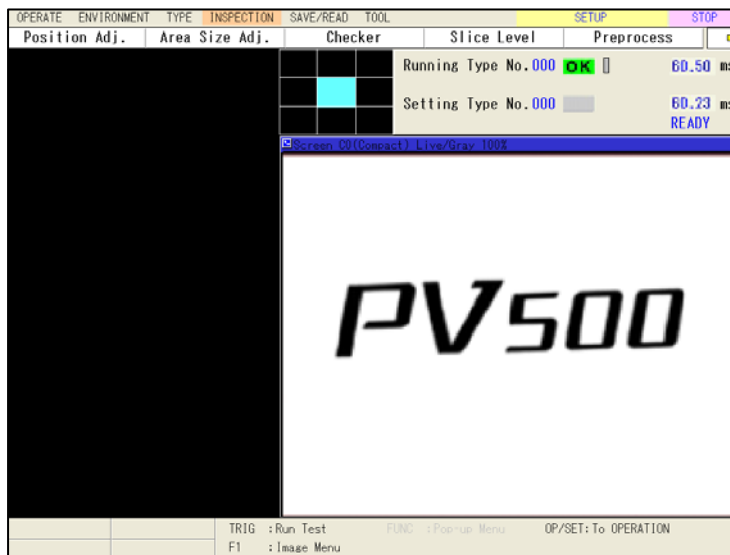
TOOL: To save data and show information of PV500



LAYOUT

This is the setting about size, number of screens and camera type for screens and data R/W windows.

SETUP window



OPERATE: Switches operation

To OPERATION	Restart Operation	Stop Operation
--------------	-------------------	----------------

ENVIRONMENT: Common setting for all product

Condition	Input/Output	Camera	Color	Password	Initialize
-----------	--------------	--------	-------	----------	------------

TYPE: Setting necessary for inspections

Select Type	Type Setting	Marker Display	Data R/W	Initialize
-------------	--------------	----------------	----------	------------

INSPECTION: Sets each inspection condition

Position Adj.	Area Size Adj.	Checker	Slice Level	Preprocess
	Num. Calcu.	Judgment	Checker List	Group Move

SAVE/READ: Saves or reads setting data and images

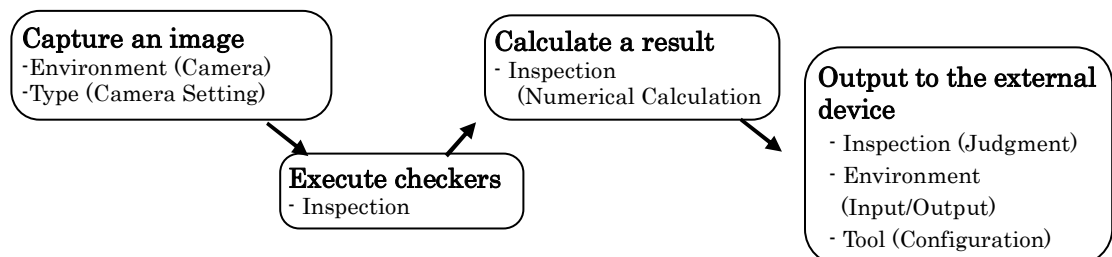
Save Setting Data	Read Setting Data	Save Image Memory	Clear Image Memory
-------------------	-------------------	-------------------	--------------------

TOOL: Sets and Shows the information of PV500

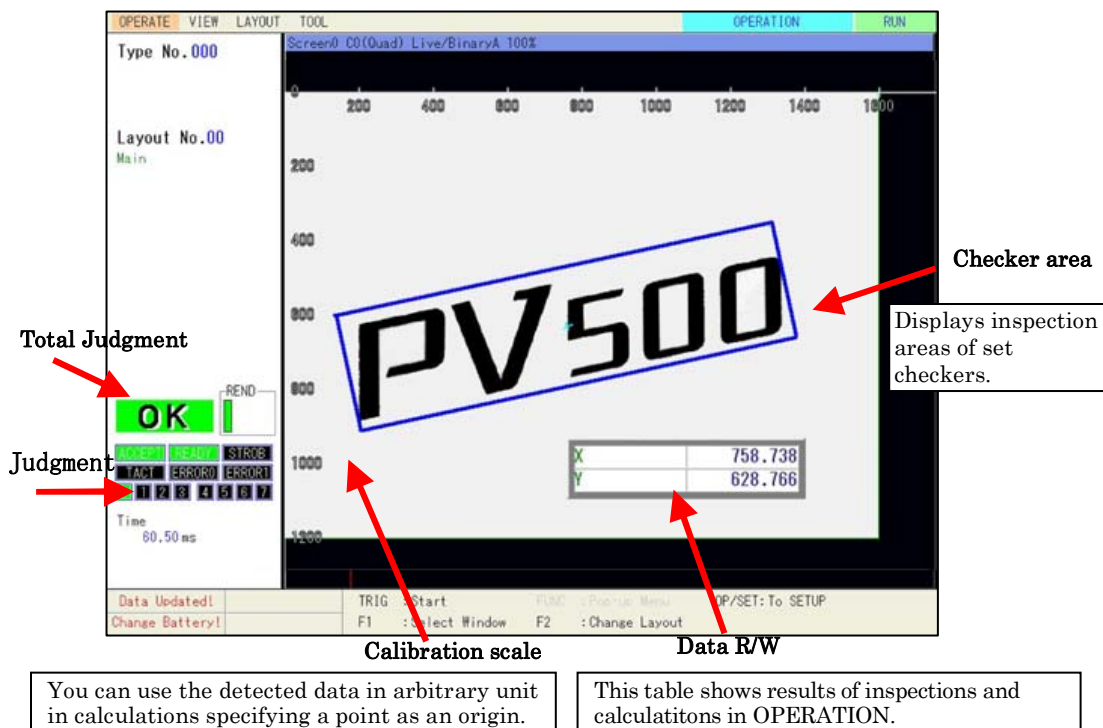
Configuration	SD Property	Eject SD Card	Information	Setting Help
Update				

Operations of Imagechecker and Main Settings

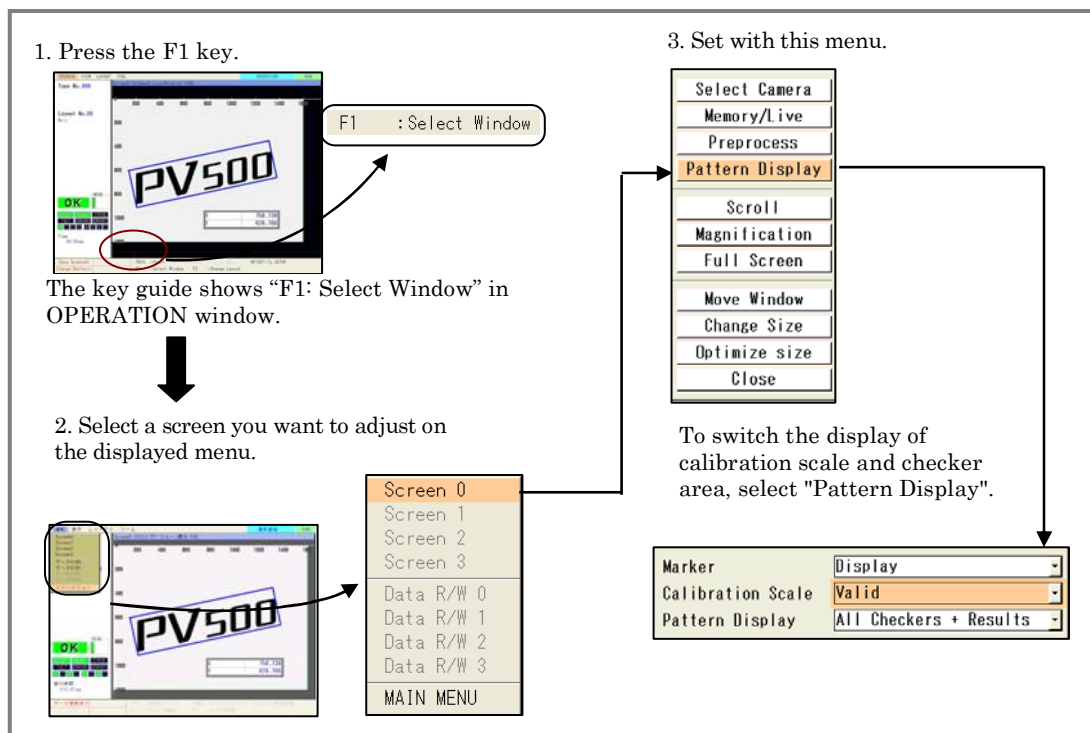
The diagram below shows the setting items described in page 3 to operate Imagechecker.



Screen of OPERATION window



To switch between showing and hiding the checker area and the calibration scale in the figure above, follow the procedure described below.



2.12 Displayed Image

Two types of images are selectable when displaying captured images on the monitor.

To select image types, press the F1 key and select “Memory/Live” in the displayed menu.

Option	Displayed Image Type
Live image	The current image. An image changes in real-time. If the lens is covered with your hands, a blacken image will be captured.
Memory image	The image stored in a memory for inspection. Unlike a live image, the images do not change in real-time.

For inspections with Imagechecker, you should use memory images.

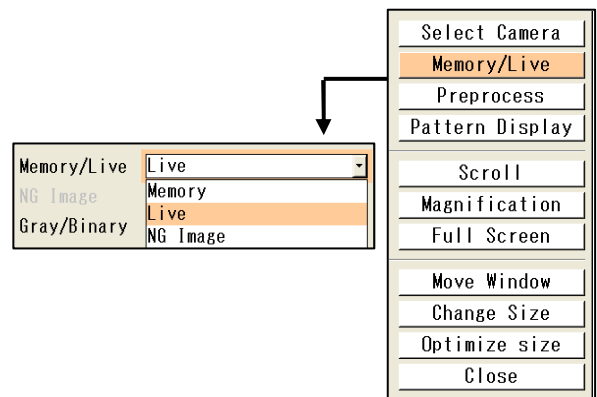
On the other hand, live images help to make settings, such as focus adjustment and aperture adjustment, thanks to their feature that they change in real time.

■ Switching between Live/Memory

Press the F1 key when the key operation guide which is on the bottom of the screen shows “Image Menu” or “Select Window” for the F1 key. A menu for display image setting appears. Select “Memory/Live” and press the ENTER key.

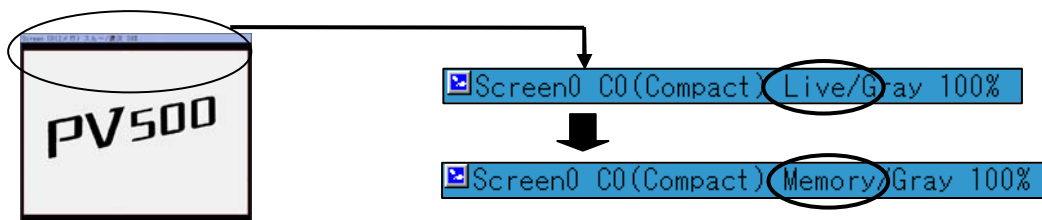
A menu to switch a display image appears as shown on the right.

You can switch a display image by selecting “Memory/Live”.



To find the display image Memory or Live, confirm the title bar on top of the screen.

The figure below shows the title bar when the display image is switched from Live to Memory. The title is switched from “Live” to “Memory”.



■ About Other Image Menu

An image captured with the connecting camera is displayed on the Screen window. You can choose a camera image and an image type to display. “Image Menu” is to set them. Press the F1 key to display the menu.

There are four main functions in Image Menu;

- 1: Setting for screen display
- 2: Size adjustment of an image displayed on the screen
- 3: Reading and saving of an image
- 4: Adjustment of size and position of the screen

The table below lists details of the functions.

1: Setting for screen display

Select Camera
Memory/Live
Preprocess
Pattern Display
Scroll
Magnification
Full Screen
Save Image
Read Image

Select Camera	To select a camera to capture an image displayed on the screen.
Select how to display a captured image in "Memory/Live", "Gray/Binary", and "Preprocess".	
Memory/Live	To select Live or Memory for an image displayed on the screen.
Gray / Binary	To select Gray or Binary for an image displayed on the screen.
Preprocess	To select to display preprocessed image or not.
Pattern Display	To select display the support tools (Marker, Calibration scale, Checker pattern) or not.

2: Size adjustment of an image displayed on the screen

Scroll	When displaying a zoomed in image, only a part of image can be shown. To show the nondisplayed part, use the scroll function.
Magnification	To display a camera image zoomed in/out.
Full Screen	To display an image in full size of the screen.

3: Reading and saving of an image (only for SETUP window)

Save Image	To save images stored in the Image Memory of PV into a SD memory card. (About Image Memory, see the figure below/)
Read Image	To read images in Image Memory of PV500 or Test Image and Image Memory of a SD memory card as images for inspection. (In the figure below, Image Memory, Test Image, and SD Image Memory are marked with *.

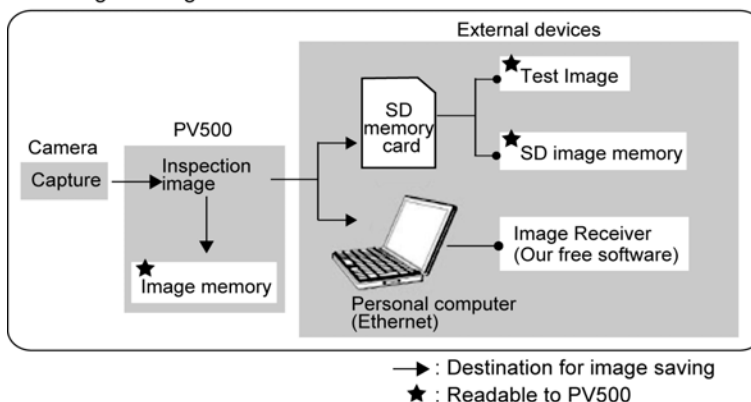
4: Adjustment of size and position of the screen (only for OPERATION window)

Move Window
Change Size
Optimize size
Close

Move Window	To move a screen window and a data R/W window displayed on OPERATION window.
Change size	To change the size of a screen window and a data R/W window displayed on OPERATION window.
Optimize size	To change the size and magnification of a screen window displayed on OPERATION window into the optimum size. Connected camera: 2-mega camera -- Magnification: 50% Connected camera: Quad-speed camera, Ultra compact camera -- Magnification: 100%

PV500 saves camera-capturing images in PV500, a SD memory card, or PC. Some of the saved images can be read out. Images can be saved in the destinations described in the table below.

Image Saving



Destination of images, Saving images, and Menu to operate

Destination	Saving Image	Menu to operate
PV500 - Image Memory	Images captured in RUN (Turning off the power deletes them.)	ENVIRONMENT > Input/Output > Save Image Memory
Test image	The last image captured in OPERATION window. (Saved when switching to SETUP window.)	ENVIRONMENT > Condition > Operation
SD image memory	Images captured in RUN	ENVIRONMENT > Input/Output > Image Output
PC (Image Receiver)	Images captured in RUN	ENVIRONMENT > Input/Output > Image Output

Chapter 3

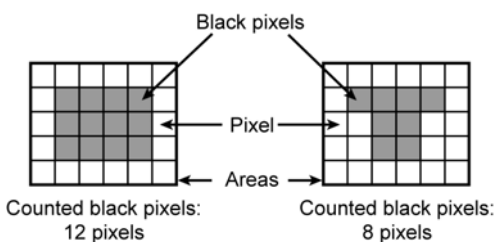
Binary Window

3.1 Overview

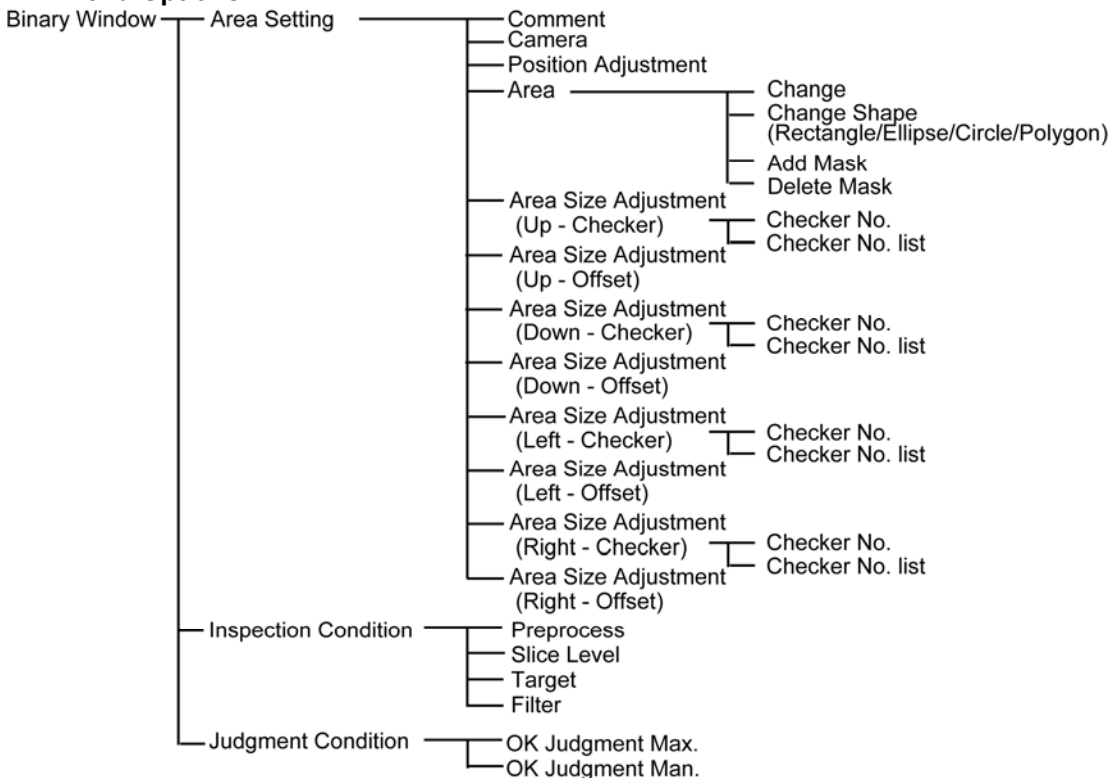
■ What Is Binary Window?

Binary Window is a function that counts the number of black and white pixels in a binary image. If the number of counted pixels is within the allowable range, the object will be judged as "OK", if it exceeds the allowable range, the object is judged as "NG".

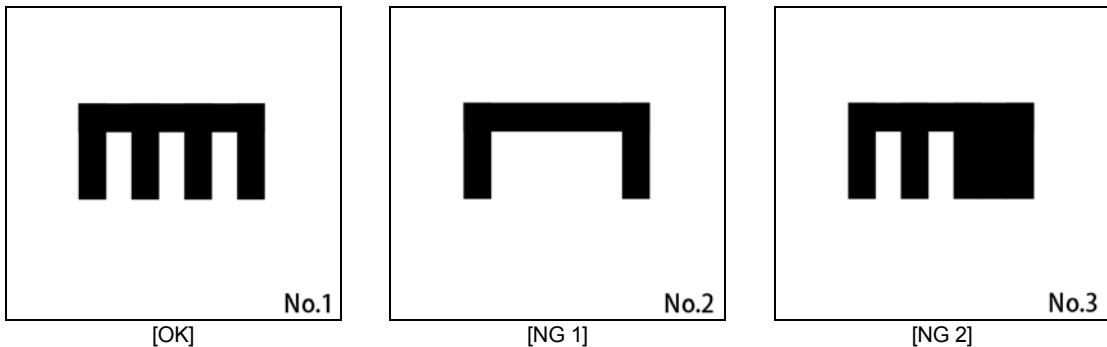
Area shape	Rectangle/Circle/Polygon (The number of settable vertices: 3 to 64)
Mask area	The Number of Settable Mask Areas: Up to 16
The Range of Measurement Results	0 to 1920000 (2-mega-pixel camera), 0 to 307200 (Quad-speed camera)



■ Menu Options



3.2 Judging Object as OK or NG



■ Overview

- 1: Create a Binary Window to measure the area of an object.
- 2: Create a comment.
- 3: Set a slice level.
- 4: Set an area to inspect.
- 5: Measure the area of OK and NG objects.
- 6: From the results of step 5, set the range to judge objects.
- 7: Make a judgment setting to output judgment results to the external devices.
- 8: Set a Total Judgment to see the judgment result at a glance.

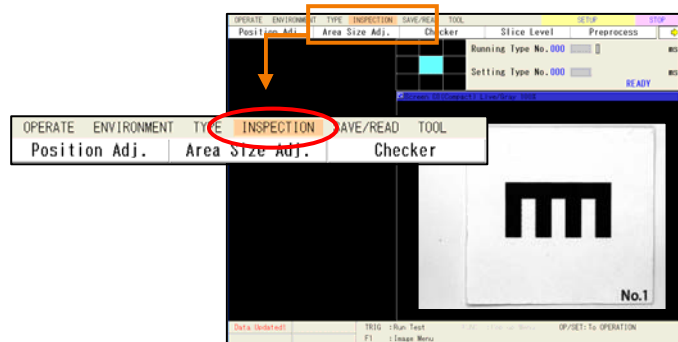
■ Exercise 1

Binary Window (Rectangle setting)
Judgment setting

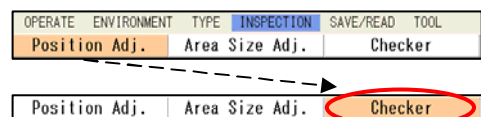
■ Preparation

Product type : No. 000
Training Card : No.1, No.2, and No.3 (3 cards)
Image preparation : Capture Training Card No.1.
Live, C0, Gray

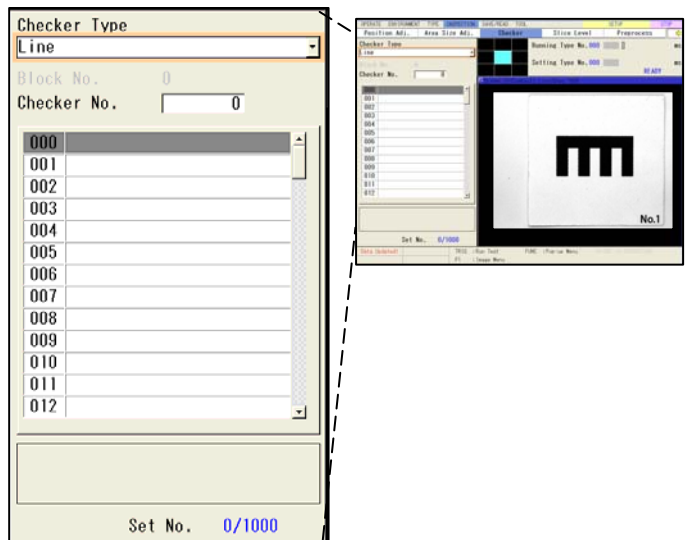
1. Press the "OPE/SET" switch in OPERATION to switch to SETUP. Next, use the right/left arrow keys (← and →) to move the cursor onto "INSPECTION", and then press the ENTER key.



2. Use the right/left arrow keys (← and →) to move the cursor onto "Checker", and then press the ENTER key.

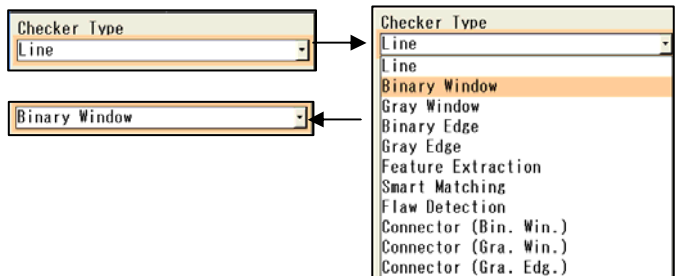


Then, the cursor moves to “Checker Type” field.
The list of checker is displayed on the screen.

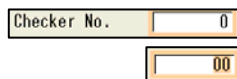


3. Press the ENTER key on “Checker Type”.

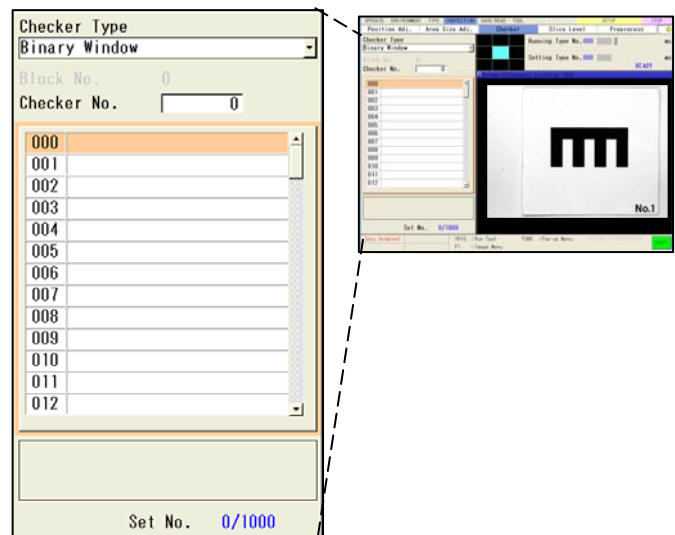
The checker select box appears.
Use the up/down arrow keys (↑ and ↓) to move the cursor onto "Binary Window" and then press the ENTER key.



4. Move the cursor with the up/down arrow keys (↑ and ↓) onto “Checker No.” Press the ENTER key and set “00”. And then press the Enter key again.

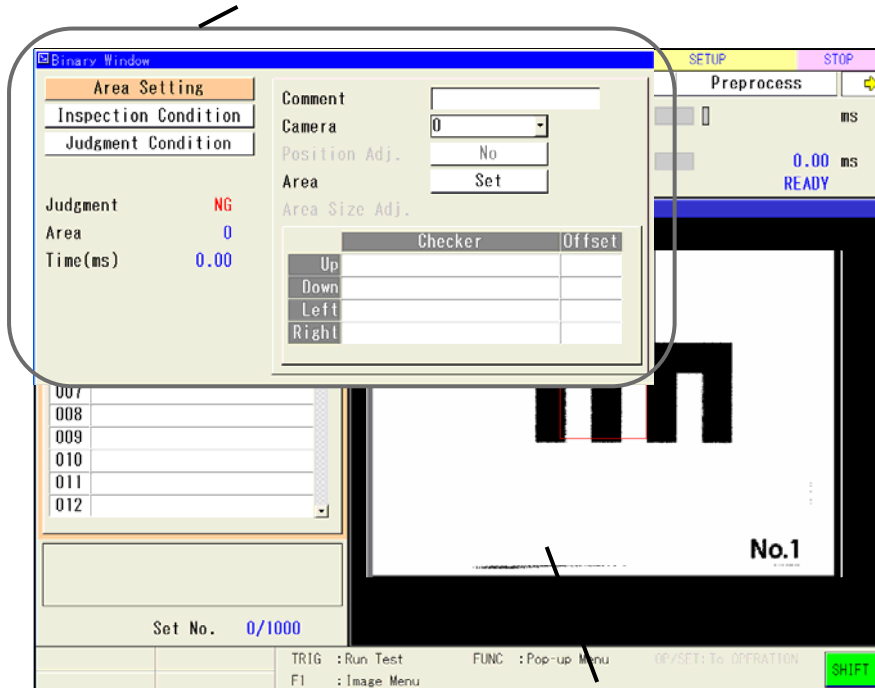


5. Move the cursor with the down arrow keys (↓) to the checker select list. Press the ENTER key to move the cursor to “000”. Press the ENTER key again to show the Binary Window setting window.



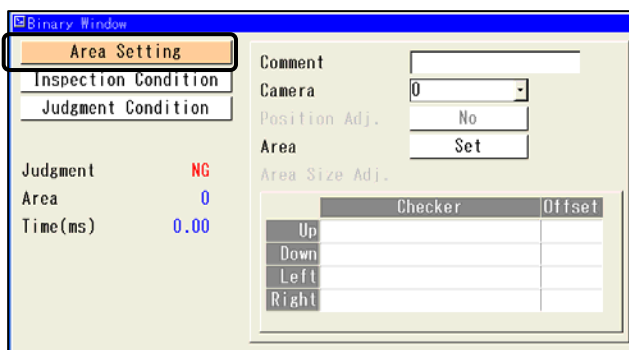
6. Check that the image displayed on the screen was changed to a binary image.
This binary image is displayed based on the slice level selected by the setting checker.

Binary Window checker setting window



Binary image

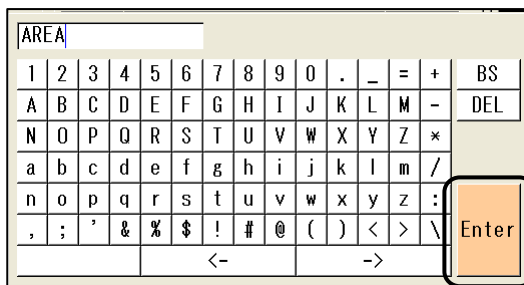
7. Set a checker name in "Comment".
Select "Area Setting" and press the ENTER key.



Move the cursor on "Comment" and press the ENTER key.



The window for entering a comment appears.
For this training, set "AREA".
After entering letters, select "Enter" and press the ENTER key.



Press the ENTER key on "Enter".

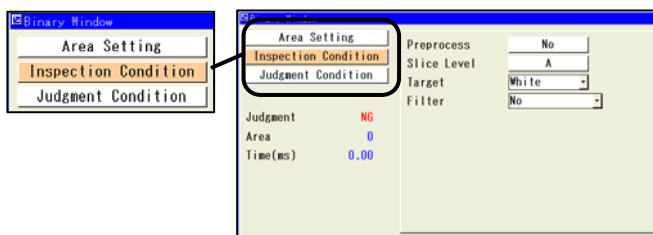
8. The cursor goes back to the checker setting window. Confirm that “AREA” is shown in “Comment”.



9. Set a slice level.

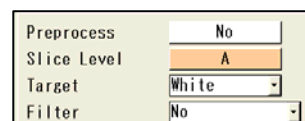
Press the CANCEL key to move the cursor to “Area Setting”.

Then, use the down arrow keys (↓) to move the cursor onto “Inspection Condition” and press the ENTER key.



10. Select a slice level group and set it.

Use the up/down arrow keys (↑ and ↓) to move the cursor onto “Slice Level” and then press the ENTER key.

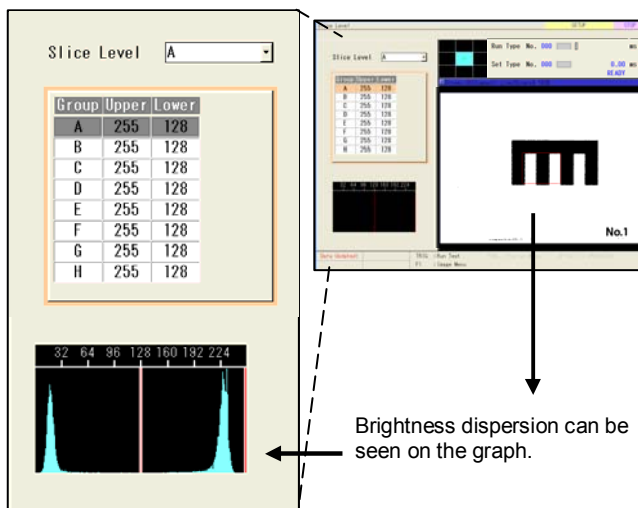


11. Slice level selecting box, slice level list, and a graph are displayed.

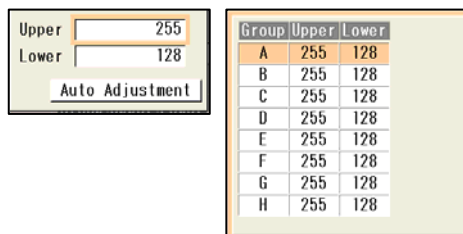
Use the up/down arrow keys (↑ and ↓) to move the cursor to the center table (Slice level list) and then press the ENTER key.

The table shows upper and lower values that are set for each slice level group A to H.

The graph shows distribution of brightness of the image on the screen.



12. Select A group and press the ENTER key. The slice level setting window for group A is displayed.



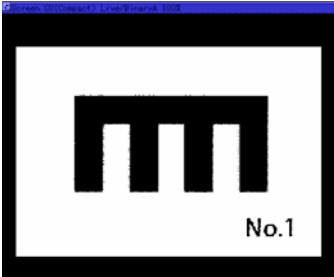
There are two ways to set a slice level, manual and automatic.
First, execute the automatic setting.
Use the up/down arrow keys (↑ and ↓) to move the cursor onto "Auto Adjustment" and then press the ENTER key to adjust them.

Upper 255
Lower 128
Auto Adjustment

<ENTER>

Upper 255
Lower 73
Auto Adjustment

Group	Upper	Lower
A	255	73
B	255	128
C	255	128
D	255	128
E	255	128
F	255	128
G	255	128
H	255	128

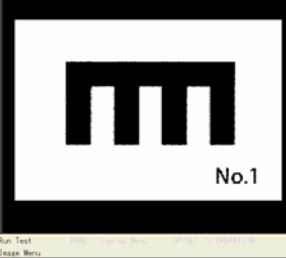


Check that the Lower value field of the setting window shows a new value and the Lower value of group A in the table is updated.

13. Pressing the CANCEL key close the menu and the values are fixed.

Slice Level A

Group	Upper	Lower
A	255	73
B	255	128
C	255	128
D	255	128
E	255	128
F	255	128
G	255	128
H	255	128



14. If auto adjustment cannot binarize the desired object, set slice level manually.
Select slice level group A and press the ENTER key.
To set it manually, select values of "Upper" and "Lower" and change them to be suitable.
We will set a lower value for an example for this training.

Select "Lower" and press the ENTER key. The cursor moves to the value field. Adjust the values with the up/down arrow keys (↑ and ↓) to set the slice level so that you can clearly distinguish between the object and the background.

Decreasing the lower value makes the entire screen lighter. In contrast, increasing it makes the screen darker.

Set a suitable value and press the ENTER key.

Upper 255
Lower 73
Auto Adjustment

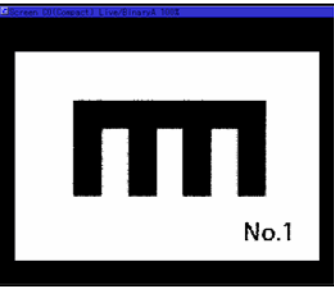
<ENTER>

073

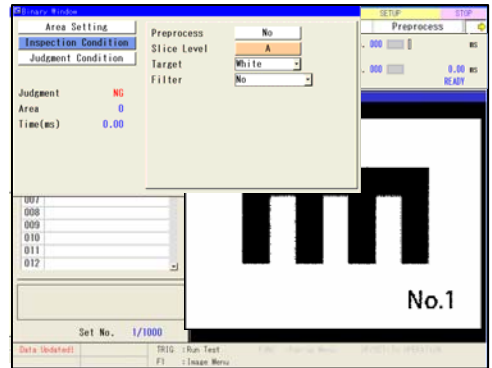
053

Upper 255
Lower 53
Auto Adjustment

Group	Upper	Lower
A	255	73
B	255	128
C	255	128
D	255	128
E	255	128
F	255	128
G	255	128
H	255	128



Now, manual setting of a slice levels is complete.
 Press the CANCEL key to close the Upper/Lower values setting window.
 And then, press the CANCEL key twice to close the slice level setting window.

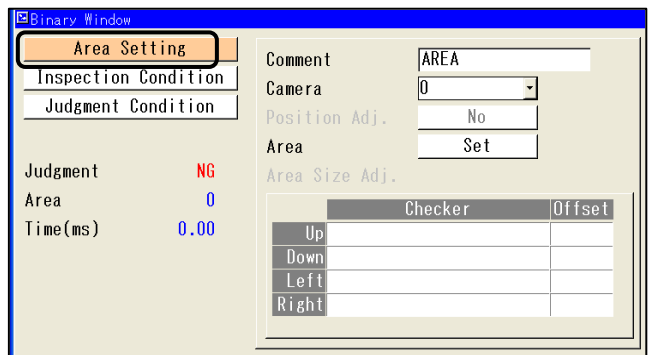


15. Next, we will set an inspection area.

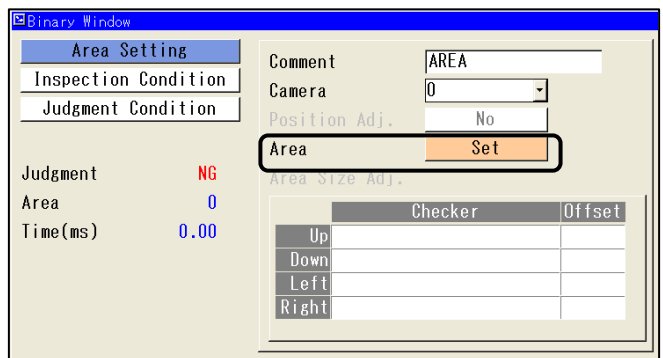
The figure below is appearance of Area setting
 Set an area surrounding the object.



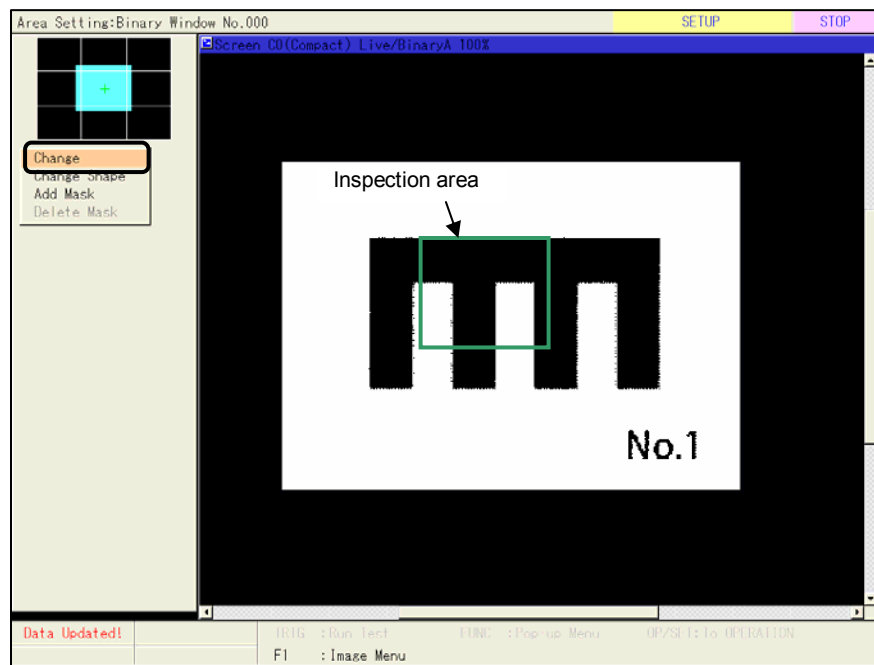
Area setting can be operated by the menu of "Area Setting".
 Press the CANCEL key to move the cursor onto "Inspection Condition". Next, use the up/down arrow keys (↑ and ↓) to move the cursor onto "Area Setting" and press the ENTER key.



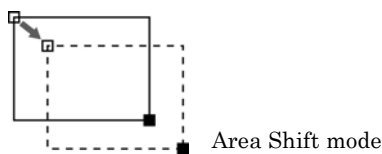
16. Use the up/down arrow keys (↑ and ↓) to move the cursor onto "Area" and press the ENTER key. (Pressing the CANCEL key at the time cancels the area setting.)



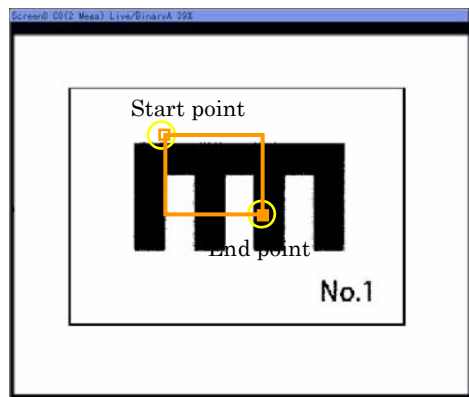
17. The inspection area is displayed in green. Set size and position of this area.
 Check to make sure that the cursor is on “Change” menu in the information display area on the left of the screen. Press the ENTER key.



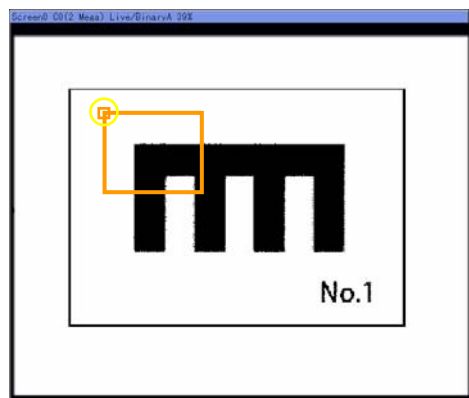
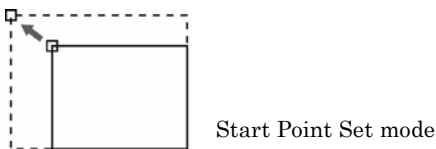
18. The area on the screen changes its color from green to orange indicating you are in “Area Shift” mode.
 In this mode, you can move the entire area by using the arrow keys (↑, ↓, ←, and →). Move the area to the desired position, then press the ENTER key. (To cancel the moving, press the CANCEL key instead of the ENTER key.)



While you are setting an area, SHIFT sign is displayed on the lower right as the right figure.
 Pressing the arrow keys and the SHIFT key on the keypad at the same time moves the area faster in the direction.

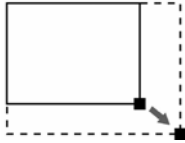


19. The end-point of the area disappears and only the start-point is displayed, indicating you are in "Start-point Set Mode".
 In this mode, you can move the start point by using the arrow keys (↑, ↓, ←, and →). Move the start point to the desired position, then press the ENTER key. (To return to "Area Shift" mode, press the CANCEL key instead of the ENTER key.)

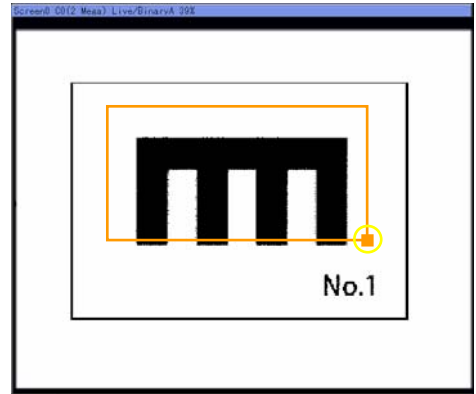


20. The start point of the area disappears and only the end point is displayed, indicating you are in **"End-point Set Mode"**.

In this mode, you can move the end point by using the arrow keys (↑, ↓, ←, and →). Move the end point to the desired position, then press the ENTER key to decide the area size. (To return to **"Start Point Set"** mode, press the CANCEL key instead of the ENTER key.)



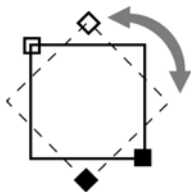
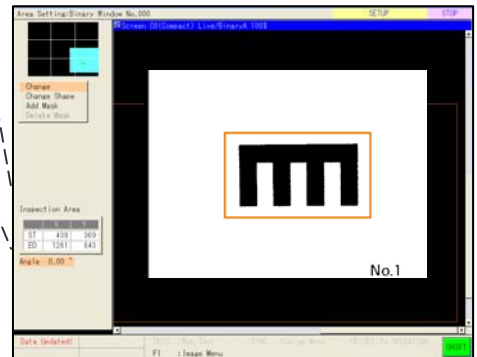
End Point Set mode



21. The rectangles representing the start point and the end point disappear and the cursor moves to "Angle" in the information display area. Now, you are in "Angle Set" mode.

In this mode, pressing the up arrow key (↑) rotates the area around the center of it clockwise. Pressing the down arrow key (↓) rotates it counterclockwise. Set the angle and press the ENTER key to decide the setting. (To return to **"End Point Set"** mode, press the CANCEL key instead of the ENTER key.)

Inspection Area		
	X	Y
ST	439	369
ED	1261	843
Angle 0.00 °		

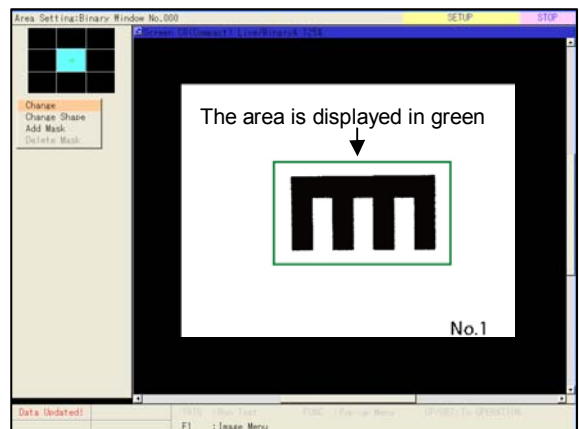
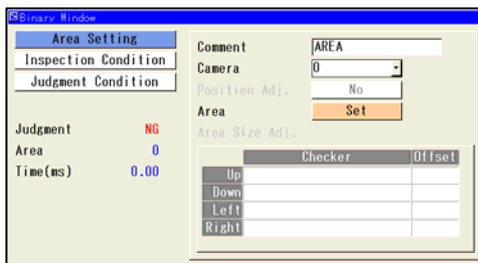


Angle Set mode

Rotatable within +/- 45-degree

22. The inspection area is displayed in green again.

Pressing the CANCEL key finishes area setting. The cursor goes back to the previous window.

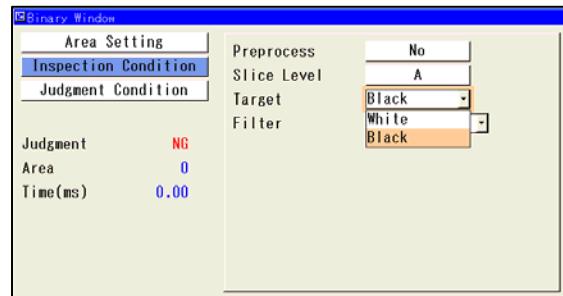


23. Because the object is black, measure the black area. Set the inspection target to black. Move the cursor onto "Inspection Condition" and press the ENTER key.



Use the up/down arrow keys (↑ and ↓) to move the cursor onto "Target" and then press the ENTER key to select it.

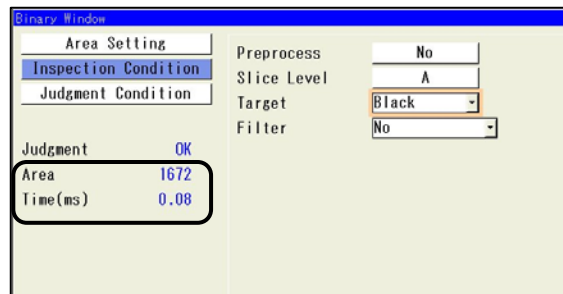
Use the up/down arrow keys (↑ and ↓) to move the cursor onto "Black" and press the ENTER key to decide.



24. Execute an inspection and see.

Press the TRIG key. Test is carried out once.

Check the area detected by the Binary Window and execution time displayed on the left of the screen.



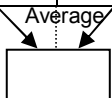
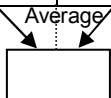
25. Now, we will create the program to judge the object as which of OK or NG according to the inspection result.

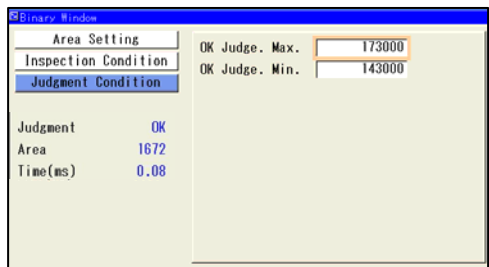
Set the checker to judge as OK if the area of the object is within the certain range, and to judge as NG otherwise. For each training card (one OK card and two NG cards), measure the area size five times (press the TRIG key five times each) and write down the results in the table below.

Card	Target Image	Measured Area Size					Minimum	Maximum
OK object (Card No.1)								
NG object (Card No.2)								
NG object 2 (Card No.3)								

26. After writing down the result, complete the table below based on the data.

Enter the obtained values in "OK Judge. Max." and "OK Judge. Min." in "Judgment Condition" menu.

NG object 1		OK object		NG object 2	
					
Min.	Max.	Min.	Max.	Min.	Max.
					
OK Judge. Max.		OK Judge. Min.			



NOTE

You cannot set a maximum value below a minimum value, or a minimum value above a maximum value.

To set a maximum value below the current minimum value, make the minimum value smaller before changing the maximum value.

27. About entering a value, refer to the example described below.

- Use the right/left arrow keys (← and →) to move the highlighted cursor onto a desired digit.
- Use the up/down arrow keys (↑ and ↓) to increase or decrease the values.

Operation Example 1: Changing 4000 to 5000

004000 <→><→><↑> 005000

Operation Example 2: Automatic Shifting Up and Down

000590 <↑> 000600

000320 <↓> 000319

Operation Example 3: Changing 4000 to 7900

004000 <→><→> 004000 <↑><↑><↑><↑> 008000 <→> 008000 <↓> 007900 <ENTER>

Operation Example 4: Changing 4000 to 202

004000 <→><→> 004000 <↓><↓><↓><↓> 000900 <↓> ... <↓> 000200 <→><→><↑><↑> 000202 <ENTER>

28. After entering the values of OK Judge. Max. and Min., run a test on each card. Observe that "Judgment" displayed above the "Area" value shows "OK" for an OK object and "NG" for an NG object.

Judgment **OK**

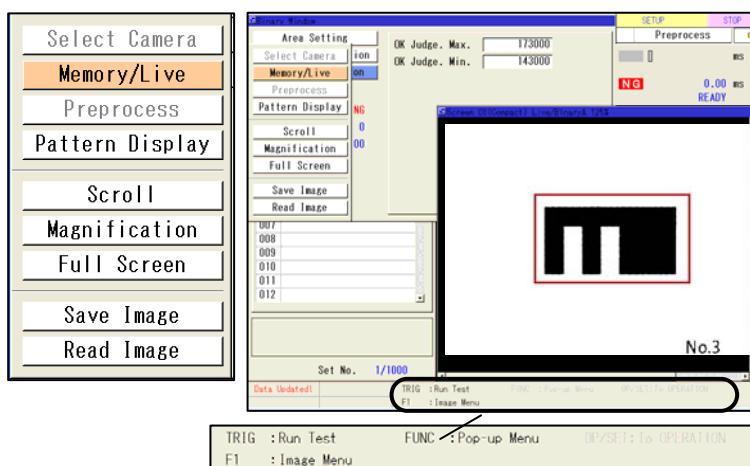
Judgment **NG**

29. It is inconvenient that you must close the setting window every time you observe the object while the inspection condition menu hides it. PV500 has functions that temporarily display the screen in the front, or display a captured image in zoomed in size on the screen.

Now use this function.

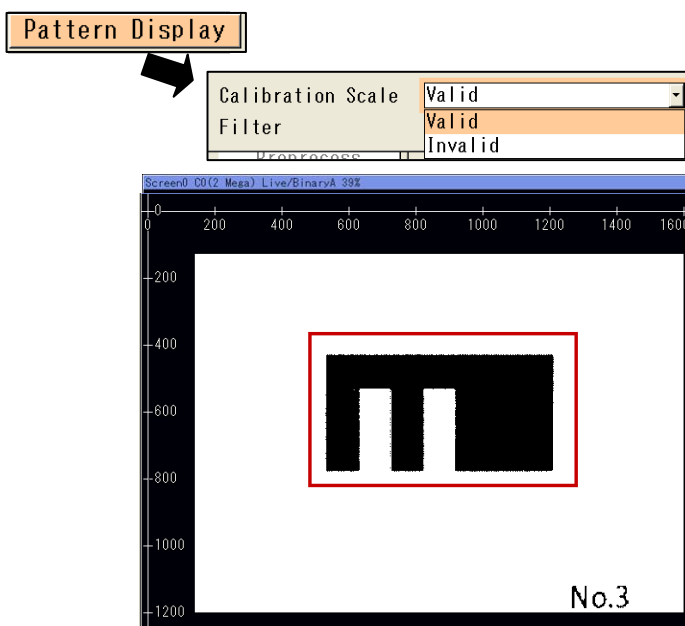
Pressing the F1 key shows the screen in the front and a box as the right figure appears. This menu box helps to select often-used commands, such as

- Switching between memory image and live image
- Switching between binary image and gray scale image
- Switching between display and hide calibration scale
- Changing image magnification



On the bottom of the screen, the current operation keys and their functions are displayed. Press them as necessary.

30. The right figure shows the screen when "Calibration Scale" in "Pattern Display" is set to "Valid". Calibration scale is displayed.



31. Make a judgment of an inspected result by the Binary Window checker we have set.

■ What Is Judgment?

PV500 has a function that totally judges on the judgments (OK or NG) of checkers and numerical calculations. Judgment can be displayed on the screen and output to the external devices through parallel and serial communication or to a SD memory card. In addition, according to the judgment, images can be saved and output to the external devices.

Up to 1000 formulas can be set for each product type in PV500.

In this exercise, we will configure the judgment function to output a signal from OUT0 if the Binary Window we have named “AREA” judges as OK, and from OUT1 if it judges as NG.

32. Use the right/left arrow keys (← and →) to move the cursor onto “Judgment”, and then press the ENTER key. The setting window as shown on the right is displayed on the screen.

No.	Expression	Judge	Comment
JDC000	Unset		
JDC001	Unset		
JDC002	Unset		
JDC003	Unset		
JDC004	Unset		
JDC005	Unset		
JDC006	Unset		
JDC007	Unset		

	Condition	Checker No.	Result	Description
Total Judg.	No			
Save Img Memory	No		No	Save JRC/JDC at NG
Image Output	No		No	Output JRC/JDC at NG

33. Use the right/left arrow keys (← and →) to move the cursor onto “Type”, and then press the ENTER key. The menu for selecting “JDC (External)” or “JRC (Internal)” is displayed.

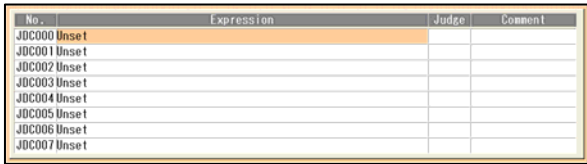
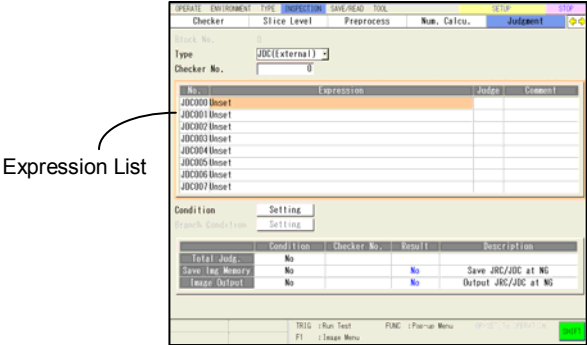
“Type” is a setting for selecting whether PV500 outputs a judgment (OK or NG) to the external device or not. To output, select “JDC (External)”, and not to output, select “JRC (Internal)”.

For now, to output a judgment of the Binary Window checker to the external device, select “JDC (External)”.

34. We will set an operation expression. You need to register a conditional expression in the expression list to output a judgment. The expression outputs (parallel signal: ON) the object judged as OK when Imagechecker is executed. As opposed to that, it does not output (parallel signal: OFF) when the judgment is NG. Thus, you need to set expressions so that JDC000 turns on when you want to output to OUT0 and JDC001 turns on to output OUT1.

First, set an expression in JDC000 to output from OUT0 when the Binary Window named “AREA” judges the object as OK.

Move the cursor onto the expression list and press the ENTER key. The cursor moves to “Expression” field in the list.

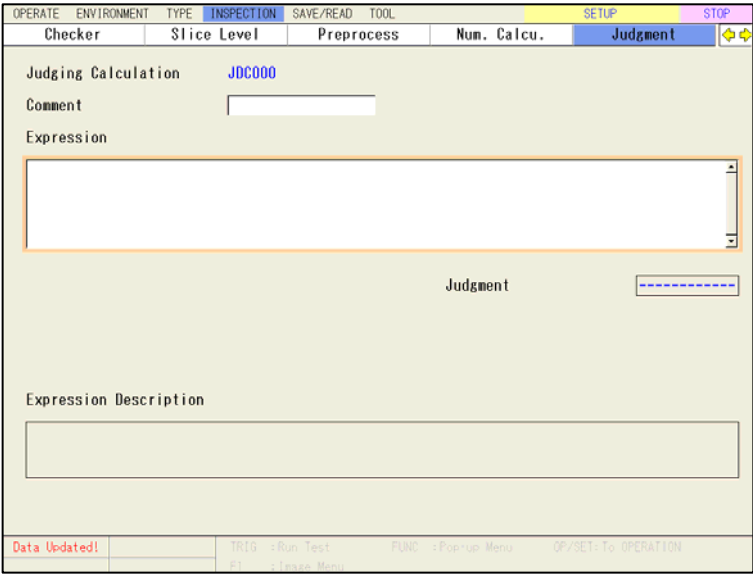


35. Move the cursor with the up/down arrow keys (↑ and ↓) onto “Expression” of JDC000 and press the ENTER key.

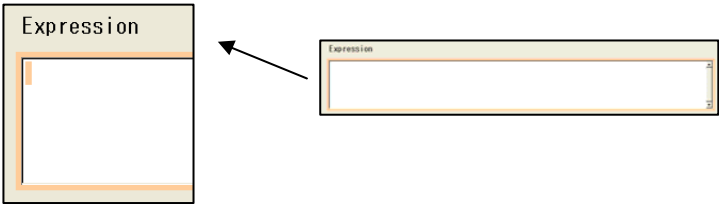
Expression setting window appears as the right figure.

Now, we will enter an expression in “Expression” field.

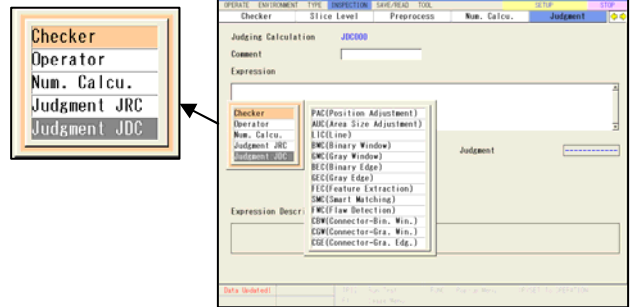
Press the ENTER key in “Expression”.



The cursor moves into “Expression” field. Press the ENTER key.

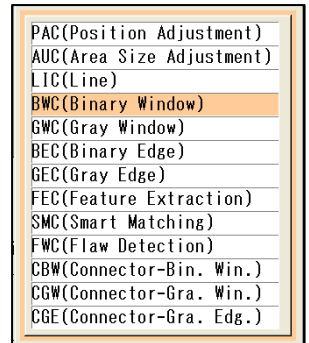


36. The list of items that can be registered in a calculation is displayed. Use the up/down arrow keys (↑ and ↓) to move the cursor onto "Checker" and then press the ENTER key.



37. Select a checker type to use.

Use the up/down arrow keys (↑ and ↓) to move the cursor onto "Binary Window" and then press the ENTER key.



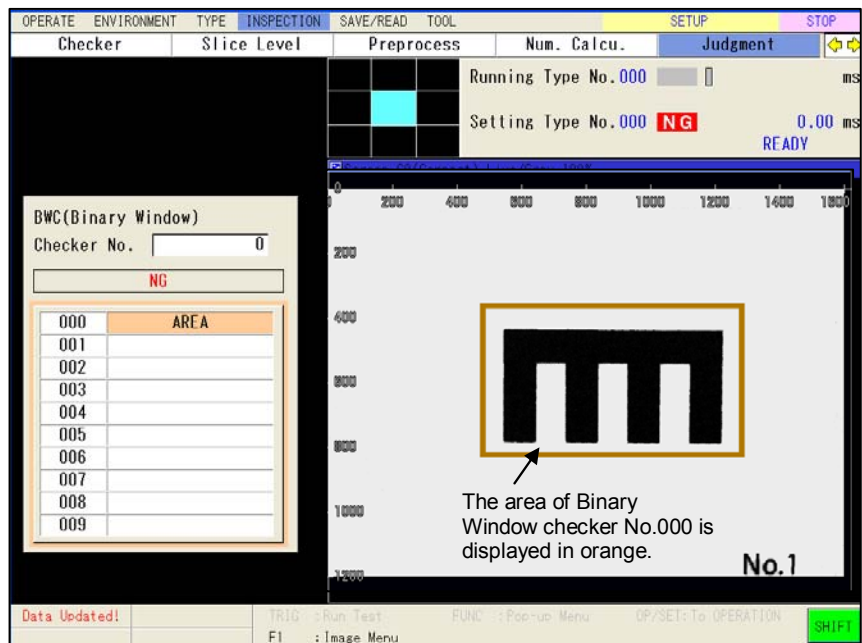
38. A window to select a checker number to refer is displayed.

Use the up/down arrow keys (↑ and ↓) to move the cursor onto Checker No. list and press the ENTER key. The cursor moves into the table.

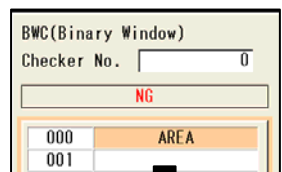
Because we have already set checker No.000, its name "AREA" is displayed.

Confirm that a judgment of the selected checker is displayed.

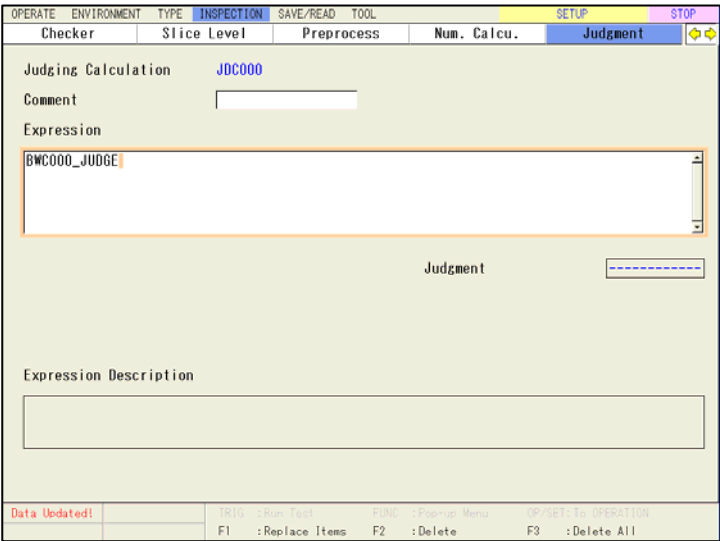
The screen shows the inspection area of the selected checker in orange.



39. Press the ENTER key while the cursor is on “AREA” of checker No.000 in the list.

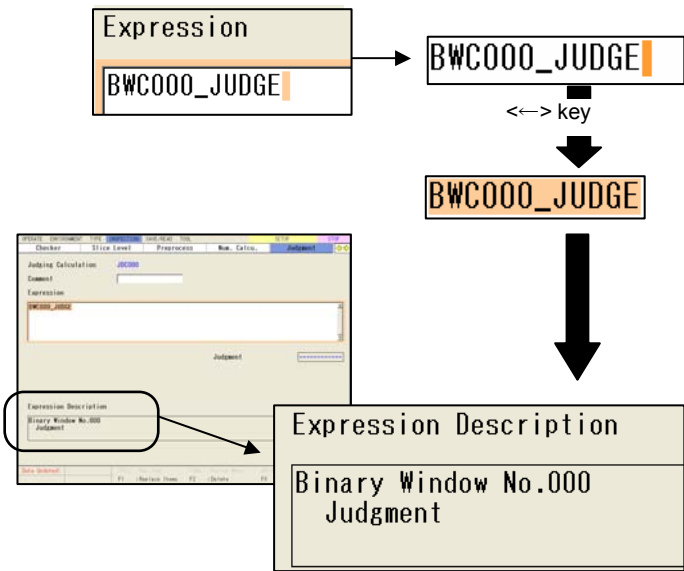


Automatically an expression is set.
BWC000_JUDGE:
Judgment of Binary Window No.000



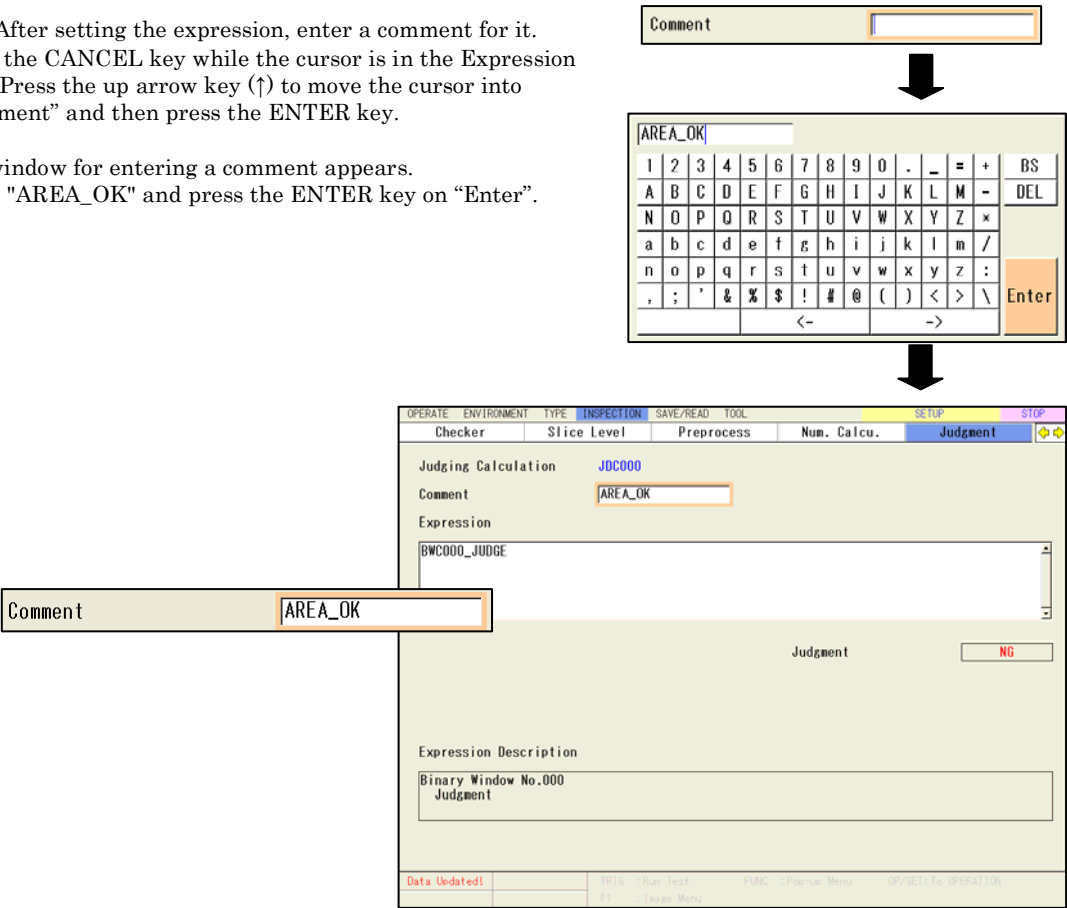
40. Press the left arrow key (←).
The cursor moves onto “BWC000_JUDGE”.
The description of the selected expression is displayed in "Expression Description" field.

Confirm that it says “Binary Window No.000 Judgment”.



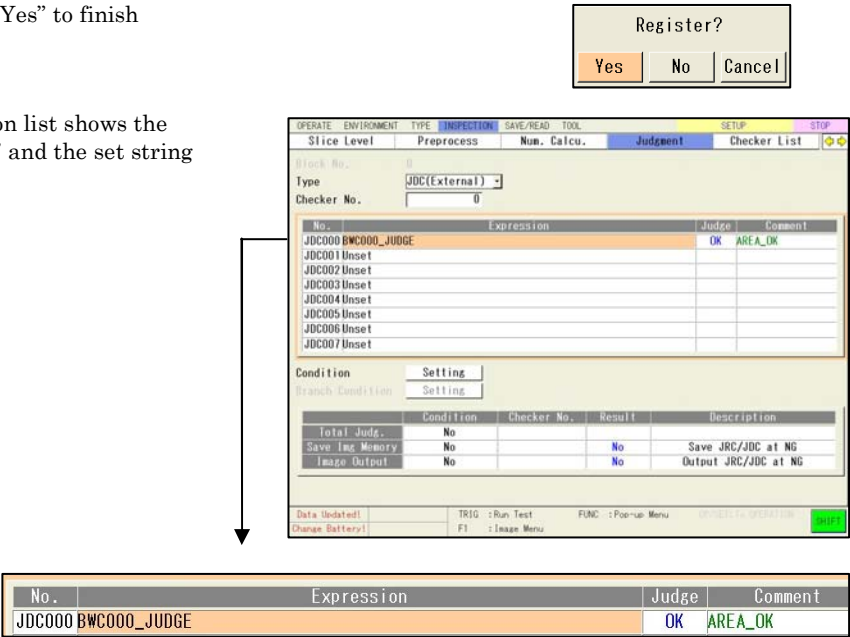
41. After setting the expression, enter a comment for it. Press the CANCEL key while the cursor is in the Expression field. Press the up arrow key (↑) to move the cursor into “Comment” and then press the ENTER key.

The window for entering a comment appears. Enter "AREA_OK" and press the ENTER key on “Enter”.



42. Pressing the CANCEL key shows a message saying “Register?” Press the ENTER key on “Yes” to finish registering.

Confirm that the expression list shows the expression in “Expression” and the set string in “Comment”.



43. Judgment of the expression JDC000 is output to OUT0.
(* PV500 outputs the judgment when it is operating as you execute an inspection.)

44. In the same way, make a setting to output to OUT1 when a judgment is NG.

JDC001 is supposed to output when the Binary Window named AREA judges the object as NG. In Judgment, parallel signal turns on when executing the expression set in JDCXXX outputs OK. Now, we use a negation operator (/) in judgment expression of the Binary Window (AREA). Then, select the Binary Window No.000 named AREA again.

JDC001 = / BWC000_JUDGE

Setting the expression gives “NG” judgment when AREA outputs OK because it negates “OK”. Conversely, when AREA outputs NG, the expression gives “OK” because it negates NG. In this case, parallel signal turns on and is output.

(In the right figure, the comment of JDC001 is set to “AREA_NG”.)

The figure illustrates the configuration of a judgment expression in a software interface. It consists of several screenshots and a final output label.

Top Screenshot: A table showing judgment results for various expressions.

No.	Expression	Judge	Comment
JDC000	BWC000_JUDGE	OK	AREA_OK
JDC001	Unset		

Checker Dialog Box: A dialog box for selecting a checker. The 'Checker' field is set to 'Logical Sum'. The 'Operator' field is set to 'Negation (/)'.

Expression Dialog Box: A dialog box for entering an expression. The 'Expression' field contains the negation symbol '/'.

Main Interface Screenshot: A screenshot of the main interface showing the 'JDC' configuration window. The 'Type' is set to 'JDC(external)'. The 'Checker No.' is set to '0'. The 'Expression' field contains '/BWC000_JUDGE'. The 'Comment' field contains 'AREA_NG'.

Bottom Label: A label showing the final expression: JDC001 /BWC000_JUDGE

45. Set Total Judgment to find an inspection result at a glance.

■ What Is Total Judgment?

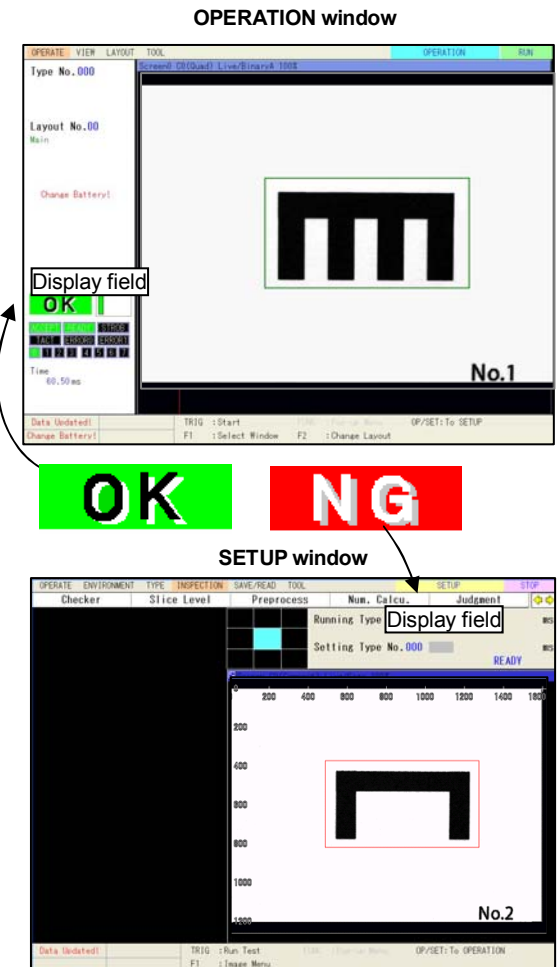
Total Judgment is a judgment displayed in the status display area in OPERATION or SETUP window. It can be output to the external devices solely.

You can display large signs in green if the result is OK, in red if it is NG in the display field as the right figure.

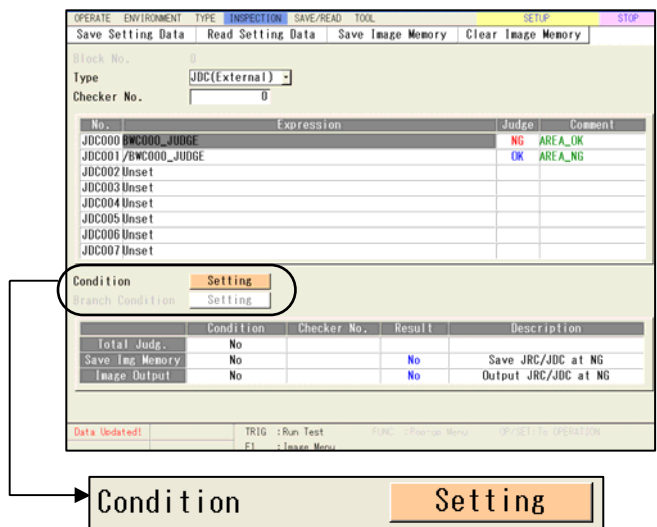
Each product type can apply one of judgment expressions (JDC(External) and JRC (Internal)) as a Total Judgment.

Now, we set to display “OK” sign when the Binary Window “AREA” outputs OK.

Because JDC000 meets this condition, set it as “Total Judgment”.



To set a total judgment, select “Condition” in the judgment setting window. Select “Condition – Setting” and press the ENTER key.



46. The setting window for condition is displayed.
Press the ENTER key on “Condition” of “Total Judg.”

Checker	Condition	Checker No.	Result	Description
Total Judg.	No	000	No	Save JRC/JDC at NG
Save Img Memory	No		No	Output JRC/JDC at NG
Image Output	No		No	

Use the up/down arrow keys (↑ and ↓) to move the cursor onto “JDC” and press the ENTER key.

Use the right arrow key (→) to move the cursor onto “Checker No.”, and then press the ENTER key.

Checker	Condition	Checker No.
Total Judg.	JDC	000

Checker	Condition	Checker No.
Total Judg.	JDC	000

Specify “000” and press the Enter key.

After setting is complete, press the CANCEL key to close the setting window.

Checker	Condition	Checker No.
Total Judg.	JDC	000

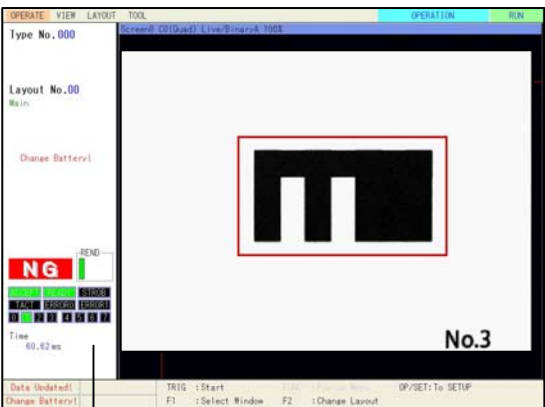
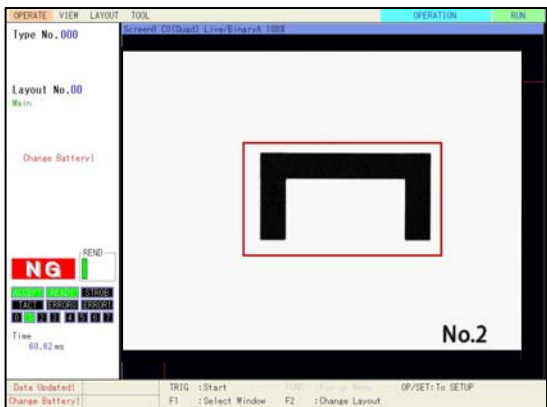
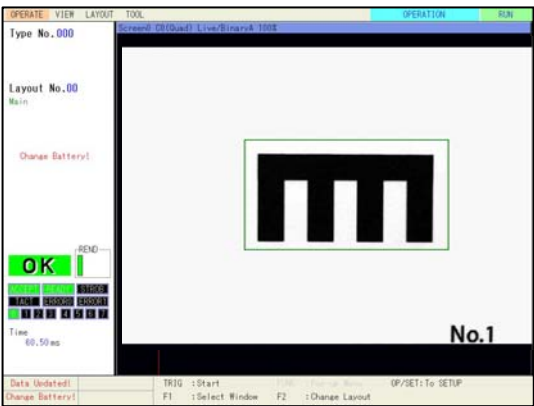
47. The cursor goes back to the judgment setting window.
The information of total judgment is displayed in the lower part of the setting window.

Checker	Condition	Checker No.	Result	Description
Total Judg.	JDC	000	OK	Save JRC/JDC at NG
Save Img Memory	No		No	Output JRC/JDC at NG
Image Output	No		No	

48. Run the inspection on OK and NG objects and verify that the screen shows judgment results correctly.

You should see that the total judgment is displayed as a green OK-sign for an OK object and a red NG-sign for an NG object.
In addition, the checker pattern of the Binary Window turns to green when the object is OK and to red when it is NG.

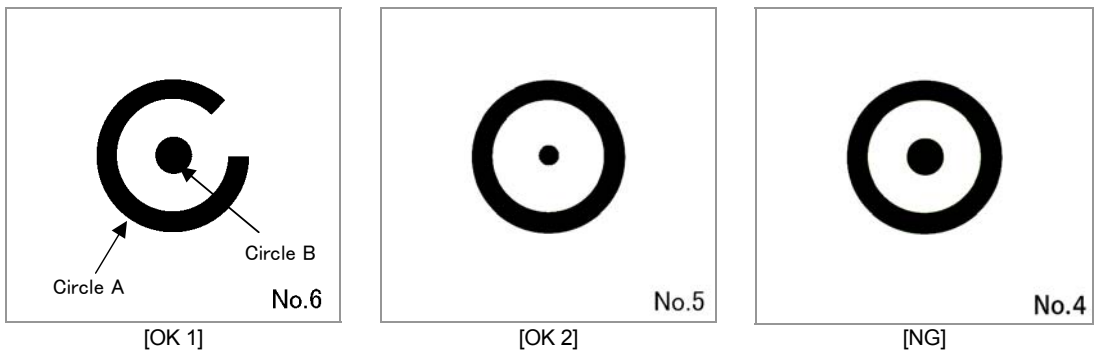
Moreover, verify that signals are correctly output from the parallel ports by viewing Output status monitor.



Output status of signals



3.3 Measure Area A on Image



■ Overview

- 1: Create a Binary Window No.000 to measure the sum of the area of Circle A and B.
- 2: Create a Binary Window No.001 to measure the area of Circle B.
- 3: Subtract the result of Step 2 from the result of Step 1 to obtain the area of Circle A.

■ Exercise 2

Binary Window (Circle setting)
Binary Window (Circle setting for Circle B)
Numeric Calculation Setting

■ Preparation

Product type : No. 001
Training Card : No.4, No.5, and No.6 (3 cards)
Image preparation : Capture Training Card No.4.
Live, C0, Gray

1. Create a new product type.

Press the “OPE/SET” switch in OPERATION. Move the cursor onto “TYPE”, press the ENTER key, select “Select Type”, and then press the ENTER key.

Select Type No.001 and press the ENTER key.

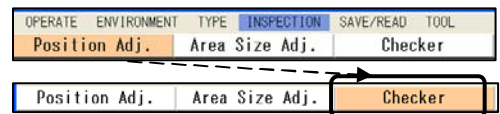
The list shows Common Setting: Yes, Comment: No Name.

Check that it shows “Current Type No.: 001”.

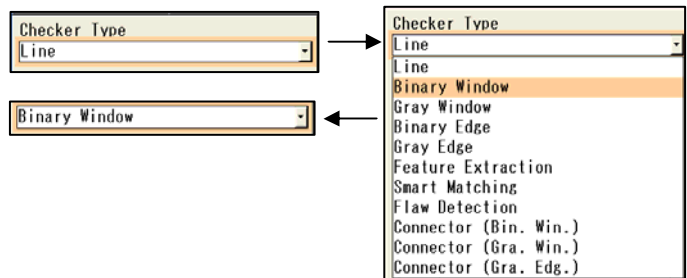
Now, the type is switched to the new one. Press the CANCEL key to return to the main menu.



2. Use the right/left arrow keys (← and →) to move the cursor onto "INSPECTION", and then press the ENTER key.



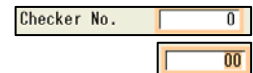
3. Use the right/left arrow keys (← and →) to move the cursor onto "Checker", and then press the ENTER key.



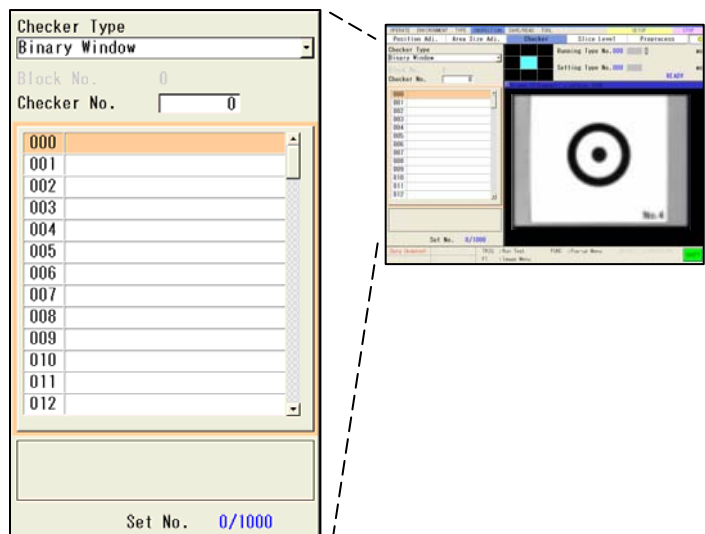
Then, the cursor moves to "Checker Type" field.

Press the ENTER key in "Checker Type" box. Use the up/down arrow keys (↑ and ↓) to move the cursor onto "Binary Window" and then press the ENTER key.

4. Move the cursor with the up/down arrow keys (↑ and ↓) onto "Checker No." Press the ENTER key to set "00" and then press the Enter key again.

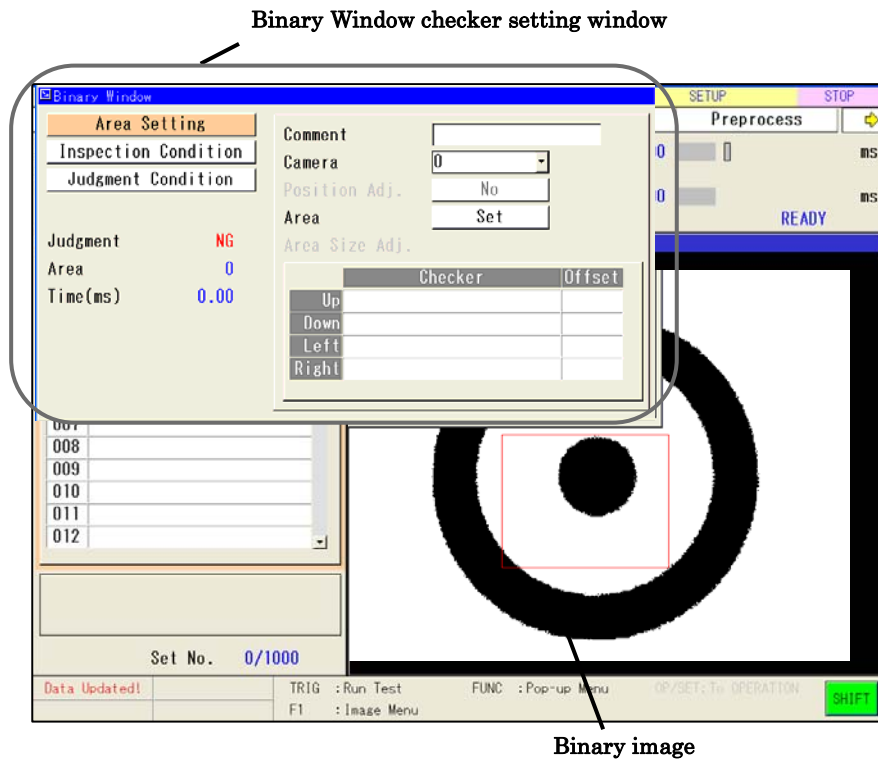


5. Move the cursor with the down arrow keys (↓) to the checker select list. Press the ENTER key to move the cursor to "000". Press the ENTER key again to show the Binary Window setting window.



6. Check that the image displayed on the screen was changed to a binary image.

This binary image is binarized based on the slice level selected by the setting checker.

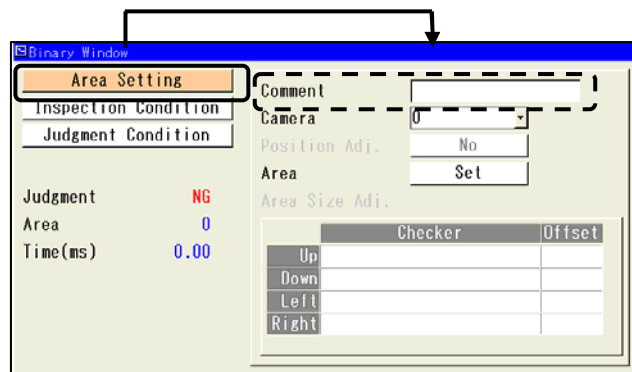


7. Set a checker name in "Comment".

Use the up/down arrow keys (↑ and ↓) to move the cursor onto "Area Setting" and then press the ENTER key.

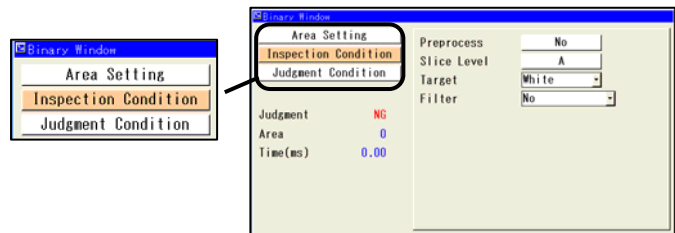
Use the up/down arrow keys (↑ and ↓) to move the cursor onto "Comment" and then press the ENTER key.

The window for entering a comment appears. For this training, enter "AB-AREA". After entering a string, select "Enter" and press the ENTER key.



8. Set a slice level.

Use the down arrow keys (↓) to move the cursor onto "Inspection Condition" and press the ENTER key.



9. Select a slice level group and set it.
Use the up/down arrow keys (↑ and ↓) to move the cursor onto "Slice Level" and then press the ENTER key.

Preprocess	No
Slice Level	A
Target	White
Filter	No

10. Use the up/down arrow keys (↑ and ↓) to move the cursor to the table on the center (Slice level list) and then press the ENTER key.

Upper	255
Lower	128
Auto Adjustment	

Group	Upper	Lower
A	255	128
B	255	128
C	255	128
D	255	128
E	255	128
F	255	128
G	255	128
H	255	128

The table shows upper and lower values that are set for each slice level group A to H.

Select group A and press the ENTER key.
The slice level setting window for group A is displayed.

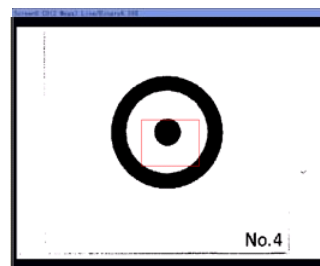
There are two ways to set a slice level, manual and automatic.

First, execute the automatic setting.

Use the up/down arrow keys (↑ and ↓) to move the cursor onto "Auto Adjustment" and then press the ENTER key to execute.

Upper	255
Lower	128
Auto Adjustment	

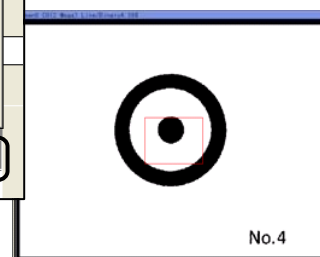
<ENTER>



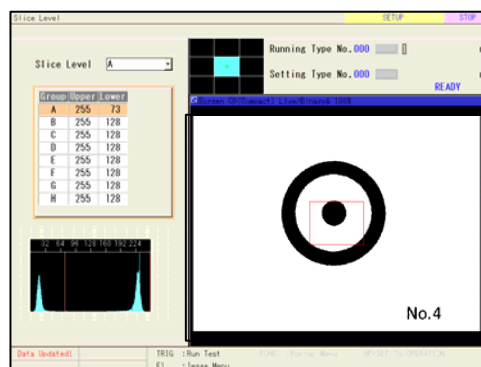
Check that the Lower value field of the setting window shows a new value and the Lower value of group A in the table is updated.

Upper	255
Lower	73
Auto Adjustment	

Group	Upper	Lower
A	255	73
B	255	128



11. Pressing the CANCEL key closes the menu and the values are fixed.



12. If auto adjustment cannot binarize the desired object properly, set slice level manually.
Select slice level group A and press the ENTER key.

Set a suitable value and press the ENTER key.

Press the CANCEL key to close the Upper/Lower values setting window.
And then, press the CANCEL key twice to close the slice level setting window.

Group	Upper	Lower
A	255	73
B	255	128
C	255	128
D	255	128
E	255	128
F	255	128
G	255	128
H	255	128

Upper: 255
Lower: 73
Auto Adjustment

<ENTER>

073

053

Upper: 255
Lower: 53
Auto Adjustment

13. Next, we will set an inspection area.
Area setting can be operated by the menu of “Area Setting”.
Press the CANCEL key to move the cursor back to “Inspection Condition”.
Select “Area Setting” and press the ENTER key.
Move the cursor with the up/down arrow keys (↑ and ↓) onto “Area (Set)”.
Press the ENTER key.

14. Select a circle shape of the inspection area to adjust the object shape.
Use the up/down arrow keys (↑ and ↓) to move the cursor onto “Change Shape” and then press the ENTER key.

Change
Change Shape
Add Mask
Delete Mask

15. A box of list of shapes to change appears. (Rectangle, Ellipse, Circle, and Polygon)

You can draw a circle with either of “Ellipse” and “Circle”. Although both shapes allow drawing a circle, we will use “Ellipse” here to go through how to operate the cursor to draw a shape.

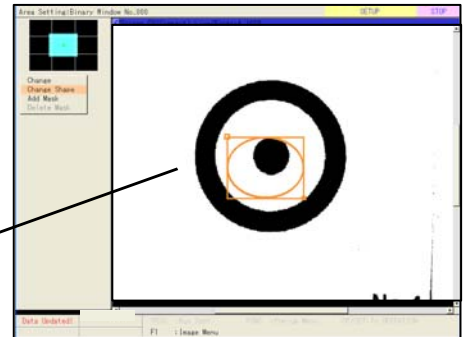
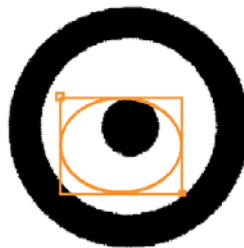
Select “Area Display”.

Use the up/down arrow keys (↑ and ↓) to move the cursor onto “Ellipse”

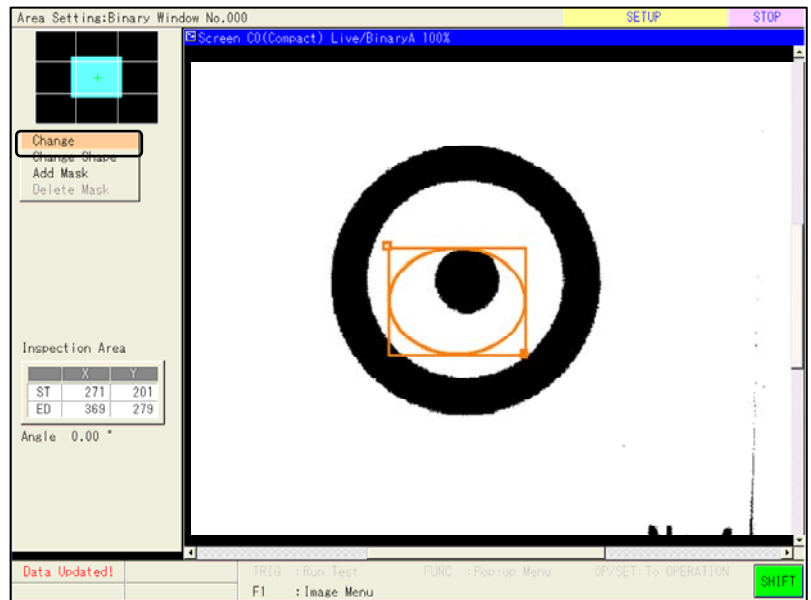
and then press the ENTER key. The checker shape which has been a rectangle changes to an ellipse.

Change	
Change Shape	Rectangle
Add Mask	Ellipse
Delete Mask	Circle
	Polygon

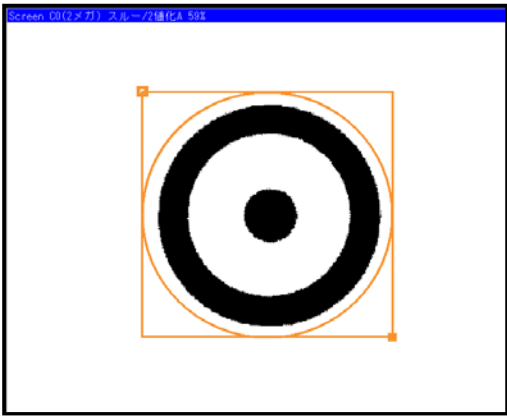
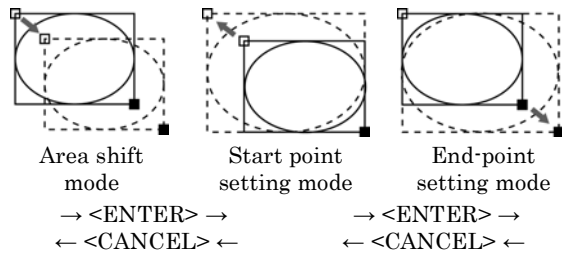
Is the rectangle changed into ellipse on your screen?



16. Use the up/down arrow keys (↑ and ↓) to move the cursor onto “Change” and then press the ENTER key. The color of the checker shape turns from green to orange and a rectangle surrounding the ellipse (circumscribing rectangle) appears.



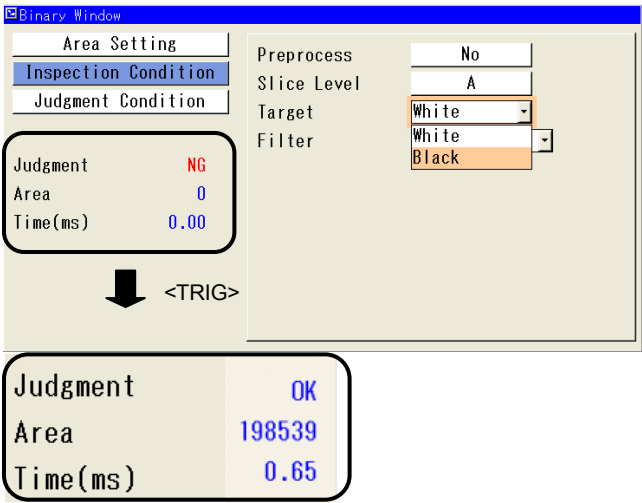
17. Set the inspection area to enclose the outer circle as the figure on the right.
 The setting procedure is all the same as the procedure for a rectangle.



After setting a start point and an end point, leave the Angle "0.00" and press the ENTER key.
 Pressing the CANCEL key finishes the area setting and the cursor goes back to the previous window.

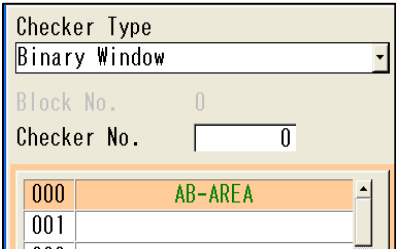
18. Press the CANCEL key and use the up/down arrow keys (↑ and ↓) to move the cursor onto "Inspection Condition", and then press the ENTER key.
 Use the up/down arrow keys (↑ and ↓) to move the cursor onto "Target". Select "Black" and then press the ENTER key again. The inspection target is changed to "Black".

Then, pressing TRIG key runs a test once. Check the area detected by the Binary Window and execution time displayed on the Binary Window setting window.



Now, we have measured the sum of the area of Circle A and B.

Press the CANCEL key twice to move the cursor to list of Binary Window.

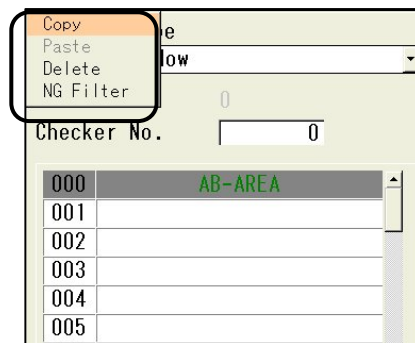


19. Next, we will create another Binary Window to obtain the area of Circle B.

This time, we will create the checker by copying and pasting the Binary Window we have created.

Select the Binary Window No.000 and press the FUNC key.

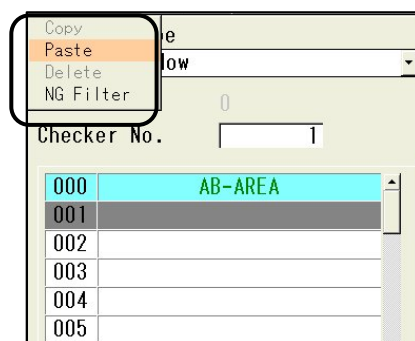
A box with options to delete, copy, or paste a checker appears. Use the up/down arrow keys ((and () to move the cursor onto "Copy" and press the ENTER key.



20. Use the up/down arrow keys ((and () to move the cursor onto a copy destination number (Use No.001 for this exercise), then press the FUNC key.

The box with options to delete, copy, or paste a checker reappears. Because we have registered nothing for Checker No.001 yet, you can select only the "Paste" command.

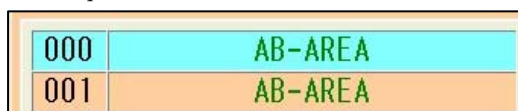
Press the ENTER key on "Paste" to paste the Checker No.000 settings..



After pasting the checker, the screen shows as follows.

When you have not set a comment for the checker, the list shows "No Name".

When you have set a comment for the checker, also the comment is copied and pasted.



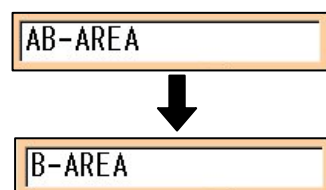
◆ NOTE

"NG Filter" is a function that displays only the checkers of which the result is NG from No.000 to No.999. Using this function allows you revise the checkers outputting NG immediately.

21. Make setting of the pasted checker. Press the ENTER key on No.001 "AB-AREA".

Select "Comment" in "Area Setting". Edit the comment "AB-AREA" to "B-AREA".

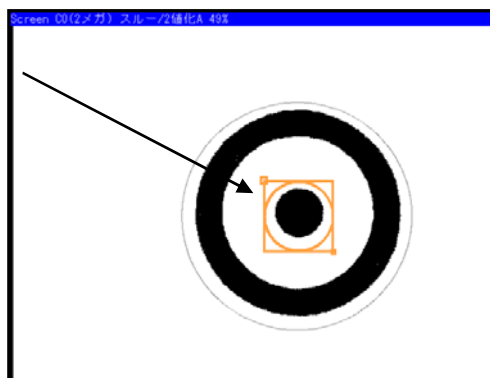
After editing, select "Area" to change the inspection area. (About how to create a comment, refer to Step 6, 7, and 8 in the previous chapter.)



22. Modify the inspection area of checker No.001 obtaining the area of the inner circle as the right figure.

The inspection area set earlier is displayed in gray circle on the screen.

After changing, press the TRIG key. Test is carried out once. Have you measured the area of Circle B?



23. Here is a summary of the exercise at this point.

- Configurations of Binary Window No.000 (specifying the area, slice level, and target).
- Configurations of Binary Window No.001 (copying No.000 and specifying the area).

You can obtain the area of Circle A by subtracting the area given by Binary Window No.001 from the area given by No.000.

Now, how can we program a subtraction in PV500?

■ **What Is Numerical Calculation?**

Numerical Calculation is a function that calculates the data detected by checkers and outputs the data to the external devices.

The area of Circle A can be calculated by using numerical calculation. The numerical calculation has the following main functions;

Executing numerical calculations

Executes calculations, including four arithmetic operations, trigonometric operations, and geometric operations. Up to 1000 functions can be set per Product Type. Statistics data of “Checkers”, “Position Adjustment”, “Area Size Adjustment”, “Numerical Calculation”, and “Judgment” can be includes in the expression. The statistics data can use only the values gathered in OPERATION and the values in STOP status are invalid.

Making judgments on the calculation result

The numeric calculations are judged according to the acceptable range for OK judgment that you have set. If the results of the numeric calculations are within the range, it is judged as “OK”; otherwise, “NG”. The maximum value of this range is “OK Judgment maximum value” and the minimum value is “OK Judgment minimum value”.

Outputting inspection results to external devices

To output inspection results to external devices, you need to make setting from “ENVIRONMENT” > “Input/Output”.

24. Now, we will set a numerical calculation expression.

Use the right/left arrow keys (← and →) to move the cursor onto “Num. Calcu.” and then press the ENTER key.

The cursor moves onto “Checker No.” Press the ENTER key and set “00”. And then press the Enter key again. Move the cursor with the down arrow keys (↓) to the numerical calculation select list.

OPERATE

ENVIRONMENT

TYPE

INSPECTION

SAVE/READ

TOOL

SETUP

STOP

Area Size Adj.

Checker

Slice Level

Preprocess

Num. Calcu.

Block No. 0

Checker No. 00

No.	Expression	Result	Judge.	Max.	Min.	Output >
CAC000	Unset					
CAC001	Unset					
CAC002	Unset					
CAC003	Unset					
CAC004	Unset					
CAC005	Unset					
CAC006	Unset					
CAC007	Unset					
CAC008	Unset					
CAC009	Unset					
CAC010	Unset					
CAC011	Unset					
CAC012	Unset					
CAC013	Unset					
CAC014	Unset					
CAC015	Unset					
CAC016	Unset					
CAC017	Unset					

TRIG :Run Test

FUNC :Pop-up Menu

OP/SET:To OPERATION

F1 :Image Menu

25. Press the ENTER key. On "Expression" of "CAC000", press the Enter key again. Expression setting window appears as the figure below.

Use the up/down arrow keys (↑ and ↓) to move the cursor onto "Comment" and then press the ENTER key. For "Comment", set "A-AREA". (Refer to Step 7 in the previous chapter on how to set it.)

No.	Expression	Result	Judge.	Max.	Min.	Output >
CAC000	Unset					

↓ <ENTER>

OPERATE ENVIRONMENT TYPE INSPECTION SAVE/READ TOOL SETUP STOP

Area Size Adj. Checker Slice Level Preprocess Num. Calcu.

Numerical Calculation CAC000

Comment A_AREA

Expression

Function Description

Maximum 0.000

Minimum 0.000

Output Yes

Result

Judgment

Expression Description

Data Updated!

TRIG : Run Test F1 : Replace Items

FUNC : Pop-up Menu F2 : Delete

OP/SET: To OPERATION F3 : Delete All

26. Use the up/down arrow keys (↑ and ↓) to move the cursor onto "Expression" and then press the ENTER key. The list of items that can be registered in a calculation is displayed.

↓ <ENTER> twice

OPERATE ENVIRONMENT TYPE INSPECTION SAVE/READ TOOL SETUP STOP

Area Size Adj. Checker Slice Level Preprocess Num. Calcu.

Numerical Calculation CAC000

Comment A_AREA

Expression

Checker

Num. Calcu.

Judgment JRC

Judgment JDC

Value

Operator

Gen. Register

Arithmetic

Statistic

Trigonometric

Geometric

Comparison

Scan Count

PAC(Position Adjustment)

AUC(Area Size Adjustment)

LIC(Line)

BWC(Binary Window)

GCW(Gray Window)

BEC(Binary Edge)

GEC(Gray Edge)

FEC(Feature Extraction)

SMC(Smart Matching)

FWC(Flaw Detection)

CBW(Connector-Bin. Win.)

CGW(Connector-Gra. Win.)

CGE(Connector-Gra. Edg.)

Maximum 0.000

Minimum 0.000

Output Yes

Result

Judgment

Expression Description

Data Updated!

TRIG : Run Test F1 : Inase Menu

FUNC : Pop-up Menu

OP/SET: To OPERATION

27. Select "Checker" and press the ENTER key. The cursor moves to "PAC(Position Adjustment)". Use the up/down arrow keys (↑ and ↓) to move the cursor onto "BWC(Binary Window)" and then press the ENTER key.

Checker
Num. Calcu.
Judgment JRC
Judgment JDC
Value
Operator

PAC(Position Adjustment)
AUC(Area Size Adjustment)
LIC(Line)
BWC(Binary Window)
GWC(Gray Window)
BEC(Binary Edge)

Checker
Num. Calcu.
Judgment JRC
Judgment JDC
Value
Operator

PAC(Position Adjustment)
AUC(Area Size Adjustment)
LIC(Line)
BWC(Binary Window)
GWC(Gray Window)
BEC(Binary Edge)

28. The list of Binary Window checkers is displayed. To subtract the area of Circle B from the area of Circle A and B, select the Binary Window measuring the area of Circle A and B first. Use the up/down arrow keys (↑ and ↓) to move the cursor onto No.000 "AB-AREA" and then press the ENTER key.

BWC(Binary Window)
Checker No. 0

000 AB_AREA
001 B_AREA
002
003

UPDATE ENVIRONMENT TYPE INSPECTION SAVE/READ TOOL
Checker Slice Level Preprocess Num. Calcu. Judgment
Running Type No. 000
Setting Type No. 000
READY

BWC(Binary Window)
Checker No. 0

000 AB_AREA
001 B_AREA
002
003
004
005
006
007
008
009

Result type list appears as the right figure. Select "Area" to input and press the ENTER key.

Result Type
Judgment
Inspection Time
Area

003
004

Result/Statistics
62065.000
Result
Result
Statistics

003
004

"Result" and "Statistics" are displayed. Check that the referred area of the Binary Window is displayed. Select "Result" and press the ENTER key.

Check that the set area is displayed in “Result” field.

The area detected by Binary Window No.000 is registered.

The screenshot shows the 'Num. Calcu.' window with the following fields:

- Numerical Calculation: CAC000
- Comment: [Empty]
- Expression: BWC000_AREA
- Function Description: [Empty]
- Maximum: 183600.000
- Minimum: 183000.000
- Output: Yes
- Result: 55188.000
- Judgment: NG
- Expression Description: [Empty]

At the bottom, there are function keys: F1: Replace Items, F2: Delete, F3: Delete All.

<ENTER>

29. Next, we will set a subtraction.
Pressing the ENTER key displays the list of items that can be registered in a calculation.
With the up/down arrow keys (↑ and ↓) and the ENTER key, select “Operator” > “-” and then press the ENTER key.

The screenshot shows a selection menu with the following options:

- Checker
- Num. Calcu.
- Judgment JRC
- Judgment JDC
- Value
- Operator
- Gen. Register

The 'Operator' option is selected, and the '-' symbol is chosen from the list of operators.

30. Next, we will register the Binary Window measuring the area of Circle B in the expression.
Make setting in the same way as the previous one.
Press the ENTER key and select “Checker” > “BWC(Binary Window)” and then press the ENTER key.
As the list of Binary Window checkers appears, press the ENTER key on No.001 “B-AREA”. Press the ENTER key again on “Area”. Select “Result” and check the value is displayed. Then press the ENTER key.

The sequence of screenshots shows the following steps:

- BWC(Binary Window) Checker No. 1**

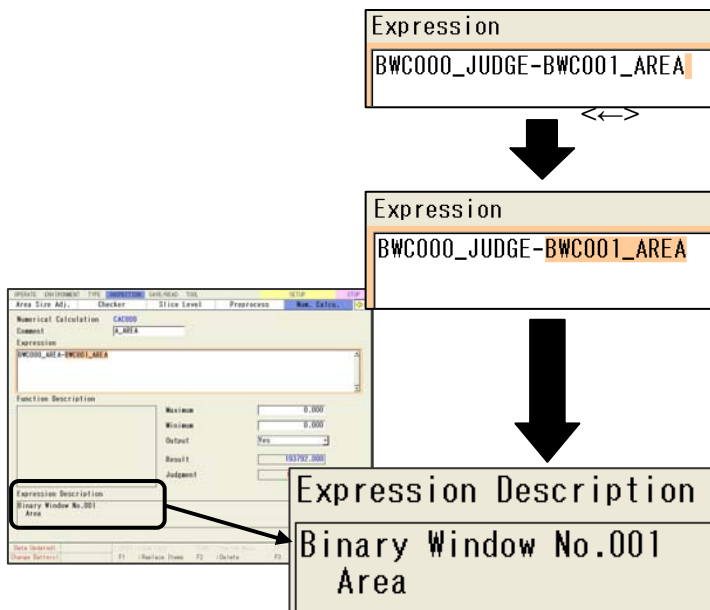
000	AB_AREA
001	B_AREA
002	
003	
004	
- Result Type**

Judgment
Inspection Time
Area
- Result/Statistics**

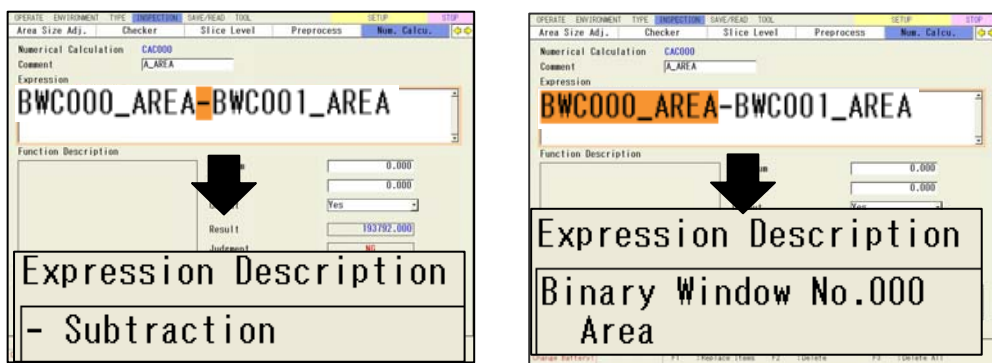
6877.000
Result
Result
Statistics

31. Now, the expression obtaining the area of Circle A is complete. Check this expression is correct or not.

Move the cursor with the left arrow key (←) to select the item. The expression description field shows the set information, checker No. and result type.



Moving the cursor further with the left arrow key (←) shows “Subtraction” and “Binary Window No.000 Area”.



32. After confirming the expression, register it. Press the CANCEL key twice. A message saying “Register?” appears. Choose "YES" and press the ENTER key.



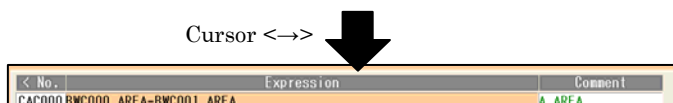
The expression below is registered.
CAC000=BWC000_AREA - BWC001_AREA

BWC000-AREA: Binary Window No.000 (Area)
 BWC001-AREA: Binary Window No.001 (Area)

Does the result field show the area of Circle A?

No.	Expression	Result	Judge.	Max.	Min.	Output
CAC000	BWC000_AREA-BWC001_A	55188.000	NG	0.000	0.000	Yes

Moving the cursor right shows the set comment on the next page.



33. To see the captured image in the current window, you need to press the F1 key. Pressing the F1 key, however, the image hides the result field. PV500 has a function to change the transparency of the setting window and the color of items. Let's have a look at the function.

Press the CANCEL key few times to move the cursor to the main menu.

Use the right/left arrow keys (← and →) to move the cursor onto "ENVIRONMENT" and press the ENTER key.

Then, use the right/left arrow keys (← and →) to move the cursor onto "Color" and press the ENTER key.

The color window appears as the right figure and the cursor moves to "Pattern". The default pattern is set to "Standard". Selecting it with ENTER key shows the preset color patterns. Select "Casual" or "Grass" with the ENTER key.

Can you find the pattern of the screen menu and the color of letters were changed?

Diagram illustrating the navigation sequence to the Color window:

- Initial screen: OPERATE, ENVIRONMENT, TYPE, INSPECTION (selected), Area Size Adj., Checker
- Press <ENTER>: OPERATE, ENVIRONMENT (selected), TYPE, INSPECTION, SAVE/READ, TOOL; Condition, Input/Output, Camera, Color (selected)
- Press <=>: OPERATE, ENVIRONMENT, TYPE, INSPECTION, SAVE/READ; Condition, Input/Output, Camera; Pattern (selected), Details, Font, Dialog, Button/Input Field, Main Menu, Submenu, Menu Selection History, Title Bar, Wall Paper, Key Guide, Information Area, Selection
- Color window details:
 - Pattern: Standard (selected), Casual, Grass, Sepia, Floral, Midnight
 - Details: Font, Dialog, Button/Input Field, Main Menu, Submenu, Menu Selection History, Title Bar, Wall Paper, Key Guide, Information Area, Selection
 - SETUP Window Transmittance: 0% (selected), 0% (No) - 80% (Transparent)

Casual

Sepia

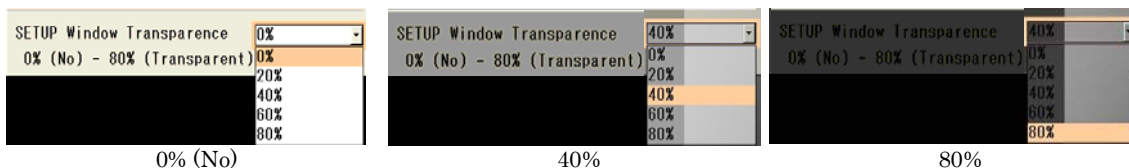
Midnight

In addition to the patterns, you can change the color of "Font" or "Title Bar". When you open "Font", for example, the window shows "R (0-255)", "G (0-255)", and "B (0-255)". By changing the values of RGB (red, green, and blue), you can set colors as you like. In the right figure, all of RGB is set to "0". The "Enter" button is black according to the values of RGB, "0".

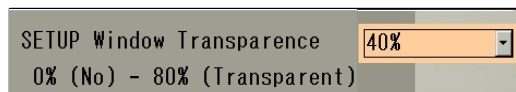
When you change the RGB values, the color of the button changed. The color of setting item will be changed to this color. After changing color and pressing "Enter" button changes the font color.

In the similar way, you can change the color of the other items.

34. To change the transparency, select “SETUP Window Transparency” on the bottom of the menu. When you select it and press the ENTER key, the box shows percentages; 0%, 20%, 40%, 60%, and 80%. Can you see the background is becoming transparent as you increase the value?

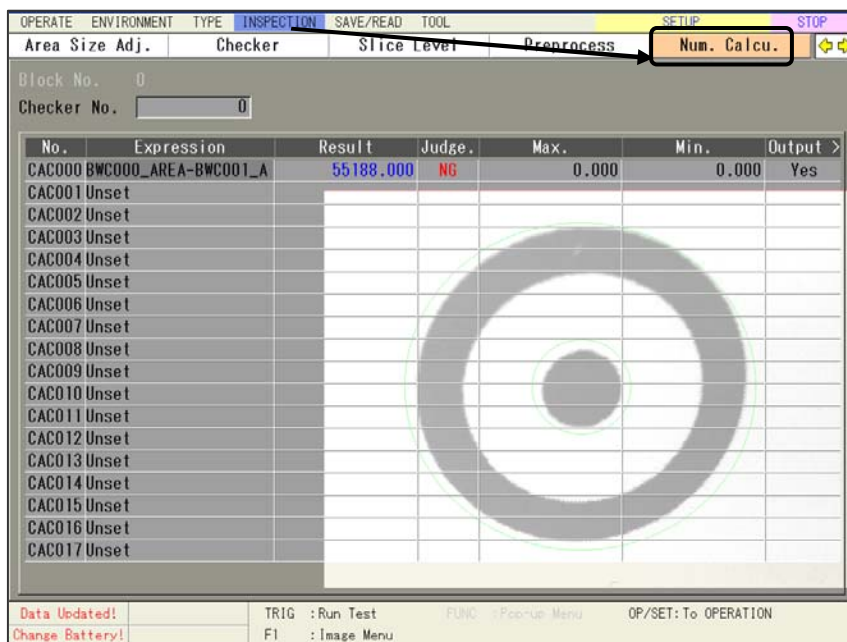


Set it to “40%” for this exercise.
Select “40%” and press the ENTER key.

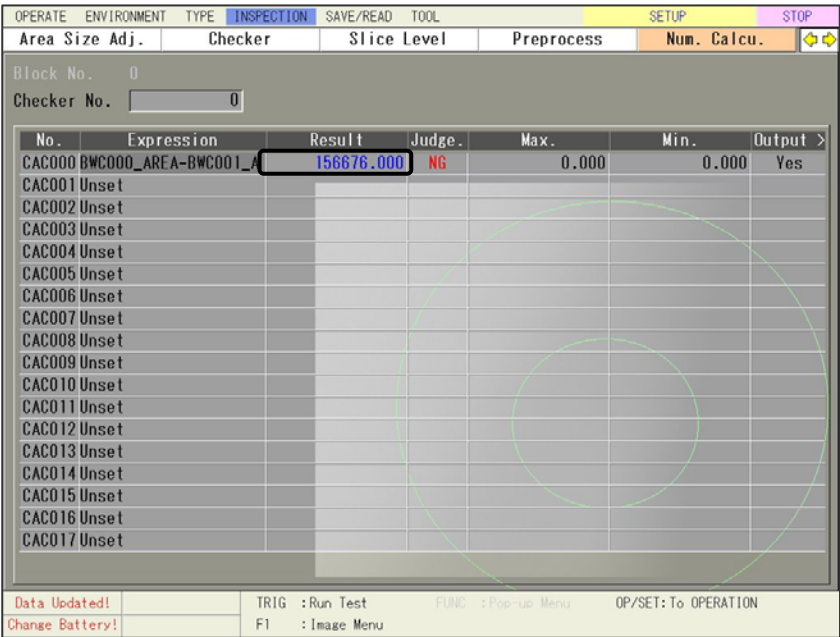


After setting is complete, press the CANCEL key to return to the main menu and select “INSPECTION”. The cursor should be on “Num. Calcu.” where we were setting in the previous step.

Can you see the screen behind the numerical calculation window? Confirm that the setting window is transparent.



35. As we have finished setting of the window transparency, we will create the program to judge the object as which of OK or NG according to the inspection result.
 First, measure the object of OK cards No.4 and No.5 and NG card No.6 (due to a chip) five times each by pressing the TRIG key five times for each card. Write down the results that are shown in the Result columns as the right figure in the table below.
 Confirm that the measured area of the NG circle is smaller than the OK circle.



Card	Target Image	Measured Area Size					Minimum	Maximum
OK object 1 (Card No.4)								
OK object 2 (Card No.5)								
NG object (Card No.6)								

36. Complete the table below using the data.
 Decide the minimum value for OK Object using OK Object and NG Object.
 For the OK Judge Max., tentatively set a value: 10% larger than the measured maximum value of the OK Object.

NG object 1		OK object	
Min.	Max.	Min.	Max.
Average		x 1.1	
OK Judge Min.		OK Judge Max.	

37. Enter the obtained values in "Max." and "Min." in "Num. Calcu." menu.
 Select "0.000" in "Max." and press the ENTER key.
 The enter value window is displayed. Enter value and press the Enter key.
 In the same way, enter minimum value.
 (Refer to NOTE in the previous chapter on how to enter a value.)

No.	Expression	Result	Judge.	Max.	Min.	Output >
CAC000	BWC000_ARE-A-BWC001_A	55188.000	NG	0.000	0.000	Yes

↓ <ENTER>

No.	Expression	Result	Judge.	Max.	Min.	Output >
CAC000	BWC000_ARE-A-BWC001_A	55188.000	NG	0.000	0.000	Yes
CAC001	Unset			0000000000.000		
CAC002	Unset					

0000060700.000

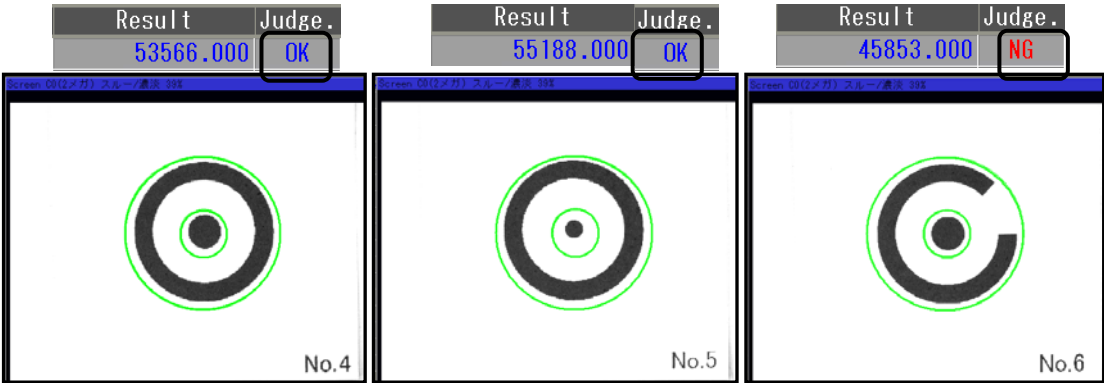
↓ Enter Maximum value and ENTER key

No.	Expression	Result	Judge.	Max.	Min.	Output >
CAC000	BWC000_ARE-A-BWC001_A	55188.000	NG	60700.000	0.000	Yes
CAC001	Unset				0000053200.000	
CAC002	Unset					

0000053200.000

↓ Enter Minimum value and ENTER key

38. Execute an inspection on each card and verify that the checker has correctly judged.



The checker should judge OK Training Cards No.4 and No.5 as “OK”, and NG Training Card No.6 as “NG”.

We have made the setting to judge the object as OK or NG. Now, the results are not output to the external device.
 To output it, set Judgment and Total Judgment. The procedure is almost the same as in the previous one.

39. Open the window of “Judgment” and select “JDC (External)” for “Type”.
Select “JDC000” with the up/down arrow keys (↑ and ↓) and the ENTER key.

No.	Expression	Judge	Comment
JDC000	Unset		
JDC001	Unset		
JDC002	Unset		
JDC003	Unset		
JDC004	Unset		
JDC005	Unset		
JDC006	Unset		
JDC007	Unset		

Condition	Setting
Total Judg.	No
Save Img Memory	No
Image Output	No

40. We have made the setting of numerical calculation to judge the object as OK or NG. Use this result in “Judgment”.
In this exercise, we will configure the judgment function to output a signal from OUT0 of the parallel terminals if the object is judged as OK, and from OUT1 if it is judged as NG.

First, set it to output a signal from OUT0 when the object is judged as OK.
Select “JDC000” and open “Expression” to display the reference item list. Select “Num. Calcu.”
Selecting “Numerical Calculation” for “Type” shows the numerical calculation list.
Select “000 A_AREA”.
The result of the numerical calculation is referred in the expression now. Press the CANCEL key to register the expression.

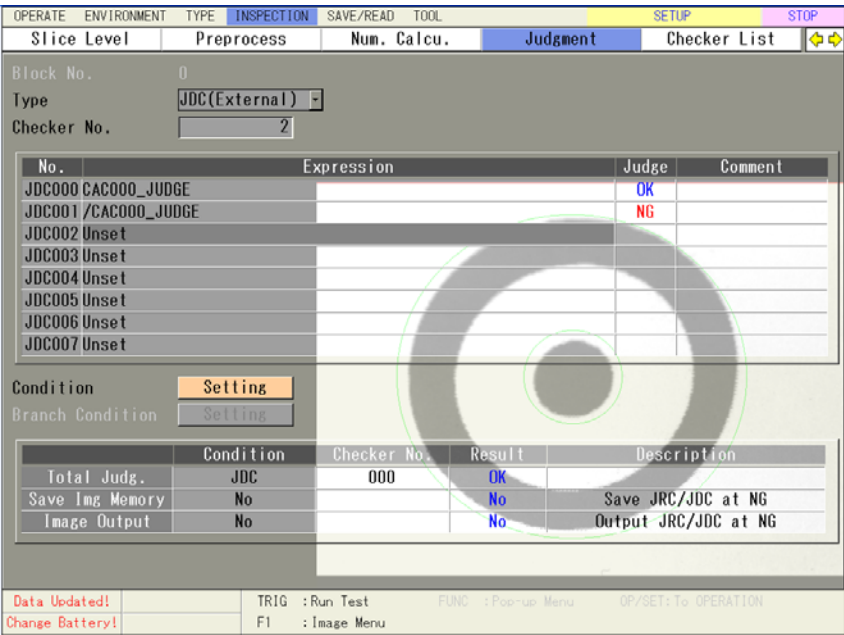
Type	Num. Calcu.	Previous Result
Numerical Calculation	000 A_AREA	

Next, set it to output a signal from OUT1 when the object is judged as NG.
Open “JDC001”, enter “/ (Negation)” from “Operator”, and refer “000 A_AREA” of “Num. Calcu.”
Check that JDC001 displays the opposite result to “JDC000”.
Press the CANCEL key to register the expression.

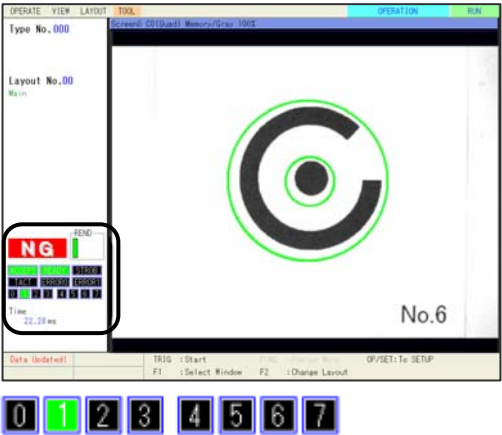
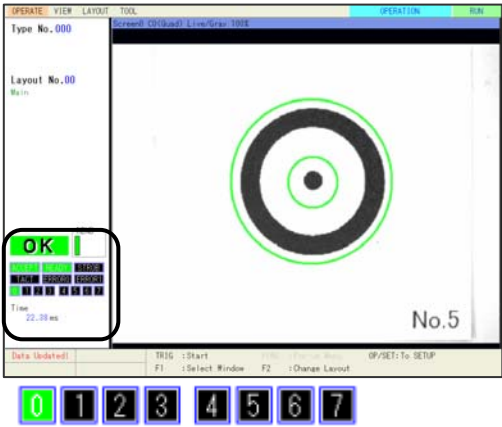
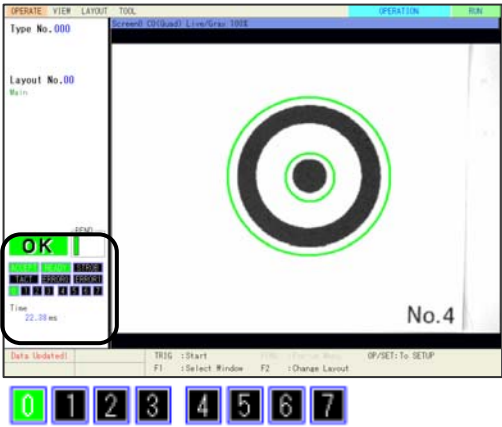
No.	Expression	Judge
JDC000	CAC000_JUDGE	OK
JDC001	/CAC000_JUDGE	NG

41. Set the result of “JDC000” to Total Judgment.
Opening “Setting” of “Condition” shows the setting window.
Open “Condition” of “Total Judg.” and select “JDC”.
Set “Checker No.” to “000”.
After setting is complete, press the CANCEL key to close the setting window.

Now you completed the setting.



42. Run the inspection on OK and NG objects and verify that the screen shows judgment and Total judgment correctly.
Press the CANCEL key few times to move the cursor to the main menu. Snap the OPE/SET Switch. OPERATION window appears.
Place the card and press the TRIG key.



Chapter 4

Connector Checker

4.1 Overview

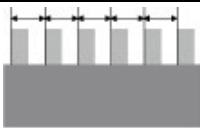
■ What is Connector (Gray Edge)?

This checker measures gaps of IC pins, pitch and float of leads, and parts size (outside/inside diameters). It detects edges of pins and an object by multiple Gray Edge checkers on lines of the area, and is suitable for inspections on a connector IC with many pins. In the same method of Gray Edge checker, it detects a size of an object such as edges of pins and chip parts. Four modes are provided; Gap, Float, Pitch, and Width Measurement. Use them according to your purpose.

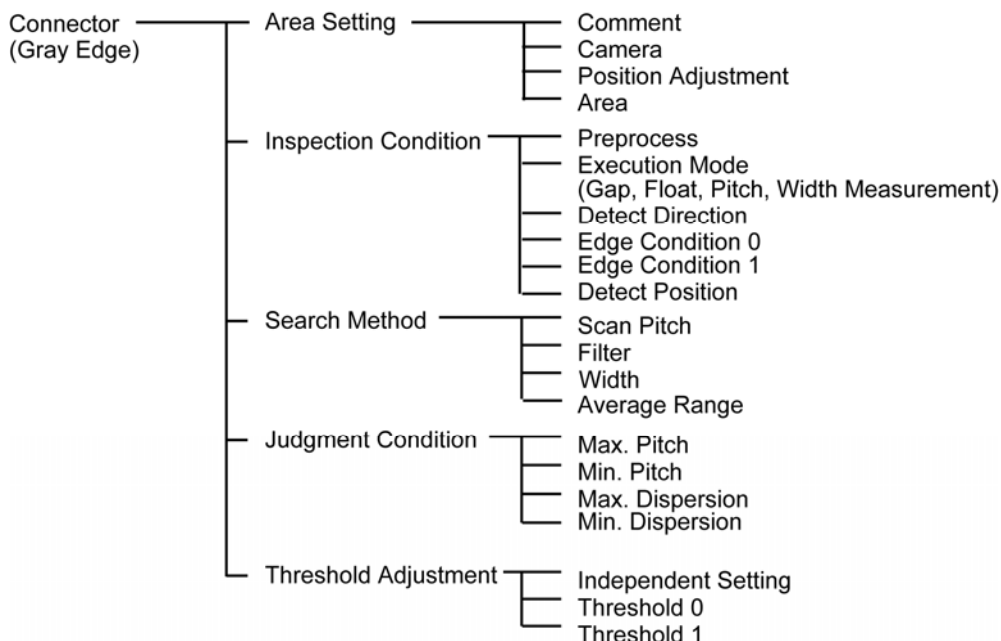
Area shape	Rectangle (Number of cells: Max. 100)					
Detect item (The results differ depending on the execution mode.)		Value	Gap	Float	Pitch	Width Measurement
	Detected Count	3-100	Yes	Yes	Yes	Yes
	Upper/lower/average Pitch		Yes	Yes	Yes	Yes
	Pitch Total Judgment		Yes	Yes	Yes	Yes
	Dispersion Total Judgment		-	Yes	-	-
	Area 1 X	0-1599.999 *	Yes	Yes	Yes	Yes
	Area 1 Y	0-1199.999 *	Yes	Yes	Yes	Yes
	Area 1 Differential	0-255	Yes	Yes	Yes	Yes
	Area 2 X	0-1599.999 *	Yes	Yes (1)	-	Yes
	Area 2 Y	0-1199.999 *	Yes	Yes (1)	-	Yes
	Area 2 Differential	0-255	Yes	Yes (1)	-	Yes

* 2-mega camera is used and calibration is set to "No"

Detection example in the execution modes

Gap	Pitch
Detects a gap between pins. 	
When all gaps are within the set tolerance range of gaps, the object is judged as OK.	Judges if the detected floats are within the set tolerance.
Float	Width Measurement
Detects a tip of each pin and a standard position. The difference between them is the base distance of a float. If the distance is short, it is judged as a float. This base distance is "Float". 	Detects two edges in an area and calculates the difference (width) between them. Multiple widths on the inspection line can be measured at the same time. 
If the float judgment and dispersion total judgment are both OK, total judgment will be OK. Float Judgement: Judges if the detected floats are within the set tolerance. Dispersion Judgement: Judges if the detected dispersion is within the set tolerance.	When all widths are within the set tolerance range of detected widths, the object is judged as OK.

■ Menu Options



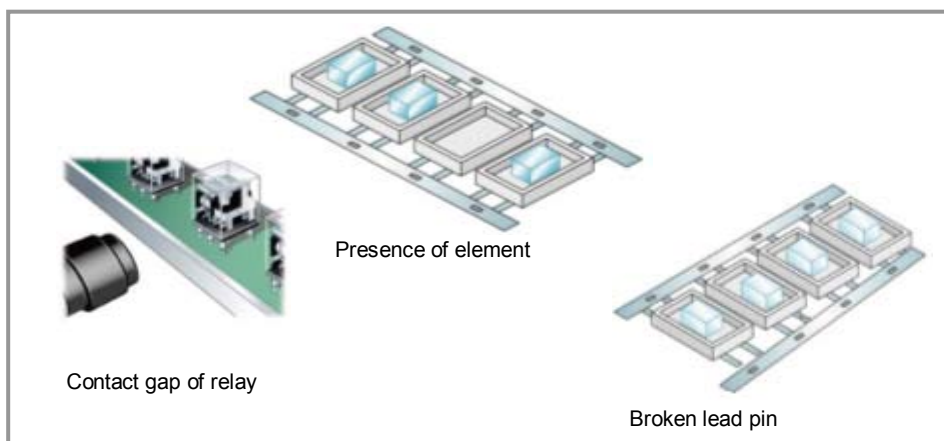
Execution Mode and Settings

	Gap	Float	Pitch	Width Measurement
Checker Direction to the cells	Right angle	Right angle	Parallel	Right angle
Number of set areas (2: Area 0 and 1, 1: only Area 0)	2	2	1	1 *
Pitch result (measurement)	Gap between opposite cells	Distance between the cell of Area 0 and the edge of Area 1.	Distance between detected edges next to each other.	Distance between two edges detected in cells.

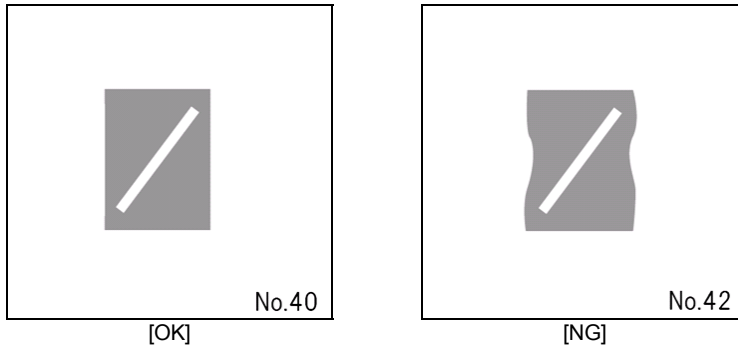
* Although only Area 0 is needed to set, two areas are set at the same time. Thus, you can obtain X/Y coordinates and differentials of both of Area 0 and 1.

Inspection Example

In this manual, we will make an inspection on length using Connector (Gray Edge). Also, you can use it in the situation as the following examples.



4.2 Measure Width of the Object



■ Overview

- 1: Create a Connector (Gray Edge) which detects the width of the object.
- 2: Set the mode to horizontally measure the width.
- 3: Set an area to inspect.
- 4: Measure the width of OK and NG objects.
- 5: From the results of step 4, set the OK range to judge objects.

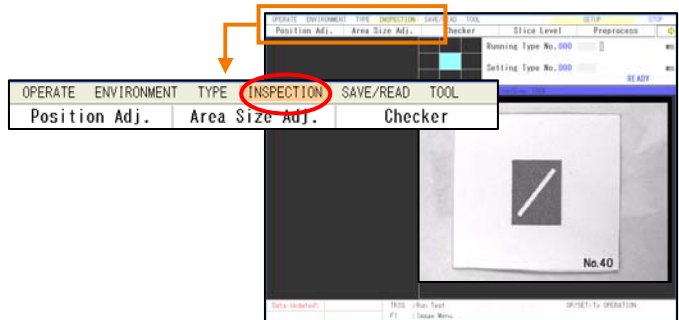
■ Exercise 1

Connector (Gray Edge), Execution mode: Width Measurement

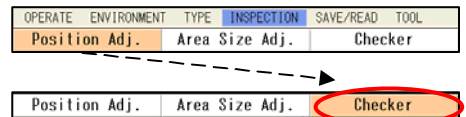
■ Preparation

- Product type : No. 001
Training Card : No.40 and No.42
Image preparation : Capture Training Card No.40.
Live, C0, Gray

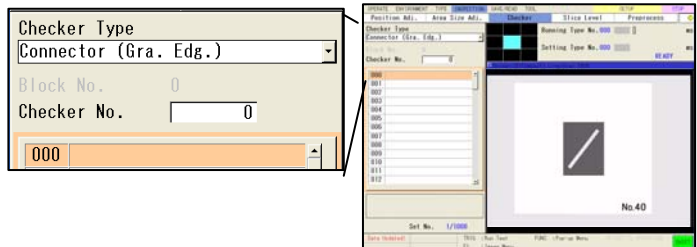
1. Go to SETUP window. Next, use the right/left arrow keys (← and →) to move the cursor onto "INSPECTION", and then press the ENTER key.



2. Use the right/left arrow keys (← and →) to move the cursor onto "Checker", and then press the ENTER key.



3. Select "Connector (Gra. Edg.)" in "Checker Type".



4. Move the cursor with the down arrow key (↓) to the checker select list. Select "000" and press the ENTER key.

5. The setting window of the “Connector (Gray Edge)” is displayed.

Setting window of Connector (Gray Edge)

No.	Pitch	Judg.	Dispers.	Judg.	X0	Y0	Diff.0	X1	Y1	Diff.1

6. We will make setting to measure the width. Move the cursor onto “Inspection Condition” and press the ENTER key.

7. Press the ENTER key on “Execution Mode”. Select “Width Measurement” and press the ENTER key.

As you switch the execution mode, the message appears as the right figure. Confirm that the cursor is on “Yes” and press the ENTER key.

8. Press the ENTER key on “Checker Direction”. Set “Vertical”.

Checker Direction	Vertical
Scan Method	Horizontal
Edge Condition 0	Vertical

The message appears as the right figure.
Select “Yes” and press the ENTER key.

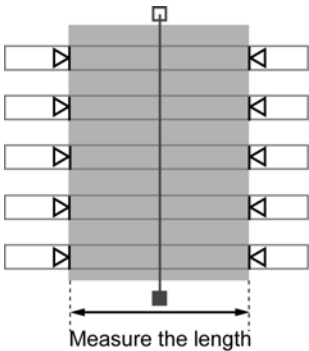
Area setting will be initialized. Are you sure?

Yes

No

■ What is Checker Direction?

Checker Direction is to set a start point and an end point of an area horizontally or vertically.
In this exercise, we will set an area vertically as the right figure to measure the widths of the carton in each position.



The settings of “Execution Mode” and “Checker Direction” in “Inspection Condition” are complete.

Connector (Gra. Edg.)	
Area Setting	
Inspection Condition	
Search Method	
Judgment Condition	
Threshold Adj.	
Judgment	NG
Time(ms)	0.00
Upper Pitch	0.000
Lower Pitch	0.000
Average Pitch	0.000
Pitch Total Judgment	NG
Dispersion Total Judgment	

Preprocess	No
Execution Mode	Width Measurement
Detect Direction	Inside->Outside
Checker Direction	Vertical
Scan Method	Single
Edge Condition 0	Both
Edge Condition 1	Both
Detect Position	Front



◆ NOTE

Be sure to make setting of “Execution Mode” and “Checker Direction” before area setting.

Note that changing them shows the message as the right figure and clears the inspection area.

Area setting will be initialized. Are you sure?

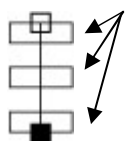
Yes

No

9. Next, make setting to measure the width.
Move the cursor onto “Area Setting” and press the ENTER key.

10. Move the cursor onto “Area (Set)” and press the ENTER key.

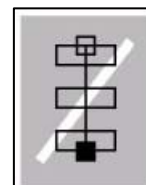
11. A checker area is displayed in the center of the screen.
Now, we are in Area Shift mode.



Each rectangle detects edges inside.

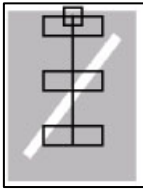
	X	Y
ST	800	480
ED	800	719
#	11	21
N	3	

Move the inspection area into the center of the object with the arrow keys (↑, ↓, ←, and →).



After deciding the position, press the Enter key.

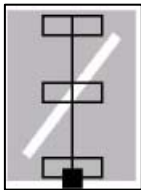
12. Only the start-point is displayed indicating you are in Start-point Set mode.



Set the top position of the cells to measure the width.
After deciding the position, press the Enter key.

13. Only the end-point is displayed indicating you are in End-point Set mode.

Set the bottom position of the cells to measure the width.

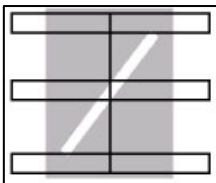


After deciding the position, press the Enter key.

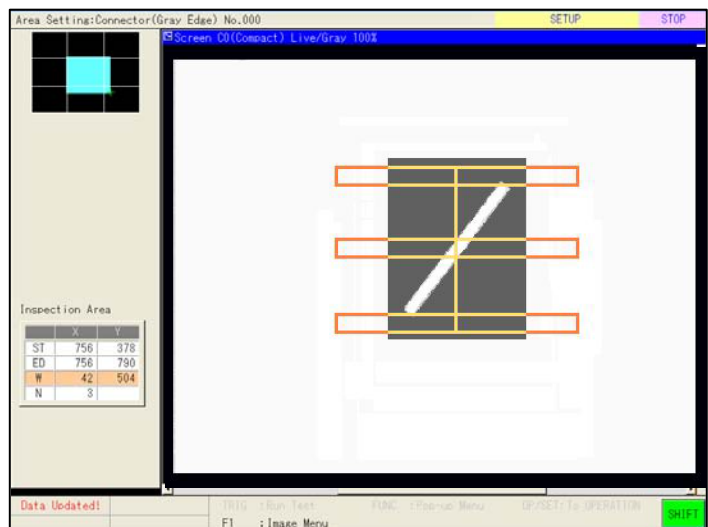
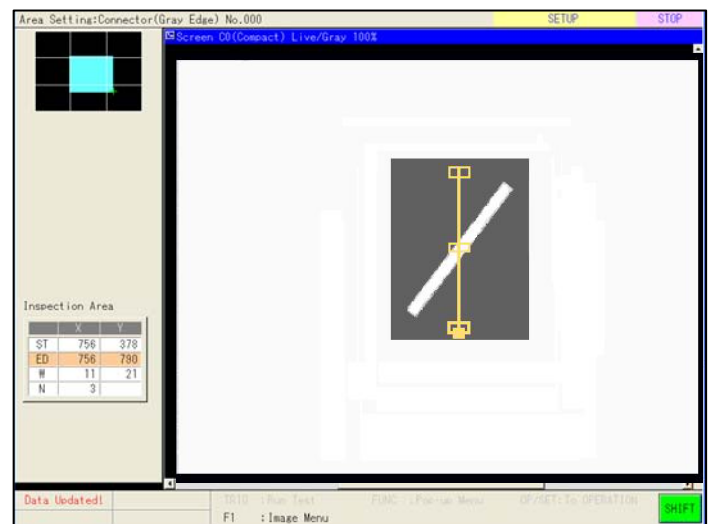
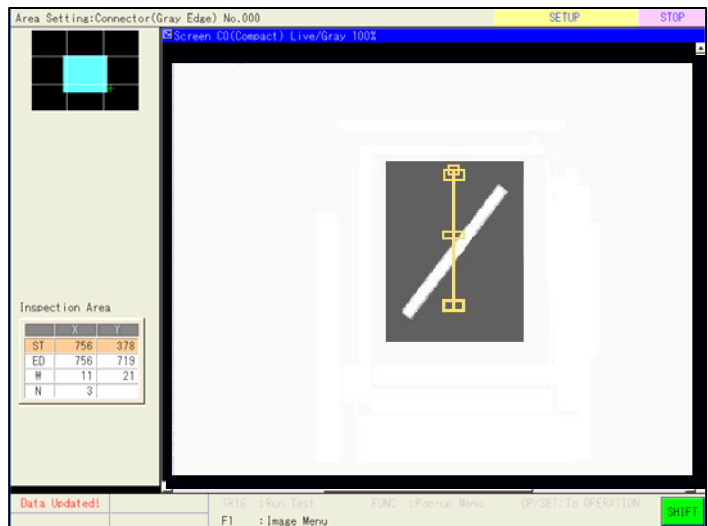
14. Now we are in Cell Size Set mode.

You can adjust the horizontal size by using the up/down arrow keys (↑, and ↓). By using the right/left arrow keys (←, and →), you can adjust the vertical size.*

Adjust the size so that you can detect the both edges of the object.



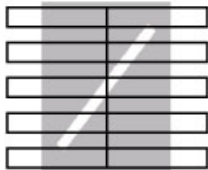
After deciding the size, press the Enter key.



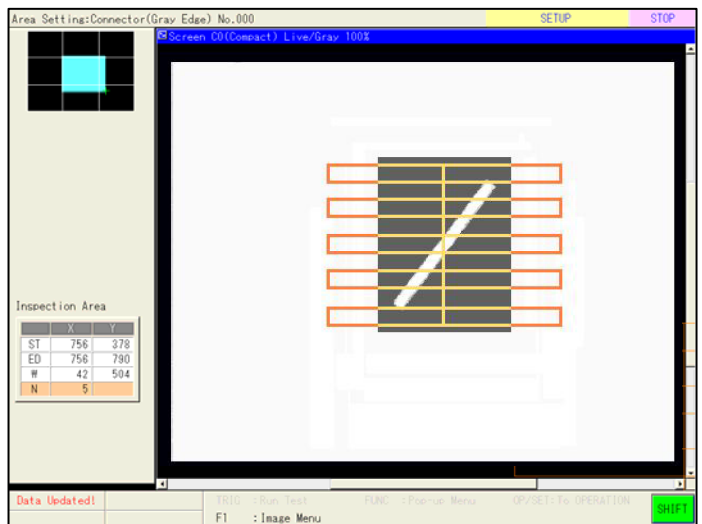
* The operation described here is due to the “Checker Direction” which we have set to “Vertical” in step 8. For further information, refer to the Note on the next page.

15. Now we are in Cell Number Set mode.
Use the right/left arrow keys to change the number of cells.

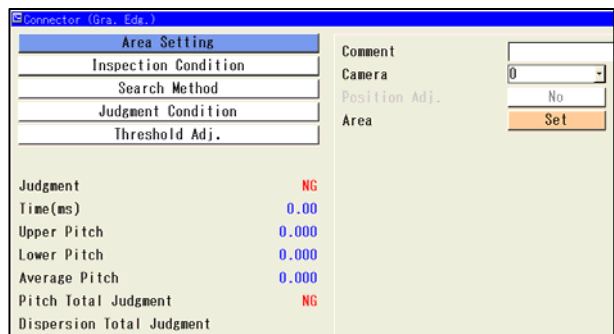
For now, set the value to “5”



After deciding the number, press the Enter key.

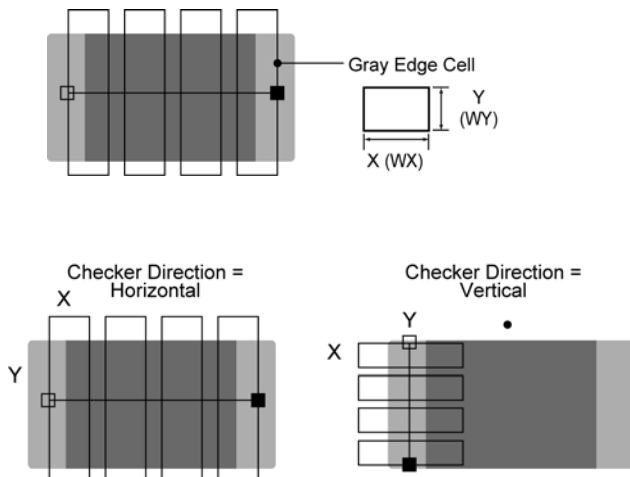


16. The cursor goes back to the previous setting window.



NOTE

In the area setting of Connector checker, the length of the side parallel to the line between the start point and end point is the cell width of X. The length of the side perpendicular to it is the cell width of Y. Note on the directions when you set cell size.



17. Set inspection conditions.
Move the cursor onto “Inspection Condition” and press the ENTER key.
For this exercise, set the condition as follows.

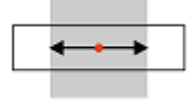
- Detect Direction: Outside -> Inside (default: Inside -> Outside)
- Edge Condition: Light -> Dark (default: Both)

In “Detect Direction”, select the direction to detect an edge from outside or inside of the object.

Outside -> Inside



Inside -> Outside



KEY POINT

When you measure the width in “Width Measurement” of “Execution Mode”, set the direction so that edges of the object will be detected sandwiching the center line of the area between them.

18. Press the TRIG key to execute a test.

The table in the bottom of the setting window lists the results.

No.	Pitch	Judg.	Dispers.	Judg.	X0	Y0	Diff.0	X1	Y1	Diff.1
0	415.484	OK	-----	--	589.463	396.286	-87	1004.946	398.118	-73
1	410.947	OK	-----	--	592.817	490.394	-81	1003.764	493.895	-76
2	411.555	OK	-----	--	592.034	585.560	-86	1003.589	580.579	-76
3	409.809	OK	-----	--	593.743	675.714	-86	1003.552	674.913	-83
4	412.081	OK	-----	--	592.960	768.545	-79	1005.041	767.733	-72

You can see each cell detects two edges on the screen.
The distances between edges detected by cells are shown in “Pitch” column.

No.	Pitch	Judg.	Dispers.	Judg.	X0	Y0	Diff.0	X1	Y1	Diff.1
0	415.484	OK	-----	--	589.463	396.286	-87	1004.946	398.118	-73
1	410.947	OK	-----	--	592.817	490.394	-81	1003.764	493.895	-76
2	411.555	OK	-----	--	592.034	585.560	-86	1003.589	580.579	-76
3	409.809	OK	-----	--	593.743	675.714	-86	1003.552	674.913	-83
4	412.081	OK	-----	--	592.960	768.545	-79	1005.041	767.733	-72

Difference

From the results in the list, the upper and lower pitches, and the average are displayed in the window.

“Pitch Total Judgment” shows OK when all cells return OK on the pitch.

19. Replace the inspection card and press the TRIG key to execute a test. Write down the obtained values on OK object and NG object.

OK object (No.40)		NG object (No.42)	
			
Minimum	Maximum	Minimum	Maximum

20. We will make setting to judge as NG when inspecting on NG card (No.42) using the values obtained in step 18. Press the ENTER key on "judgment Condition". Input the setting values for "Max. Pitch" and "Min. Pitch".

Connector (Gra. Eds.)

Area Setting		Max. Pitch	416.000
Inspection Condition		Min. Pitch	408.000
Search Method		Max. Dispersion	9999999.999
Judgment Condition		Min. Dispersion	0.000
Thresh.Adj.			

Judgment

Time(ms)

Upper Pitch

Lower Pitch

Average Pitch

Pitch Total Judgment

Dispersion Total Judgment

OK

3.24

415.484

409.809

411.975

OK

OK

21. Confirm that OK judgment is output when you inspect OK card and NG judgment is output when you inspect NG card.

[OK object] (No.40)
(The judgment is OK and the area is displayed in green.)

Judgment

Time(ms)

Upper Pitch

Lower Pitch

Average Pitch

Pitch Total Judgment

Dispersion Total Judgment

OK

3.24

415.484

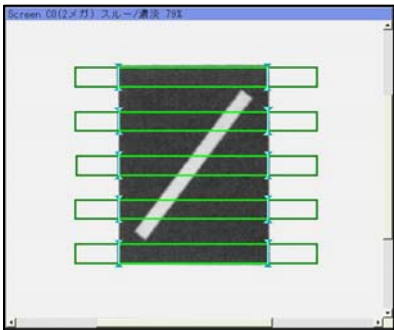
409.809

411.975

OK

OK

No.	Pitch	Juds.	Dispers.	Juds.	X0
0	415.484	OK	-----	--	589.483
1	410.947	OK	-----	--	592.817
2	411.555	OK	-----	--	592.034
3	409.809	OK	-----	--	593.743
4	412.081	OK	-----	--	592.960



[NG object] (No.42)
(The judgment is NG and the area is displayed in red.)

Judgment

Time(ms)

Upper Pitch

Lower Pitch

Average Pitch

Pitch Total Judgment

Dispersion Total Judgment

NG

2.06

399.571

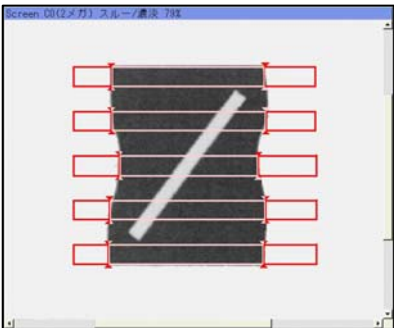
218.611

311.132

NG

NG

No.	Pitch	Juds.	Dispers.	Juds.	X0
0	0.000	NG	-----	--	552.333
1	218.611	NG	-----	--	574.766
2	376.862	NG	-----	--	583.016
3	399.571	NG	-----	--	585.012
4	249.485	NG	-----	--	738.487



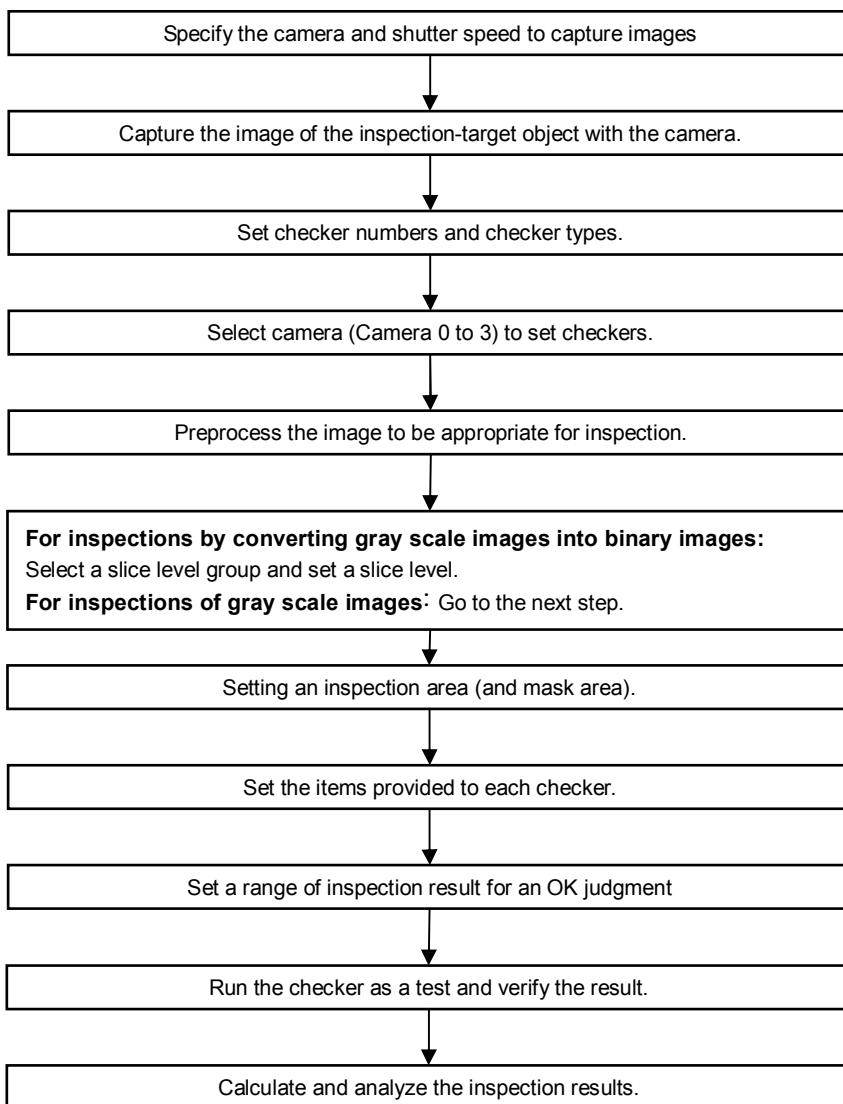
Chapter 5

Basic Setting of Checkers

5.1 Overview

In this chapter, we will learn how to set and modify a "checker" that is a basic unit of image processing functions.

The general procedure of checker setting is as follows. Every step is not always needed and you can skip some steps depending on the condition and images. The checker described here includes "Position Adjustment" and "Area Size Adjustment".



5.2 Checker Number and Checker Type

Select a checker number and the checker type to create. Twelve types of checkers are available in the PV500. You can set up to 1000 checkers per checker type. However, the maximum number of checkers available for a product type is 1000.

■ Creating a New Checker

1. Select "INSPECTION" by tilting the ENTER key left and right, and press the ENTER key.

OPERATE	ENVIRONMENT	TYPE	INSPECTION
---------	-------------	------	------------

The submenu of Inspection appears.

2. Select "Checker" by tilting the ENTER key left and right, and press the ENTER key.

INSPECTION	SAVE/READ	TOOL
Size Adj.	Checker	

3. Select "Checker Type" by tilting the ENTER key up and down, and press the ENTER key.

The list of checker is displayed.

Checker Type
Line
Line
Binary Window
Gray Window
Binary Edge

4. Select a desired checker type by tilting the ENTER key up and down, and press the ENTER key.

5. Select "Checker No." by tilting the ENTER key up and down, and press the ENTER key.

Checker No.	00
-------------	----

6. Enter the number you want to create by tilting the ENTER key up and down, and press the ENTER key.

If a comment is shown next to the checker number, the checker has been already set.

If a comment has not been set, the list shows "No Name".

000	
001	
002	
003	

7. Select "Checker No." by tilting the ENTER key up and down, and press the ENTER key. The cursor moves to the checker number you have set in step 6. Press the ENTER key then.

The setting window of the checker that you selected is displayed.

■ Deleting the Checker

To delete a checker that is already created:

1. Select "INSPECTION" from the main menu, select "Checker", and press the ENTER key.

INSPECTION	SAVE/READ	TOOL
Size Adj.	Checker	

2. Select a checker type to delete.

Checker Type
Line
Line
Binary Window
Gray Window
Binary Edge

3. Move the cursor onto the checker number to delete in the checker list.

4. Press the FUNC key.

The submenu associated with the checker function is displayed.

000	No Name
001	No Name

5. Select "Delete" and press the ENTER key.

The message saying "Are you sure to delete?" appears.

Copy
Paste
Delete
NG Filter

6. Select "Yes" and press the ENTER key.

The checker is deleted, and the title field is cleared.

■ Copying the Checker

To copy a checker that is already created:

1. Select "INSPECTION" from the main menu, select "Checker", and press the ENTER key.

INSPECTION	SAVE/READ	TOOL
Size Adj.	Checker	

2. Select a checker type to copy. Select the checker number you want to copy.

000	No Name
001	

3. Press the FUNC key.

The submenu associated with the checker function is displayed.

Copy
Paste
Delete
NG Filter

4. Select "Copy" and press the ENTER key.

5. Move the cursor onto the checker number you want to paste.

000	No Name
001	

6. Press the FUNC key.

The submenu associated with the checker function is displayed.

Copy
Paste
Delete
NG Filter

7. Select "Paste" and press the ENTER key.

After the checker number was copied, the comment of the source checker is displayed in the pasted checker field.

When you have not set a comment for the checker, the list shows "No Name".

When you have set a comment for the checker, also the comment is copied and pasted.

000	No Name
001	No Name



◆ NOTE

- You can set up to 1000 checkers per product type. (The checker described here includes "Position Adjustment" and "Area Size Adjustment".) The number of checkers which have been set is displayed beneath the checker number list as "Set No." For Area Size Adjustment and the inspection checkers, creating a checker adds one to "Set No." For Position Adjustment, however, creating a checker adds two or three to "Set No."

Checker	Added number
Position Adjustment	3
Rotation Adjustment	3
Position Rotation Adjustment	2
Area Size Adjustment	1
Inspection Checker	1

000	No Name
001	
002	
003	
004	
005	
006	
007	
008	
009	
010	
011	
012	

Set No. 1/1000

Set No. 1/1000

Select Camera

Select a camera (Camera 0 to 3) to set checkers.

Imagechecker temporarily stores captured images in the memory. The images captured with Camera 0 are stored in Memory 0, with Camera 1 are in Memory 1, with Camera 2 are in Memory 2, and with Camera 3 are in Memory 3. This chapter describes how to select a camera and how to switch a displayed image to a memory image when you create a checker.

■ Switching Camera When Creating Checker

1. In the checker setting window, move the cursor onto "Camera" of "Area Setting" and press the ENTER key.

The subwindow for camera selection is displayed.

2. Select a camera number you want to set and press the ENTER key.

The displayed image is replaced with an image of the selected camera.

Camera	0
Position Adj.	0
Area	1
Area Size Adj.	3

■ Switching to Memory Image

1. Press the F1 key in the checker setting window.

Image menu is displayed.

2. Move the cursor onto "Memory/Live" > "Memory" and press the ENTER key.

Memory/Live	Live
Gray/Binary	Memory
	Live

Select Camera
Memory/Live
Preprocess
Pattern Display
Scroll
Magnification
Full Screen
Save Image
Read Image

■ Adjusting Memory Image

Gray Image

You do not have to make an adjustment of gray images on the PV500. However, make a setting checking the live image to use, because an image changes due to lens aperture setting and brightness of the light for image processing.

Binary Image

You need to set a slice level to binarize an image. The checker considers that the pixels having gray scale values within the range of the upper value and the lower value as white; and the other pixels as black.

Eight groups (Group A to H) of upper/lower levels can be specified for each product type.

5.3 Area Setting

The region on the screen that checkers inspect is "Area", which is displayed in green. The function to exclude some parts of an area is "Mask" function and the specified region not to be inspected is "Mask Area". The mask area is displayed in blue. Although the shapes of Area and Mask Area include rectangle, ellipse, circle, polygon (up to hexadecagon), plane scan (rectangle), and line scan (line), broken line, and arc, the settable shapes vary depending on checker type.

■ Setting an area

A setting example for binary window checker is explained below.

1. In the Binary Window setting window, move the cursor onto "Area (Set)" of "Area Setting" and press the ENTER key.

The Area menu is displayed.

Area Setting		Comment	
Inspection Condition		Camera	1
Judgment Condition		Position Adj.	No
		Area	Set

2. Select "Change Shape" and press the ENTER key.

A list of shapes available for the selected checker is displayed.

Change	
Change Shape	Rectangle
Add Mask	Ellipse
Delete Mask	Circle
	Polygon

3. Select "Rectangle", "Ellipse", "Circle", or "Polygon".

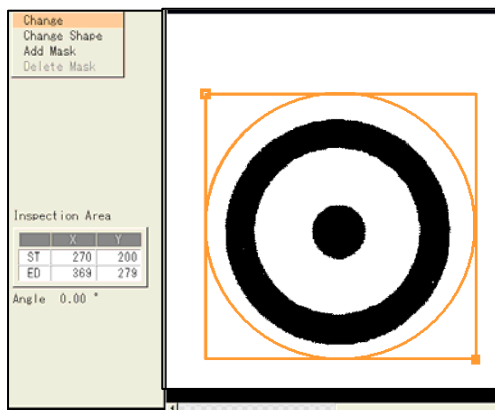
4. Select "Change" and press the ENTER key.

An area is displayed on the screen. Change its position, angle, and size. Refer to the next page for how to set an area.

Change
Change Shape
Add Mask
Delete Mask

5. After deciding the position, the angle, and the size of the area, the area shape is displayed in green indicating it is registered. Then, press the CANCEL key.

The checker menu is displayed.



Shape of Area and Mask for Checkers

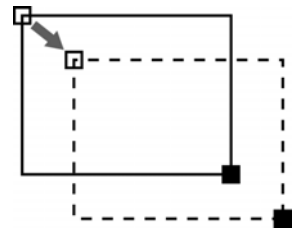
Checker	Area	Mask
Line	Line/ Broken line/ Arc	-
Binary Window	Rectangle/ Ellipse/ Circle/ Polygon	Rectangle/ Ellipse/ Circle/ Polygon
Gray Window	Rectangle/ Ellipse/ Circle/ Polygon	Rectangle/ Ellipse/ Circle/ Polygon
Binary Edge	Line Scan/Plane Scan	-
Gray Edge	Line/ Plane/ Ellipse	-
Feature Extraction	Rectangle/ Ellipse/ Circle/ Polygon	Rectangle/ Ellipse/ Circle/ Polygon
Smart Matching	Template: Rectangle/ Ellipse/ Circle/ Polygon Area: only Rectangle	Template: Rectangle/ Ellipse/ Circle/ Polygon Area: -
Flaw Detection	Line/ Plane/ Ellipse	Rectangle
Connector (Binary Window)	Line Scan	-
Connector (Gray Edge)	Line Scan	-
Connector (Gray Edge)	Line Scan	-

■ Drawing a Rectangle/ Plane

Follow the steps below after displaying a checker shape on the screen by selecting "Change".

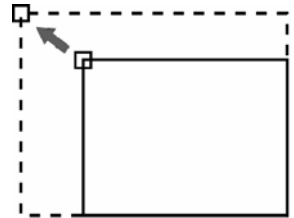
1. Tilt the ENTER key in the desired direction to move the whole rectangle.
Now you are in "Area Shift mode".

2. Press the ENTER key to set the position of the rectangle.



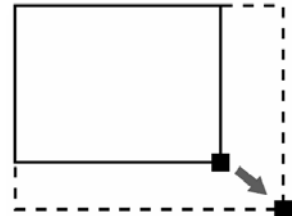
3. Tilt the ENTER key in the desired direction to move the start-point.
Pressing the CANCEL key goes back to step 1.
Now you are in "Start-point Set mode".

4. Press the ENTER key to set the position of the start-point.



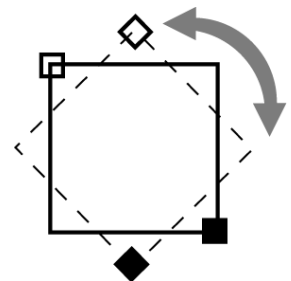
5. Tilt the ENTER key in the desired direction to move the end-point.
Pressing the CANCEL key goes back to step 3.
Now you are in "End-point Set mode".

6. Press the ENTER key to set the position of the end-point.
The screen returns to the area setting menu.



7. Tilt the ENTER key up/down to rotate the area by 1-degree. . Tilt the ENTER key up/down with pressing the SHIFT key to rotate the area by 0.01-degree. Pressing the CANCEL key goes back to step 5.

8. Press the ENTER key to decide the angle of the area.



■ Drawing a Circle

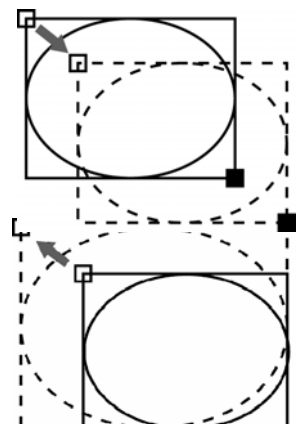
Follow the steps below after displaying a checker shape on the screen by selecting "Change". Set start and end points of a rectangle circumscribing a circle.

1. Tilt the ENTER key in the desired direction to move the whole circle.

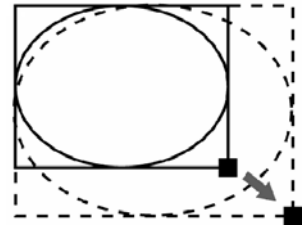
2. Press the ENTER key to set the position of the circle.

3. Tilt the ENTER key in the desired direction to move the start-point of the circumscribed rectangle. Pressing the CANCEL key goes back to step 1.

4. Press the ENTER key to set the position of the start-point.

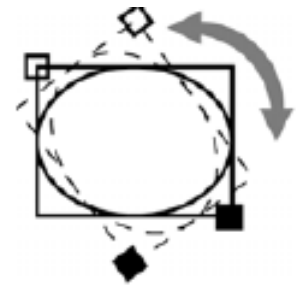


5. Tilt the ENTER key in the desired direction to move the end-point of the circumscribed rectangle. Pressing the CANCEL key goes back to step 3.



6. Press the ENTER key to set the position of the end-point.
The screen returns to the area setting menu.

7. Tilt the ENTER key up/down to rotate the area by 1-degree. . Tilt the ENTER key up/down with pressing the SHIFT key to rotate the area by 0.01-degree. Pressing the CANCEL key goes back to step 5.



8. Press the ENTER key to decide the angle of the area.

■ Drawing a Line (Line scan)

1. Tilt the ENTER key in the desired direction to move the whole line.



2. Press the ENTER key to set the position of the line.

3. Tilt the ENTER key in the desired direction to move the start-point.
Pressing the CANCEL key goes back to step 1.



4. Press the ENTER key to set the position of the start-point.

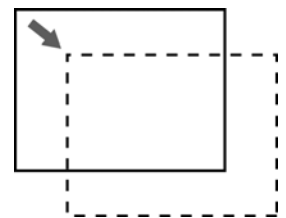
5. Tilt the ENTER key in the desired direction to move the end-point.
Pressing the CANCEL key goes back to step 3.



6. Press the ENTER key to set the position of the end-point.
The screen returns to the area setting menu.

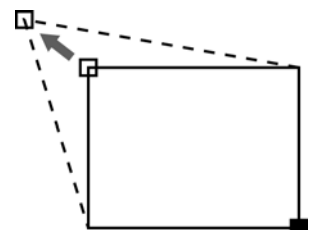
■ Drawing a Polygon

1. Tilt the ENTER key in the desired direction to move the whole polygon.



2. Press the ENTER key to set the position of the polygon.

3. Tilt the ENTER key in the desired direction to move the vertex 1.
Pressing the CANCEL key goes back to step 1.



4. Press the ENTER key to set the position of the vertex 1.
Now you can set the next vertex. To set the vertices, repeat step 3 and step 4. Repeat this operation until the final vertex.

■ Adding Polygon Vertices

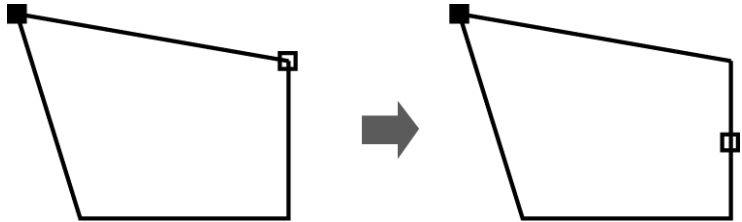
You can add up to 16 vertices to a polygon.

1. Move the desired vertex and press the FUNC key.

The menu adding/deleting vertices is displayed.

2. Select "Add Vertex" from the menu.

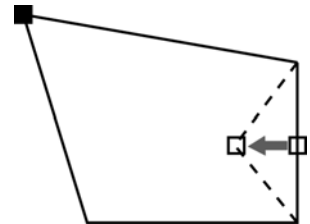
A new vertex is added about the middle position between the currently selected vertex and the next vertex.



3. Tilt the ENTER key in the desired direction to move the added vertex.

4. Press the ENTER key to set the position of the added vertex.

Now you can set the next vertex.



■ Deleting Polygon Vertices

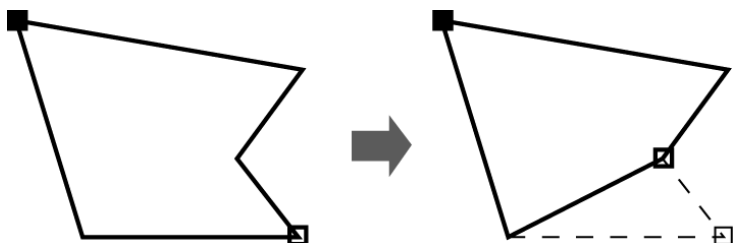
1. Select the vertex you want to delete.

2. Press the FUNC key.

The menu adding/deleting vertices is displayed.

3. Select "Delete Vertex" from the menu.

The vertex you selected is deleted.



■ Drawing Flaw Detection Checker

1. Tilt the ENTER key in the desired direction to move the whole line.

2. Press the ENTER key to set the position of the line.

3. Tilt the ENTER key in the desired direction to move the start-point.

Pressing the CANCEL key goes back to step 1.

4. Press the ENTER key to set the position of the start-point.

5. Tilt the ENTER key in the desired direction to move the end-point.

Pressing the CANCEL key goes back to step 3.

6. Press the ENTER key to set the position of the end-point.

7. Tilt the ENTER key to change the cell size.

Pressing the CANCEL key goes back to step 5.

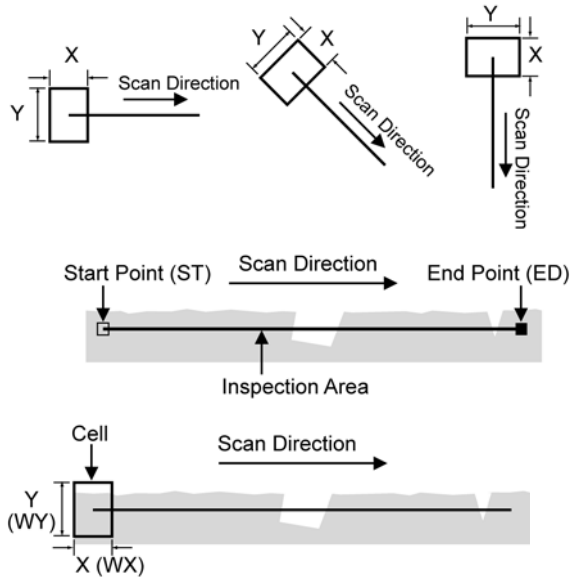
8. Press the ENTER key to decide the cell size.

9. Tilt the ENTER key right/left to change the number of cells.

Pressing the CANCEL key goes back to step 7.

10. Press the ENTER key to decide the number of cells.

The screen returns to the area setting menu.



The Number of Cells (N)



	X (Left/right key of the keypad)	Y (Up/down key of the keypad)
ST	X coordinate of the start point	Y coordinate of the start point
ED	X coordinate of the end point	Y coordinate of the end point
W	Width-X of cell	Width-Y of cell
N	Number of cells	

■ Drawing Connector Checker

1. Tilt the ENTER key in the desired direction to move the whole line.

2. Press the ENTER key to set the position of the line.

3. Tilt the ENTER key in the desired direction to move the start-point.

Pressing the CANCEL key goes back to step 1.

4. Press the ENTER key to set the position of the start-point.

5. Tilt the ENTER key in the desired direction to move the end-point.

Pressing the CANCEL key goes back to step 3.

6. Press the ENTER key to set the position of the end-point.

7. Tilt the ENTER key to change the cell size.

Pressing the CANCEL key goes back to step 5.

8. Press the ENTER key to decide the cell size.

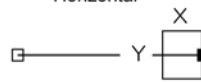
9. Tilt the ENTER key right/left to change the number of cells.

Pressing the CANCEL key goes back to step 7.

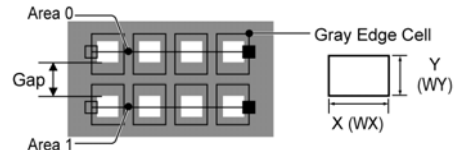
10. Press the ENTER key to decide the number of cells.

The screen returns to the area setting menu.

Checker Direction
= Horizontal



Checker Direction
= Vertical



	X (ENTER key, left/right)	Y (ENTER key, up/down)
ST	X coordinate of the start point	Y coordinate of the start point
ED	X coordinate of the end point	Y coordinate of the end point
W	Width-X of cell	Width-Y of cell
N	Number of cells (Max. 100)	



◆ NOTE

- Pressing the SHIFT key when you tilt the ENTER key moves an area by 10-pixel. You can use the SHIFT key also in setting of a start/end point and vertices of a polygon.

■ Setting Mask Area

You can set up to 16 mask areas for each checker. (Except Flaw Detection.)

- In the checker setting window, move the cursor onto "Area" of "Area Setting" and press the ENTER key.

The Area menu is displayed.

Area Setting	Comment	
Inspection Condition	Camera	1
Judgment Condition	Position Adj.	No
	Area	Set

- Select "Add Mask" and press the ENTER key.

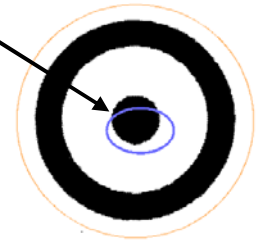
The shape of the mask area is displayed.

Change	
Change Shape	
Add Mask	Rectangle
Delete Mask	Ellipse
	Circle
	Polygon

- Select a desired shape from Rectangle/ Ellipse/ Circle/ Polygon and press the ENTER key.

A blue mask area is added to the center of the image display area.

Mask: Ellipse



■ Changing Position and Size of Mask Area

- In the checker setting window, move the cursor onto "Area" of "Area Setting" and press the ENTER key.

The Area menu is displayed.

Area Setting	Comment	
Inspection Condition	Camera	1
Judgment Condition	Position Adj.	No
	Area	Set

- Select "Change" and press the ENTER key.

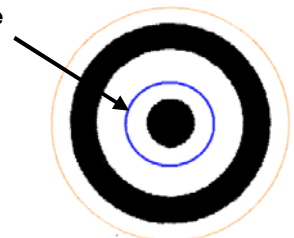
The color of the area changes to orange.

Tilt the ENTER key up/down to display the deleting mask area to in orange. And then, press the ENTER key to select the area to change.

Change
Change Shape
Add Mask
Delete Mask

- In the same steps for setting an area, move the area and set the start point and the end point.

Mask: Ellipse



■ **Changing Area Shape**

1. In the checker setting window, move the cursor onto “Area” of “Area Setting” and press the ENTER key.

The Area menu is displayed.

Area Setting	
Inspection Condition	Comment
Judgment Condition	Camera
	Position Adj.
	Area

1
No
Set

2. Select "Change Shape" and press the ENTER key.

Available shapes are displayed.

Change	
Change Shape	Rectangle
Add Mask	Ellipse
Delete Mask	Circle
	Polygon

■ **Deleting Mask Area**

1. In the checker setting window, move the cursor onto “Area” of “Area Setting” and press the ENTER key.

The Area menu is displayed.

Area Setting	
Inspection Condition	Comment
Judgment Condition	Camera
	Position Adj.
	Area

1
No
Set

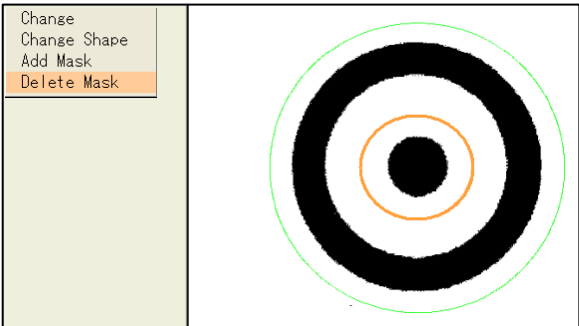
2. Select "Delete Mask" and press the ENTER key.

The mask area is displayed in orange.

Change
Change Shape
Add Mask
Delete Mask

3. Make sure the mask area you want to delete is displayed in orange and press the ENTER key.

The selected mask area will be deleted.



◆ **KEY POINT**

- **Enhanced Color:**
Normally, areas and mask areas are displayed in green and blue respectively, but when setting and changing the area and the mask area, they are shown in orange. In PV500, this orange color is “enhanced color”. This is a helpful function to select the mask area to edit when you have set multiple mask areas.



◆ **NOTE**

- Regardless of an inspection execution or a test run, the mask area and the checker area that were judged as "NG" are displayed in red when you press the TRIG key.

Appendix 1: The List of Checkers

Checker		Description	Judgment criteria of OK/NG
Name	Main application		
Line	Presence/absence inspection Counting	Counts the number of white or black pixels, or the number of object on a line in a binary image.	Number of Pixels Number of the object
Binary Window	Measurement of size Presence/absence inspection	Counts the number of white or black pixels (area value) in a binary image.	Number of black/white pixels
Gray Window	Measurement of brightness Orientation recognition	Calculates the gray average values of all pixels in a specified area.	Gray Average
Binary Edge	Position detection Measurement of length (at high speed)	Detects borders (edges) between white and black area in a binary image.	Edge existence
Gray Edge	Position detection Measurement of length (at high inspection accuracy)	Detects a changing point (edge) in certain brightness based on the gray value of each pixel. This function is effective if the variation in image brightness is small and the contrast of an edge is low.	Number of edges
Feature Extraction	Position detection Angle detection Counting	Detects a black or white pixel cluster larger than a certain size in a binary image. Outputs the feature amount such as the coordinates of the gravity center or principal axis angle.	Number of clusters
Smart Matching	Position detection Angle detection Type recognition	Detects an image similar to a base image saved as a template by using the data of the image brightness (gray value). Supports for low-contrast images or 360-degree rotated images. Extracts the difference between the base image and the detected image (finds out the difference in gray by superposing the base image with the detected image). Setting a Mask area where inspection is not performed is available within a template.	Detection count / Subtraction count
Flaw Detection	Flaw detection Crack or chip detection Burr detection	Calculates gray average value within the segmented area (cell) in a line, arc and circle or rectangular area. Judges areas as flaws where there is certain difference in the average gray level by comparing the other cells.	Flaw detection count
Connector (Binary Window)	Presence/absence inspection	Counts white or black pixels within the segmented area (cell) on a specified line on a binary image.	Number of black/white pixels of each cell
Connector (Gray Window)	Presence/absence inspection	Calculates gray average value of all pixels within the segmented area (cell) on a specified line.	Gray average of each cell
Connector (Gray Edge)	Measurement of pitch of lead pins, float check Width measurement of connector gap	Four modes are available; Gap, Float, Pitch, and Width measurement. Switch among modes depending on inspection type. Using the edge detecting principle of Gray Edge, measures pitches of many pins, detects floats, and measures gaps of a connector. It has also Detect Mode which inspects width or height of parts, using many edges.	Measured size

The table below lists obtainable results by each checker.
Refer to the chapters of each checker for details.

Checker		Area	Position		Shape		Count	Flaw	Gray Value
			Coordinates	Angle	Feature	Correlation			
Line	LIC	Yes					Yes		
Binary Window	BWC	Yes							
Gray Window	GWC								Yes
Binary Edge	BEC		Yes				Yes		
Gray Edge	GEC		Yes				Yes		
Feature Extraction	FEC	Yes	Yes	Yes	Yes		Yes		
Smart Matching	SMC		Yes	Yes		Yes	Yes		
Flaw Detection	FWC		Yes				Yes	Yes	Yes
Connector (Binary Window)	CBW	Yes							
Connector (Gray Window)	CGW								Yes
Connector (Gray Edge)	CGE		Yes						

Checker		Description
Name	Usage	
Position Adjustment	Measurement of a moving amount (X, Y) Movement of a checker shape (toward the current position of an object)	Calculates the distance (adjustment mount) between the base position and the object position obtained by each checker. Grouped checkers perform in the position where the object moved from the base position by this adjustment mount. However, each checkers can refer to only the smaller number of Position Adjustment checkers. The following checkers are available to detect an object.
	Binary Edge	
	Gray Edge	
	Feature Extraction	
	Matching	
Rotation Adjustment	- Measurement of a moving amount (X, Y) - Measurement of rotation angle - Movement of a checker shape (toward the current position of an object) - Rotation of a checker shape according to the rotation angle of the object	Obtains the angle of the object, using the object position (coordinates) obtained by each checker, and calculates the rotation angle (adjustment mount) of the object from the base angle. Grouped checkers perform in the position where the object moved from the base position by this adjustment mount. However, each checkers can refer to only the smaller number of Rotation Adjustment checkers. The following checkers are available to detect an object.
	Binary Edge-Horizontal	Detects an angle using the coordinates of two edges detected by scanning horizontally.
	Binary Edge-Vertical	Detects an angle using the coordinates of two edges detected by scanning vertically.
	Gray Edge-Horizontal	Detects an angle using the coordinates of two edges detected by scanning horizontally.
	Gray Edge-Vertical	Detects an angle using the coordinates of two edges detected by scanning vertically.
	Feature Extraction (Principal Axis Angle)	Adjusts rotation using the angle of the principle axis angle detected by Feature Extraction (+/- 90 degrees).
	Matching 360-degree	Adjusts rotation by using Smart Matching supporting 360-degree rotation.
	Feature Extraction (2 checkers)	Adjusts rotation using the angle created by the straight line connected to the two points detected by two Feature Extraction checkers and the X axis.
	Matching (2 checkers)	Adjusts rotation using the angle created by the straight line connected to the two points detected by two Smart Matching checkers and the X axis.

Appendix 2: The List of Environment Setting

Item	Option		Description	
ENVIRONMENT	Condition	Startup setting	Layout No./ Select Layout No.	Last Layout No./ Selected Layout No. To set Layout No. to call at startup.
			Type No./ Select Type No.	Last Type No./ Selected Type No. To set Type No. to call at startup.
		Operation	Run in SETUP	Stop To stop operation when switching to SETUP window while performing inspection (RUN) in OPERATION
				Continue To continue operation even when switching to SETUP window while performing inspection (RUN).
			Use as Test Image at Going to SETUP	No To save no test image when you switch the window from OPERATION to SETUP.
				Yes To save the lastly inspected image of camera in a SD memory card when you switch the window from OPERATION to SETUP.
			Operation Mode	Parallel To capture the next image after an image is captured.
				Sequential To execute inspection one by one in order.
			General Output	Synchronous/ Asynchronous To select whether or not to output data within the inspection time.
			Image Output	Synchronous/ Async.(img output first)/ Async.(sequence first) To select whether or not to output an image within the inspection time.
			Parallel Reset Condition	Hold To hold a parallel output signal until the next inspection result is output.
				Reset To reset a parallel output signal before capturing the next image.
			Repeat	No To start inspection using input signals from the external device.
				After Trigger To start inspection using input signals from the external device and repeat.
				Automatic To start and repeat inspection before receiving input signals from an external device.
			Template Setting	Use the Last Image To use the current memory image, which is the last captured inspection image to register a template.
				Capture New Image To capture a new image to register a template.
			Position	Set Position/ Adjusted Position To set the position of the re-register area.
			Area Display	No/Yes To switch re-register area display On/Off. To display the area, the re-register start signal must be input twice.
			Registration	Per Checker To save a template as the common for all product types and select it from the common template in Smart Matching.
				Common To save a template as the common for all product types and select it from the common template in Smart Matching.
		General Register	SYS: REG0 Default to SYS: REG7 Default	-9999999.999 to 9999999.999 There are eight registers for values. These registers can be referred to an expression of numerical calculation.

Item	Option		Description	
ENVIRONMENT	Parallel	REND OFF Min. (ms)	0 to 1000 ms	To set these items when external devices such as a PLC cannot detect signal switch between ON and OFF because the OFF time of ReadEnd signal and Accept signal is too short.
		ACCEPT OFF Min. (ms)		
			Set ASSIGN 0 to 5	To use this to perform the function below by a signal from the external device. Template setting/ Switch RUN and STOP/ Save data in PV/ Save data in SD/ Read data from PV/ Read data from SD/ Reinspect/ Reset statistics/ Reset error/ Save image memory to SD/ Output latest image/ Clear image memory/ Print screen/ Pause inspection and process
	Parallel output	Output Data, Handshake, Scan Count, Judgment, Numerical Calculation, Bit Width, Data Bit, Output Signal Guarantee Time, Timeout	Once: outputs only 16 judgments of No.0 to 15 to OUT0 to 15 of the I/O connector. All: outputs data of Scan Count, Judgment, and Numerical Calculation that have been set to "Output" to the external device.	
	Serial	Baud Rate, Bit Length, Stop Bit, Parity Check, Flow Control	To select a condition for RS-232C communication with the external device	
	General Output	Destination	None	Not to output inspection result.
			Serial (COM.0)	To output data of Scan Count, Total Judgment, Judgment, and Numerical Calculation that have been set to "Output" to the external device.
			Ethernet	
			SD Card	
		Protocol	General Output	To communicate with the external device through COM.0 port using RS232C except when you use a PLC.
			Computer Link	To communicate in Computer Link mode.
		Scan Count	No/ Output	To output the scan count to the external device.
		Total Judgment	No/ Output	To output results of Total Judgment set in "INSPECTION" > "Judgment" > "Total Judgment" to the external device.
		Judgment	No/ Output	To output all results set to "JDC (external)" in "INSPECTION" > "Judgment" to the external device.
Numerical Calculation		No/ Output	To output numerical calculations set to "Yes" for "Output" in "INSPECTION" > "Num. Calcu." to the external device.	
Digit (General Output)		4 to 14	To specify the digit number of output data.	
Decimal Digit (General Output)	0 to 3	To specify the decimal digit number of output data.		
Unused Digit (General Output)	Filled with Zeros/ Comma Separated	To set a process when the output digit number is less than output digit number.		

Item	Option		Description		
ENVIRONMENT	Input/ Output	General Output	PLC Type (Computer Link)	MEW: FP/ Mitsubishi: MELSEC-A/ Mitsubishi: MELSEC-Q/ Mitsubishi: MELSEC-FX/ Mitsubishi: MELSEC-FX-2/ OMRON: C+CV+CS1/ Allen-Bradley: SLC/ Fuji: MICREX-SX	To set a PLC type for communicating in Computer Link communication mode.
			Start Register (Computer Link)	0 to 99999	To specify the data register number of the target PLC.
			Bit Width (Computer Link)	16-bit/ 32-bit	To select 16-bit or 32-bit to output one data.
			Timeout (ms) (Computer Link)	20 to 20000	To limit the response time from a PLC.
			Data Output Completion Notice (Computer Link)	No/ Yes	To notice to a PLC outputting data from the imagechecker is complete.
			Output Register (Computer Link)	0 to 99999	To specify the data register of the target PLC.
			Output Bit (Computer Link)	0 to 15	To set data bit to output.
			Type Signal (Computer Link)	Parallel/ Computer Link	To select which of parallel I/O communication or reference data stored in the specified register to input a type switch signal in Computer Link mode.
			Type No. Register (Computer Link)	0 to 99999	To specify the register number to store the number of type switch signal that is input through Computer Link.
	Image Output	Destination	None	Not to output inspection images.	
			SD Card	To output images to a SD memory card attached to PV500.	
			Ethernet	To output images to the PC in which the designated software* is installed via Ethernet. * Image Receiver for PV310 which is available in our web site.	
		Output Conditions	All	To output images at every inspection.	
			NG Judgment	To output images when the judgment selected in “Image Output” in “Judgment” is NG.	
			At Interval	To output images per the specified number of inspections.	
			Command Reception	To output images when receiving the special command from external device.	
		Interval	2 to 10000	This setting is activated when you set “At Interval” to output images. To output images at every specified value.	
		Camera No.0 to 3 Output	No/Yes	To output images captured with camera No.0 to 3 to a SD memory card or to a PC through Ethernet.	
	File Header	8 characters	To specify the header at the destination where an image is output.		

Item	Option		Description		
ENVIRONMENT	Input/ Output	Image Output	Additional Information 0 to 3	None/ Type No./ Date/ Time/ Total Judgment To select the information to be added to a file name. File name = “Header”, “Additional Information 0_”, “Additional Information 1_”, “Additional Information 2_”, “Additional Information 3_” and “.bmp (extension)”	
			Overwrite (SD Card)	No/Yes	To overwrite images from the older image file in the older folder or to stop saving images.
			Save Folder (SD Card)	1 to 1000	To decide the number of folders to save images.
			ERR signal ON at Output Error (Ethernet)	No	Not to turn on Error signal.
				Yes	To turn on Error0 signal when an error occurs.
			Forced Outage at Output Error (Ethernet)	No	To continue inspecting.
		Yes		To abort inspections.	
		Save Image Memory	Saving Condition	No	Not to save images.
				All	To save all inspection images.
			Overwrite	NG Judgment	To save only the inspection images of which “Total Judgment” results are judged as NG.
				No	To stop image saving. (The inspection will be continued.)
		Yes	To continue to save images overwriting the older images.		
		Print screen	Destination	To copy the contents displayed on the entire screen in all windows and output to a SD card or Ethernet. The images are saved as bitmap.	
	Camera	Camera	—	To set a type of camera for each connecting camera ports.	
		FLASH Polarity	—	PV500 sends a FLASH signal which notices the timing of light emission to a strobe lighting. Four terminals are provided for four cameras. To select the polarity of the FLASH signals for each camera.	
	Color	Pattern	Standard/ Casual/ Grass/ Sepia/ Floral/ Midnight	To change the colors of letters, menus, and areas displayed on the screen. You can select from six preset color patterns. In addition, you can create a new color (as a custom setting) based on the selected color pattern.	
		SETUP Window Trans- parency	0, 20, 40, 60, 80%	To change the transparency of the displayed setting windows.	
	Password	Password/ Enter Password	Up to 15 characters	To set a password requested when you switch the window from OPERATION to SETUP.	
		Save Data in OPERA- TION Window	No/ Yes	To save data in the main memory when you modify some data in OPERATION window.	
	Initialize		—	To return the configuration data to default settings.	

Appendix 3: The List of Reference Data for Calculation and Restrictions

■ A List of the Data Can Be Referred to Numeric Calculation

The reference data listed below can be incorporated into Numeric Calculation formulas. After performing calculations, the formulas including the symbols and numbers from 0 to 9 in the table below are displayed. The data described below is that can be used in numerical calculation. The symbols in parentheses are displayed in operation expressions.

Inspection data that can be registered in Numerical Calculation

▶ Note

Depending on type of result data, selectable statistics data varies when selecting “Statistics”.

Statistics type: 1

Scan Count (@TIME)	OK count (@OK)	NG count (@NG)
--------------------	----------------	----------------

Statistics type: 2

Minimum (@MIN)	Min. OK Judg. (@OKMIN)	Min. NG Judg. (@NGMIN)
Maximum (@MAX)	Max. OK Judg. (@OKMAX)	Max. NG Judg. (@NGMAX)
Average (@AV)	OK average (@OKAV)	NG average (@NGAV)
Range (@RG)	OK range (@OKRG)	NG range (@NGRG)
Disperse (@DV)	OK disperse (@OKDV)	NG disperse (@NGDV)

Checker

Item	Result No.	Result Type	Statistics type	Details
Position Adjustment (PAC) No.0-999	---	Judgement (JUDGE)	1	Output data OK=1, NG=0
		Inspection Time (TIME)	2	
		X Adjustment Amount (AJX)	2	
		Y Adjustment Amount (AJY)	2	
		Adjustment Amount (AJA)	2	
		X	2	
		Y	2	
		Theta(ANG)	2	
		Base Judgement (BJUDGE)	No.0-3	1
		Base Inspection Time (BTIME)	No.0-3	2
		Base X (BX)	No.0-3	2
		Base Y (Y)	No.0-3	2
		Base Projection X (BPX)	No.0-3	2
		Base Projection Y (BPY)	No.0-3	2
Area Size Adjustment (AUC) No.0-999		Judgement (JUDGE)	1	Output data OK=1, NG=0
		Inspection Time (TIME)	2	
		X coordinate (X)	2	
		Y coordinate (Y)	2	
		Projection distance of X (PX)	2	
		Projection distance of Y (PY)	2	
Line (LIC) No.0-999	---	Judgement (JUDGE)	1	Output data OK=1, NG=0
		Inspection Time (TIME)	2	
		Dot count judgment (DJ)	1	Output data OK=1, NG=0
		Land count judgment (LJ)	1	Output data OK=1, NG=0
		Dot count (DCNT)	2	Output value: 0 - 125938
		Land count (DCNT)	2	Output value: 0 - 41979
Binary Window(BWC) No.0-999	---	Judgement (JUDGE)	1	Output data OK=1, NG=0
		Inspection Time (TIME)	2	
		Area (AREA)	2	Output value: 0 - 1920000

Item	Result No.	Result Type	Statistics type	Details
Gray Window(GWC) No.0-999	---	Judgement (JUDGE)	1	Output data OK=1, NG=0
		Inspection Time (TIME)	2	
		Gray Average (AVE)	2	Output value: 0 - 255
Binary Edge(BEC) No.0-999	---	Judgement (JUDGE)	1	Output data OK=1, NG=0
		Inspection Time (TIME)	2	
		Detection count (COUNT)	2	Output value: 0 - 256
	0-255	X coordinate (X)	2	
		Y coordinate (Y)	2	
		Detected color (COLOR)	2	Output value: White > Black=0, Black > White=1
Gray Edge(GEC) No.0-999	---	Judgement (JUDGE)	1	Output data OK=1, NG=0
		Inspection Time (TIME)	2	
		Detection count (COUNT)	2	Output value: 0 - 256
	0-255	X coordinate (X)	2	
		Y coordinate (Y)	2	
		Differential Value (DEF)	2	Output value: 0 - 255
Feature Extraction (FEC) No.0-999	---	Judgement (JUDGE)	1	Output data OK=1, NG=0
		Inspection Time (TIME)	2	
		Detection count (COUNT)	2	Output value: 0 - 10000
	0-9999	Area (AREA)	2	Output value: 0 - 1920000
		X coordinate of gravity center (X)	2	
		Y coordinate of gravity center (Y)	2	
		Projection width (PWX)	2	Output value: 0 - 2000
		Projection height (PWY)	2	Output value: 0 - 2000
		X coordinate of the upper left point of circumscribing rectangle (LUX)	2	
		Y coordinate of the upper left point of circumscribing rectangle (LUY)	2	
		X coordinate of the upper right point of circumscribing rectangle (RUX)	2	
		Y coordinate of the upper right point of circumscribing rectangle (RUY)	2	
		X coordinate of the lower left point of circumscribing rectangle (LDX)	2	
		Y coordinate of the lower left point of circumscribing rectangle (LDY)	2	
		X coordinate of the lower right point of circumscribing rectangle (RDX)	2	
		Y coordinate of the lower right point of circumscribing rectangle (RDY)	2	
		Perimeter (PLEN)	2	
		Principal axis angle (ANG)	2	Output value: -89.9 - 90.0
		Projection distance of X (PX)	2	
		Projection distance of Y (PY)	2	

Item	Result No.	Result Type	Statistics type	Details
Smart Matching(SMC) No.0-999	---	Judgement (JUDGE)	1	Output data OK=1, NG=0
		Inspection Time (TIME)	2	
		Detection count (COUNT)	2	Output value: 0 - 255
	0-255	Detect Template No. (TEMP)	2	
		Correlation (COR)	2	
		X coordinate (X)	2	
		Y coordinate (Y)	2	
		Theta(ANG)	2	Output value: -179.9 - -180.0
		Max. subtraction (AREA)	2	
		Subtraction number (LCNT)	2	Output value: 0 - -128
		Projection distance of X (PX)	2	
		Projection distance of Y (PY)	2	
	0 - 5	Interim detection count (SCNT)	2	Output value: 0 - -256
		Interim correlation (SS)	2	Output value: 0.001 - -1,000
Flaw Detection(FWC) No.0-999	---	Judgement (JUDGE)	1	Output data OK=1, NG=0
		Inspection Time (TIME)	2	
		Detection count (COUNT)	2	Output value: 0 - -512
	0-511	Flaw size (SIZE)	2	Output value: 1 - 254
		Top cell No. (FCELL)	2	Output value: 1 - -255
		X coordinate (X)	2	
		Y coordinate (Y)	2	
		Projection distance of X (PX)	2	
		Projection distance of Y (PY)	2	
Connector - Binary Window(CBW) No.0-999	---	Judgement (JUDGE)	1	Output data OK=1, NG=0
		Inspection Time (TIME)	2	
		Detection count (COUNT)	2	Output value: 0 -
	0-99	Area (AREA)	2	
		Individual judgment (PJ)	1	Output data OK=1, NG=0
Connector Gray Window (CGW) No.0-999	---	Judgement (JUDGE)	1	Output data OK=1, NG=0
		Inspection Time (TIME)	2	
		Detection count (COUNT)	2	Output value: 0 -
	0-99	Gray Average (AVE)	2	Output value: 0 - 255
		Individual judgment (PJ)	1	Output data OK=1, NG=0
Connector Gray Edge (CGE) No.0-999	---	Judgement (JUDGE)	1	Output data OK=1, NG=0
		Inspection Time (TIME)	2	
		Detection count (COUNT)	2	Output value: 0 -
		Pitch total judgment (PTJG)	1	Output data OK=1, NG=0
		Pitch dispersion total judgment (UPJG)	1	Output data OK=1, NG=0
		Max. Pitch (PMAX)	2	
		Min. Pitch (PMIN)	2	
		Average Pitch (PAVE)	2	
	0-99	Edge X coordinate 0 of area 0 (X1)	2	
		Edge X coordinate 1 of area 1 (X2)	2	
		Edge Y coordinate 0 of area 0 (Y1)	2	
		Edge Y coordinate 1 of area 1 (Y2)	2	
		Edge differential 0 of area 0 (D1)	2	Output value: 0 - 255
		Edge differential 1 of area 1 (D2)	2	Output value: 0 - 255
		Pitch (PT)	2	
		Pitch Dispersion (UPT)	2	
		Pitch Individual Judgment (JG)	1	Output data OK=1, NG=0
		Dispersion individual judgment (UJG)	1	Output data OK=1, NG=0

Numerical Calculation

Item	Result Type	Statistics type	Details
Numerical Calculation (CAC) No.0-999 (Only smaller No. than the setting numerical calculation No. is settable.)	Judgement (JUDGE)	1	Output data OK=1, NG=0
	Result (VALUE)	1	
Previous Result (OCA) No.0-999	Judgement (JUDGE)	1	Output data OK=1, NG=0
	Result (VALUE)	1	

Judgment

Item	Result Type	Statistics type	Details
Judgment Internal (JRC) No.0-999	Judgement (JUDGE)	1	Only statistics
Judgment External (JDC) No.0-999	Judgement (JUDGE)	1	Only statistics

Value/ General Register/Scan Count

Item	Result	Statistics type	Details
Value	Input value: 0.000 to 9999999.999	No	
General register (SYS: REG) No.0-7	---	No	Output Value 0.000 -9999999.999
Scan Count (SYS)	Number of Scans (COUNT)	No	

Referring to Position Adjustment: Base result No.

* Select a base checker carefully when you refer to the following items in Position Adjustment.

Items: Base judgment, Base inspection time, Base X, Base Y, Base projection X, and Base projection Y

Result No. (Base checker No.)	Position Adjustment Binary / Gray Edge	Position Rotation Adjustment Feature Extraction, Matching (2 checkers)	Rotation Adjustment
No.0 (.0)	Horizontal Base Checker 0	Base Checker 0	Base Checker 0-0
No.1 (.1)	Horizontal Base Checker 1 (Center Detection)		Base Checker 0-1 (Center Detection)
No.2 (.2)	Vertical Base Checker 0	Base Checker 2	Base Checker 1-0
No.3 (.3)	Vertical Base Checker 1 (Center Detection)		Base Checker 1-1 (Center Detection)

Operators and Functions

Operators

+	Addition	
-	Subtraction	
*	Multiplication	
/	Division	If denominator becomes "0", the calculation will be terminated and an error signal (ERROR1) will be output.
(,)	Parenthesis	Up to three parentheses can be used successionaly. You cannot use four or more of them successionaly. Correct: (((A+B)-C+D)+E), Wrong: (((A+B)-C+D)+E)+F)

Arithmetical Function

MOD (S0, S1)	Remainder when S0 is divided by S1	e.g.) MOD (9,4) = 1
POW (S0, S1)	Value of S0 multiplied by S1.	e.g.) POW (3, 2) = 9
LOG10 (S)	Common Logarithm of S	e.g.) LOG10 (100) = 2
SQRT (S)	Square root of S	e.g.) SQRT (144) = 12
ABS (S)	Absolute value of S	e.g.) ABS (-255) = 255
PAI	Pi (fixed value)	PAI = 3.142
INT (S)	Integer portion of S	e.g.) INT (-1.8) = -1
ROUND (S)	Round S to a whole number	e.g.) ROUND (1.485) = 1
FLOOR (S)	Round S down to a whole number	e.g.) FLOOR (1.485) = 1
CEIL (S)	Round S up to a whole number	e.g.) CEIL (-1.3) = -1

Difference among INT, ROUND, FLOOR and CEIL

S	INT (S)	ROUND (S)	FLOOR(S)	CEIL(S)
1.5	1	2	1	2
1.4	1	1	1	2
-1.4	-1	-1	-2	-1
-1.5	-1	-2	-2	-1

Statistical Function

MAX(C,S)	Maximum value from S-number of results of numerical calculation No.C	Example) CA000=10 CA001=5.8 In the case of CA002=3 MAX(0, 3) = 10 MIN(0, 3) = 3 AVE(0, 3) = 6.267 SUM (0, 3) = 18.8 SORT(0,3, 1,1)=3
MIN(C,S)	Minimum value from S-number of results of numerical calculation No.C	
AVE(C,S)	Average of S-number of results of numerical calculation No.C	
SUM(C,S)	Sum of S-number of results of numerical calculation No.C	
SORT(C,S0,S1,S2)	S2th value when sorting S-number of numerical calculation No.C in order of S1 condition (0=descending, 1=ascending).	

Trigonometrical Function

SIN(DR)	Sine of angle DR (radian)	
COS(DR)	Cosine of angle DR (radian)	
TAN(DR)	Tangent of angle DR (radian)	e.g.) $\text{TAN}(0.785) = 0.999$
ASIN(DR)	Arcsine of angle DR (radian)	
ACOS(DR)	Arccosine of angle DR (radian)	
ATAN(DR)	Arctangent of angle DR (radian)	
SIND(D)	Sine of angle D	e.g.) $\text{SIN}(90) = 1$
COS(D)	Cosine of angle D	e.g.) $\text{COS}(60) = 0.5$
TAND(D)	Tangent of angle D	e.g.) $\text{TAN}(45) = 1$
ASIND(S)	Arcsine of angle D	e.g.) $\text{ASIN}(1) = 90$
ACOS(D)	Arccosine of S	e.g.) $\text{ACOS}(60) = 0.5$
ATAND(S)	Arctangent of S	e.g.) $\text{ATAN}(1) = 45$
RAD(D)	Radian of angle D	e.g.) $\text{RAD}(45) = 45 \div 360 \times 2\pi = 0.785$
DEG(RD)	Angle of radian RD	e.g.) $\text{DEG}(0.785) = 45$

Geometric Function

MIDDLEX(X0,Y0,X1,Y1) MIDDLEY(X0,Y0,X1,Y1)	Coordinate X and Y of the middle point of two points Q0 (X0, Y0) and Q1 (X1, Y1)	
CPOINTX (a0,b0,c0,a1,b1,c1) CPOINTY (a0,b0,c0,a1,b1,c1)	Coordinate X and Y of the intersection of two lines L0 ($a_0x+b_0y+c_0=0$) and L1 ($a_1x+b_1y+c_1=0$) If two lines are parallel, the judgment will be "ERR".	
ELINEPA (x0,y0,x1,y1) ELINEPB (x0,y0,x1,y1) ELINEPC (x0,y0,x1,y1)	Element a, b and c of a line ($ax+by+c=0$) which connects two points (x0,y0) and (x1,y1).	
CANGLE (a0,b0,c0,a1,b1,c1)	Narrow intersecting angle DR (radian) of two lines L0 ($a_0x+b_0y+c_0=0$) and L1 ($a_1x+b_1y+c_1=0$) If two lines are parallel, the judgment will be "ERR".	
DIST (X0,Y0,X1,Y1) VDIST (X0,Y0, a0,b0,c0)	Distance between two points Q0 (X0,Y0) and Q1(X1,Y1) in pixels Length of a perpendicular to line L ($a_0x+b_0y+c_0=0$) through point Q (X0,Y0) in pixels	
VPOINTX (X0, Y0, a, b, c) VPOINTY (X0,Y0, a, b, c)	Coordinate X and Y of Q1 which is a intersection of line L ($ax+by+c=0$) and a perpendicular to line L through point Q0 (X0,Y0)	
CIRCLEX (x0,y0,x1,y1,x2,x3) CIRCLEY (x0,y0,x1,y1,x2,x3) CIRCLER (x0,y0,x1,y1,x2,x3)	Coordinate X and Y of the center and radius (in pixels) of a circle through three points, (x0,y0), (x1,y1) and (x2,y2)	 If it cannot be calculated, the judgment will be "Error".

Appendix 4: The List of Reference Data for Judgment and Restrictions

■ A List of the Data Can Be Referred to Judgment

All of the data listed below can be incorporate into a Judgment formula. After creating a Judgment formula, the formula consisting of the symbols listed below and numbers from 0 to 9 is displayed.

Data That Can Be Used in Judgment

The data described below is that can be used in judgment expression. The symbols in parentheses are displayed in operation expressions.

Item					Condition for OK judgment
Checker - Position Adjustment (PAC) No.0-999					
	Judgement (JUDGE)				The specified object or edge is detected.
	Base Judgement (BJUDGE)	Position Adjustment Binary / Gray Edge	Position Rotation Adjustment Feature Extraction, Matching (2 checkers)	Rotation Adjustment	The base checkers can detect the specified object or edge.
	No.0 (.0)	Horizontal Base Checker 0	Base Checker 0	Base Checker 0-0	
	No.1 (.1)	Horizontal Base Checker 1 (Center Detection)		Base Checker 0-1 (Center Detection)	
	No.2 (.2)	Vertical Base Checker 0	Base Checker 2	Base Checker 1-0	
	No.3 (.3)	Vertical Base Checker 1 (Center Detection)		Base Checker 1-1 (Center Detection)	
Checker - Area Size Adjustment (AUC) No.0-999		Judgement (JUDGE)			The specified object or edge is detected.
Checker - Line (LIC) No.0-999		Judgement (JUDGE)			Dot count judgment and Land count judgment are both OK.
		Dot count judgment (DJUDGE)			The number of dots is within the upper/lower values of OK Judgment.
		Land count judgment (LJUDGE)			The number of lands is within the upper/lower values of OK Judgment.
Checker - Binary Window(BWC) No.0-999		Judgement (JUDGE)			Area value is within the upper/lower limitations of OK Judgment.
Checker- Gray Window(GWC) No.0-999		Judgement (JUDGE)			Gray Average is within the upper/lower limitations of OK Judgment.
Checker - Binary Edge(BEC) No.0-999		Judgement (JUDGE)			The number of detected edges is within the range of OK Judgment.
Checker - Gray Edge(GEC) No.0-999		Judgement (JUDGE)			
Checker- Feature Extraction (FEC) No.0-999		Judgement (JUDGE)			The number of detected objects is within the range of OK Judgment.
Checker - Smart Matching(SMC) No.0-999		Judgement (JUDGE)			Detected count at the last phase is equal to the upper limitation of detected count that was set at the last phase of the sequence.
Checker - Flaw Detection(FWC) No.0-999		Judgement (JUDGE)			The number of detected flaws is within the range of OK Judgment.
Checker - Connector - Binary Window(CBW) No.0-999		Judgement (JUDGE)			
		Individual Judgement(PJUDGE) No.0-99			

Checker - Connector Gray Window (CGW) No.0-999	Judgement (JUDGE)	
	Individual Judgement (PJUDGE) No.0-99	
Checker - Connector Gray Edge (CGE) No.0-999	Judgement (JUDGE)	Pitch Total Judgment and Dispersion Total Judgment are both OK.
	Pitch total judgment (PTJUDGE)	Pitch Judgments are all OK.
	Dispersion Total Judgment (UTJUDGE)	Dispersion Judgments are all OK.
	Pitch Judgement (PJUDGE) No.0-99 (Judgment of each pitch)	The detected pitches are within the range of OK Judgment.
	Dispersion Judgement (UJUDGE) No.0-99 (Judgment of each dispersion)	The detected dispersion is within the range of OK Judgment.
Numerical Calculation (CAC) No.0-999	Judgement (JUDGE)	Calculation result is within the range of the upper/lower limitations.
Numerical Calculation Previous Result (OCA) No.0-999	Judgement (JUDGE)	
Judgment Internal (JRC) No.0-999	Judgement (JUDGE)	Judgment formula returns true.
Judgment External (JDC) No.0-999	Judgement (JUDGE)	

About Operators

Use operators to judge results of multiple checkers or numerical calculations.

+: Logical sum Returns "OK (1)", if the result of either A or B is OK (1).	Example: JD01=A+B <table><tr><th>A</th><th>B</th><th>JD01</th></tr><tr><td>OK (1)</td><td>OK (1)</td><td>OK (1)</td></tr><tr><td>OK (1)</td><td>NG (0)</td><td>OK (1)</td></tr><tr><td>NG (0)</td><td>OK (1)</td><td>OK (1)</td></tr><tr><td>NG (0)</td><td>NG (0)</td><td>NG (0)</td></tr></table>	A	B	JD01	OK (1)	OK (1)	OK (1)	OK (1)	NG (0)	OK (1)	NG (0)	OK (1)	OK (1)	NG (0)	NG (0)	NG (0)
A	B	JD01														
OK (1)	OK (1)	OK (1)														
OK (1)	NG (0)	OK (1)														
NG (0)	OK (1)	OK (1)														
NG (0)	NG (0)	NG (0)														
*: Logical product Returns "OK (1)", if the results of both A and B are OK (1).	Example: JD01=A*B <table><tr><th>A</th><th>B</th><th>JD01</th></tr><tr><td>OK (1)</td><td>OK (1)</td><td>OK (1)</td></tr><tr><td>OK (1)</td><td>NG (0)</td><td>NG (0)</td></tr><tr><td>NG (0)</td><td>OK (1)</td><td>NG (0)</td></tr><tr><td>NG (0)</td><td>NG (0)</td><td>NG (0)</td></tr></table>	A	B	JD01	OK (1)	OK (1)	OK (1)	OK (1)	NG (0)	NG (0)	NG (0)	OK (1)	NG (0)	NG (0)	NG (0)	NG (0)
A	B	JD01														
OK (1)	OK (1)	OK (1)														
OK (1)	NG (0)	NG (0)														
NG (0)	OK (1)	NG (0)														
NG (0)	NG (0)	NG (0)														
#: Exclusive OR Returns "OK (1)", if the results differ between A and B.	Example: JD01=A#B <table><tr><th>A</th><th>B</th><th>JD01</th></tr><tr><td>OK (1)</td><td>OK (1)</td><td>NG (0)</td></tr><tr><td>OK (1)</td><td>NG (0)</td><td>OK (1)</td></tr><tr><td>NG (0)</td><td>OK (1)</td><td>OK (1)</td></tr><tr><td>NG (0)</td><td>NG (0)</td><td>NG (0)</td></tr></table>	A	B	JD01	OK (1)	OK (1)	NG (0)	OK (1)	NG (0)	OK (1)	NG (0)	OK (1)	OK (1)	NG (0)	NG (0)	NG (0)
A	B	JD01														
OK (1)	OK (1)	NG (0)														
OK (1)	NG (0)	OK (1)														
NG (0)	OK (1)	OK (1)														
NG (0)	NG (0)	NG (0)														
/: Negation Reverses a judgment. Do not put a symbol "/" before the multiple contents in parentheses. Wrong: JD01=/(A+B) Correct: JD01=/A+B	Example: JD01=/A <table><tr><th>A</th><th>/</th><th>JD01</th></tr><tr><td>OK (1)</td><td>Reversed</td><td>NG (0)</td></tr><tr><td>NG (0)</td><td>Reversed</td><td>OK (1)</td></tr></table>	A	/	JD01	OK (1)	Reversed	NG (0)	NG (0)	Reversed	OK (1)						
A	/	JD01														
OK (1)	Reversed	NG (0)														
NG (0)	Reversed	OK (1)														
(: Left parenthesis): Right parenthesis	Judges the contents in parentheses by priority.															

Appendix 5: Error Codes and Error Signals

Turning on the signals of Error 0 and Error 1 indicates that processes such as executed inspection or type switching have not completed correctly.

Check if PV500 makes the causes of turning on the error signals. And then, to prevent those causes, adjust the settings of PV500 or recheck the signal and the command that the external device sends to PV500.

Error 0 (ERR0): Error in executing an inspection or outputting a result

Error 0 signal turns on as Result signal is output when an error occurs on result output or template setting (when Reentry signal is input) during an inspection.

Error 1 (ERR1): Parallel signal command error

It turns on when an error occurs in operations after inputting the signals which are marked with (*) in the table of input signal including Type (type switch) and Display (change layout).

While the error signal is ON, inputting the signals again operates correctly and turns off the error signal.

When Error0 turns on...

Error Code	Cause	Solution, etc
---	Parallel Handshake Timeout occurred. (No Acknowledge signal indicating that the external device has received data was input to PV500 within the Timeout.)	Connect and set correctly.
E0151	Values exceeded the following ranges during calculation. Effective range of values during calculation = -2147483648 to +2147483647 (-2^{31} to $(2^{31} - 1)$)	Check the expression of Numerical Calculation or Judgment which shows "E" sign in the Checker List.
E0152	Denominator became "0" in the division that is specified as a numeric calculation.	
E0153	Any item that does not exist is referred to the Numeric calculation, Judgment. (If the referred item is deleted although it existed when it was set.)	
E0160	Position adjustment for a detect trigger is unset when you use "Detect Trigger (common)".	Register a Position Adjustment for the detect trigger.
E0200	While PV500 stops the operation, a signal or a command to execute one of the following is input or sent. - Start executing an inspection - Execute template setting of Smart Matching	Operate (run) PV500.
E0201	The command specifying a block number is sent when execution mode is set to "Execute All" or "Automatic Switch".	Send an inspection start command which specifies no block number.
	- The command specifying a camera is sent when "Trigger" of Camera Setting is set to "Common". - The command specifying no camera is sent when "Trigger" of Camera Setting is set to "Independent".	Send a command matching the setting of "Trigger".
E0202	The error when execution mode is set to "User-Defined". - The specified block number does not exist. - The different block numbers are specified when inputting inspection start signal of cameras while "Trigger" of Camera Setting is set to "Independent".	Specify block numbers correctly.
E0203	Image capturing error occurred. - No camera is connected. - Disconnection of the camera cable, loose connection of the camera connector - Independent Trigger Timeout Not all of image capturing signals were completed to input within the specified "Timeout" from the first capture start when "Trigger" is set to "Independent". - No camera is connected to the specified number of camera port when you use "Independent Trigger". - No image exists in Inspection image memory when executing reinspection (without capturing any image after PV starting up).	Connect and set correctly. If the error reoccurs, try the following procedures. - Cut the power and reconnect the camera cable. - Replace the cable.

Error Code	Cause	Solution, etc
When you make Template setting with the following conditions.		
E0230	- It was executed when SETUP window was displayed. - It was executed when Detect trigger was processing or Repeat start was used. - While "Area Display" is set to "Yes", the command for Send 2 (%A) was sent when Send 1 was supposed to. - While "Area Display" is set to "Yes", the command for Send 1 (%Accc,??) was sent when Send 2 was supposed to.	Operate PV500.
		Stop Detect trigger and Repeat start, and then execute Template setting.
		Enter a command correctly.
E0231	- The specified checker number or template number has not be created. - Other number than 000-999 for checker number, or 00-63 for template was specified.	Specify a correct checker number or template number.
E0232	Template cannot be set because no image has been captured after PV500 started up when you select "Use the Last Image" for "Template Setting".	Execute an inspection, or change the setting to "Capture New Image" to execute Template setting.
E0233	- No feature on the image of template registration area. - An error occurs in Position adjustment when you use it.	Check the captured image.

When Error1 turns on...

Error Code	Cause	Solution, etc
E0100	The following errors when sending a command to PV500. Block Check Code (BCC) error An undefined command was sent.	
E0200	While PV500 stops the operation, a signal or a command to execute one of the following is input or sent. - Type Switch - Switch layout - Read/write Parameter - Save or read product type or images to or from a SD memory card - Print screen - Clear the saved image memory of PV500 - Save to or read from the image memory of PV500. - Statistics Data Reset	Operate (run) PV500 and execute again.
E0212	Other number than 00-99 was specified as an area number when saving or reading setting data to or from PV or a SD memory card.	
When reading setting data from a SD memory card		
E0213	- No SD memory card is attached or cannot be accessed. - No data file in the designated area of a SD memory card.	Check attachment of the SD memory card or presence of data file.
E0214	- The data file is not data of PV500. - The Data file is incompatible. (Data of the later version, etc.) - The number and types of cameras connected to PV500 is different from the Camera setting of the data file.	Prepare a correct data file.

Error Code	Cause	Solution, etc
E0216	When saving setting data in a SD memory card. - No SD memory card is attached or cannot be accessed. - Capacity of the SD memory card is used up. The SD memory card is write-protected.	Check attachment, write-protection, and presence of enough free space of the SD memory card.
E0245	When switching layout Although PV500 is operating (RUN), displaying SETUP window cannot switch layout. Other number than 00-31 is specified for layout number. No layout has been registered in the specified layout number.	Switch to OPERATION window. Specify a correct layout number.
When sending parameter write command		
E0250	Because PV500 shows SETUP window, parameters cannot be written.	Switch to OPERATION window.
E0251	Specification of the parameter is wrong. (e.g. Undefined parameter is specified. The specified values led to the status of "Upper value < Lower value" when entering them.)	Specify correct parameters.
E0252	- The specified parameter does not exist. (e.g. The number of uncreated checker is specified as a parameter.) - The specified parameter value is out of the settable range. (e.g. Upper value of slice level is being set to over 256.)	
E0260	When saving Image memory of PV500 in a SD memory card. - No SD memory card is attached or cannot be accessed. - Capacity of the SD memory card is used up. The SD memory card is write-protected.	Check attachment, write-protection, and presence of enough free space of the SD memory card.
	When saving Image memory of PV500 in a SD memory card, there is no blank folder. (All of 00-99 are used.)	Delete all or some folders of 00 - 99 in the "Backup" folder of the SD memory card.
E0061:	When saving Print screen in a SD memory card or a PC through Ethernet. - No SD memory card is attached or cannot be accessed. - Capacity of the SD memory card is used up. The SD memory card is write-protected.	Check attachment, write-protection, and presence of enough free space of the SD memory card.
E0266	When Ethernet communication cannot be established (with connection problems including disconnection). Image Receiver is not activated.	

Appendix 6: The List of Menus

SETUP

OPERATE

- └ To OPERATION
- └ Restart Operation
- └ Stop Operation

ENVIRONMENT

- └ Condition
 - └ Startup Setting
 - └ Layout No.
 - └ Type No.
 - └ Run in SETUP
 - └ Use as Test Image at Switch to SETUP
 - └ Operation Mode
 - └ General Output
 - └ Image Output
 - └ Parallel Reset Condition
 - └ Repeat
 - └ Template Setting
 - └ Registration
 - └ Register 0-7 Default
 - └ General Register
 - └ Parallel
 - └ REND OFF Min. (ms)
 - └ ACCEPT OFF Min. (ms)
 - └ Set ASSIGN0 - 5
 - └ Parallel Output
 - └ Output Data/ Handshake/ Scan Count/ Judgment/ Numerical Calculation/ Bit Width/ Output Signal Guarantee Time (ms)/ Timeout (ms)
 - └ Baud Rate (bps)/ Bit Length/ Stop Bit/ Parity Check/ Flow Control
 - └ Serial
 - └ General Output
 - └ Destination
 - └ Protocol
 - └ Scan Count
 - └ Total Judgment
 - └ Judgment
 - └ Numerical Calculation
 - └ Digit
 - └ Decimal Digit
 - └ Unused Digit
 - └ PLC Type
 - └ Start Register
 - └ Bit Width
 - └ Timeout (ms)
 - └ Data Output Completion Notice
 - └ Type Signal
 - └ Type No. Register
 - └ Image Output
 - └ Destination/ Output Conditions/ Interval/ Camera No.0-3 Output/ File Header/ Additional Information 0-3/ Overwrite/ Save Folder/ ERR Signal ON at Output Error/ Forced Outage at Output Error
 - └ Image Memory
 - └ Saving Condition/ Overwrite
 - └ Print Screen
 - └ Destination
 - └ Camera
 - └ Type of Camera No.0 - 3
 - └ FLASH Polarity
 - └ Pattern
 - └ FLASH Polarity 0-3
 - └ SETUP Window Transmittance
- └ Input/Output
- └ Camera
- └ Color
- └ Password
- └ Initialize

TYPE

- └ Select Type
 - └ Type Setting
 - └ Execution Condition
 - └ Camera Setting
 - └ Execution Mode
 - └ Number of Blocks
 - └ Common Setting
 - └ Trigger
 - └ Detects Error Outside Search Area
 - └ Camera No. to Set
 - └ Connected Camera
 - └ Shutter Speed
 - └ Gain
 - └ Shutter Delay (ms)
 - └ FLASH Signal Delay (ms)
 - └ FLASH Span (ms)
 - └ Partial Imaging
 - └ Calibration
- └ Marker Display
- └ Data R/W
- └ Initialize

INSPECTION

- └ Position Adjustment
- └ Area Size Adjustment
- └ Checker
 - └ Line
 - └ Binary Window
 - └ Gray Window
 - └ Binary Edge
 - └ Gray Edge
 - └ Feature Extraction
 - └ Smart Matching
 - └ Flaw Detection
 - └ Connector (Binary Window)
 - └ Connector (Gray Window)
 - └ Connector (Gray Edge)
- └ Slice Level
- └ Preprocess
- └ Numerical Calculation
- └ Judgment
- └ Checker List
- └ Group Move

SAVE/READ

- └ Save Setting Data
- └ Read Setting Data
- └ Save Image Memory
- └ Clear Image Memory

TOOL

- └ Configuration
 - └ Startup Setting
 - └ Network
 - └ Calendar
 - └ Language
 - └ Initialize
 - └ SD Property
 - └ Eject SD Card
 - └ Information
 - └ Setting Help
 - └ Update
 - └ Firmware
 - └ Splash Screen

- F1**
- Image Menu**
 - └ Select Camera
 - └ Memory/Live
 - └ Preprocess
 - └ Pattern Display
 - └ Scroll
 - └ Magnification
 - └ Full Screen
 - └ Save Image
 - └ Read Image

OPERATION

- OPERATE**
 - └ Select Type
 - └ Reset Statistics
 - └ Restart Operation
 - └ Stop Operation
 - └ To SETUP

- VIEW**
 - └ Screen
 - └ Data R/W
 - └ OPERATION Window Transmittance
 - └ Window Overlap Adjustment

- LAYOUT**
 - Layout

- TOOL**
 - └ Eject SD
 - └ Save Setting Data
 - └ Save Image Memory
 - └ Clear Image Memory
 - └ Information

- F1**
- Select Window**
 - └ Screen 0-3
 - └ |
 - └ |
 - └ Data R/W 0-3

— Select Camera/ Memory/Live/ Preprocess/ Pattern Display/
 Scroll/ Magnification/ Full Screen/ Move Window/ Change
 Size/ Optimize Size

- F2**
 - Switch Layout

Overview of Checkers

Chapter 6

Binary Edge

6.1 Overview

■ What Is Binary Edge?

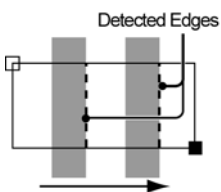
Binary Edge is a function that detects the boundaries (edges) between white and black in a binary image and outputs the detected count and coordinates of detected edges. Outputs type of an edge, which is white -> black (-) or black -> white (+).

Up to 256 edges can be detected. If the number of detected objects is within the allowable range you have set, the object will be judged as "OK", if it exceeds the allowable range, the object is judged as "NG". A triangle mark shown on the screen indicates the position of the detected edge.

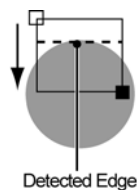
Area shape	Line Scan/Plane Scan
Mask area	None
Judgment Condition	Detected count: 0 - 256
Output Data	Coordinate X and Y of an edge Detect color of edges (+ / -) Detected count Judgement

Detect Example)

Condition Scan direction = Horizontal
 Target = Black -> White
 Detect Position = Plural



Condition Scan direction = Vertical
 Target = White -> Black



Chapter 7

Gray Edge

7.1 Overview

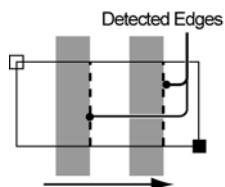
■ What Is Gray Edge?

Gray Edge is a function that detects the points where brightness of pixels changes more than a certain level using the gray value of each pixel in a gray image. It outputs detected count of the points, and their coordinates and differential value (amount of brightness change). This function detects up to 256 edges fulfilling the preset conditions within an area. If the number of detected objects is within the allowable range you have set, the object will be judged as "OK", if it exceeds the allowable range, the object is judged as "NG". A triangle mark shown on the screen indicates the position of the detected edge.

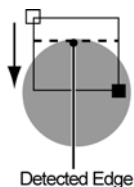
Area shape	Line/ Plane/ Ellipse
Mask area	None
Judgment Condition	Detected count: 0 - 256
Output Data	Coordinate X and Y of an edge Differential value (0 - 255) Detected count Judgement

Detect Example)

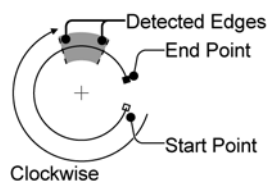
Condition
Scan direction = Horizontal
Target = Dark -> Light
Detect Position = Plural



Condition
Scan direction = Vertical
Target = Light -> Dark



Condition
Scan direction = Clockwise*
Target = Both
Area shape = Ellipse



* To specify scan direction in Ellipse of area shape, press the FUNC key and select "Clockwise" or "Counterclockwise" when you select "Change" in Area Setting window. Default is "Clockwise".

Chapter 8

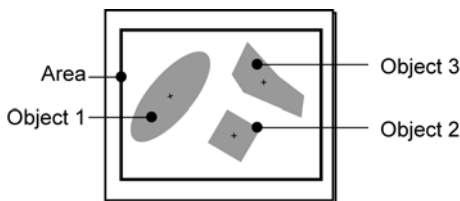
Feature Extraction

8.1 Overview

■ What Is Feature Extraction?

Feature Extraction is a function that counts the number of the clusters (hereinafter called “object”) of a certain size within the area on a binary image. If the number of counted objects is within the preset limits, the object will be judged as "OK", if the number of counted objects is out of the preset limits, the object will be judged as "NG". Feature data of detected clusters includes Area, Gravity X and Y, Principal Axis Angle, Perimeter, Projection Width, and Projection Height. (To specify the range to judge an object, enter values in “Extraction Condition” > “Max. Area” and “Min. Area”.)

Area shape	Rectangle/ Ellipse/ Circle/ Polygon
Mask area	Up to 16.
Judgment Condition	0 to the value specified in “Max. Detected Count” (0 to 10000)
Output Data	Area (in pixels) Gravity Y/ Gravity X Principal axis angle Perimeter Projection Width/ Projection Height Detected count Judgement

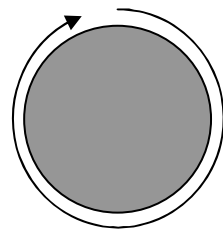


NOTE

Feature Data

Perimeter

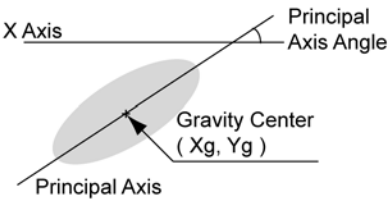
Length of border around the object. If an object is circle, its perimeter refers to “circumference”.



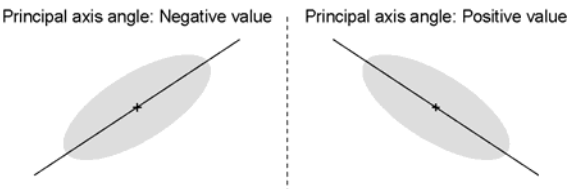
Principal Axis Angle

The angle formed by principal axis of an object and X axis.

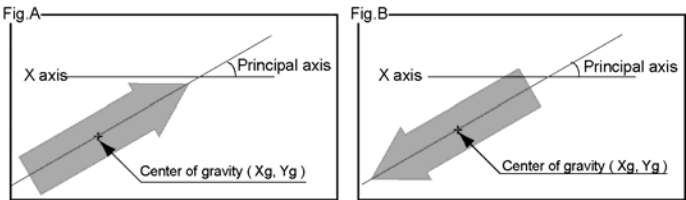
For rectangle-, circle- or triangle-shaped objects, the PV500 cannot compute the angle of the principal axis. (The device might possibly output the angle of the principal axis, but you cannot use the data due to its incorrectness.) *In the case, "180.0" is output indicating no principal axis angle has been obtained for practical usage.*



The detected angle of principal axis may be positive or negative depending on the slanting direction of the object. The slope of the principal axis rising from left to right is negative as the figure shown below. The slope of the principal axis falling from left to right is positive.



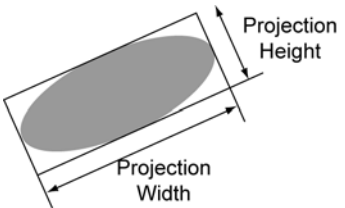
Note: As shown in Figures A and B, the same value is output even if rotational angles of the objects are different.



Projection Width and Projection Height

They are the width and height of the rectangle circumscribing around an object.

The vertical length between the principal axis and the circumscribing rectangle is Projection Height.
The horizontal length between the principal axis and the circumscribing rectangle is Projection Width.



Plugging

If there is a part with different color from the target color inside an object, measurement of coordinate of gravity center or principal axis angle is interfered.
To prevent this, processes to plug inside the object with the target color.
Plugging is not available when Labeling is set to "No".

Original image White spots on black object	Yes: Executes plugging.	No: Does not execute plugging.
		

Chapter 9

Smart Matching

9.1 Overview

■ What Is Smart Matching?

Smart Matching is a function that detects the location of the saved base image (a template) within the search area (a specified area). If as many images as you have set are detected after searching, the positions (X/Y coordinate values), the Rotation Angle and similarity degree (a correlation value) to the template are output and then the object is judged as "OK". If no image was detected or the number of detected images was less than the specified "Det. Count", the object is judged as "NG".

Smart Matching of PV500 can register up to 64 templates per checker. This checker is suitable to detect a target having variable image pattern or to recognize types.

The function finds an image that matches or resembles the template within the search area based on the gray value.

Some of the parameters of searching order can be changed.

The Smart Matching checker is also provided with a function that is effective if the difference in brightness between the background and the inspection object is small (hereinafter called "Low contrast") or some parts of the object image may not be shown on the screen.

Area shape	Template: Rectangle/ Ellipse/ Circle/ Polygon
	Search area: Rectangle
Mask area	Up to 16 masks available on template area
Detected count	0 to 256
Output Data	Template No. (0 - 63) Correlation: 0 - 1.000 Coordinate X, Y (Output point) Detection Angle: -179.000 - 180.000 Subtraction (Maximum subtraction area, Subtraction count 0 to 128)

Subtraction

The Subtraction function extracts a pixel that exceeds a certain degree of the difference in the gray value when the detected area overlaps the template. With this feature, the PV can detect up to 128 subtraction parts that are difficult to reflect in the correlation value. It judges the object based on the number of detected subtraction parts.



About Items Related to Subtraction

Subtraction Threshold

This function extracts pixels that exceed the set degree of the difference in the grayscale value or more between the detected image and the template. The lower the Subtraction Threshold value, the stricter extraction standard is.

Filter

Dilates or erodes the pixel clusters extracted under the condition of Subtraction Threshold value, or does so after dilation or erosion. Use the Filter function to enhance the extracted pixel cluster or remove fine noises or dusts.

Subtraction Area Min.

Detects only the clusters of the filtered extraction pixels having the area value more than the Subtraction Area Min. For example, if you want to exclude 10-pixel or less of extracted subtraction parts from the criteria for judgment, set Subtraction Area Min. to "11".

Subtraction Number (0-128)

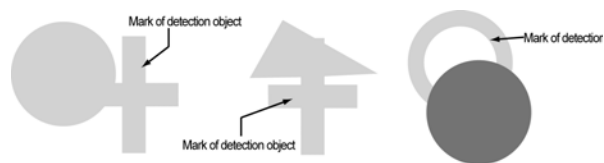
A tolerance of a detected pixel cluster. If the number of detected pixel clusters is less than the subtraction number, the object will be judged as "OK".

In the Case of Detection Failure

If you cannot detect the part you want to detect as the result of tests, adjust two conditions described below according to the inspection conditions and image status. Using the functions below takes longer time to process compared with the case being not in use.

Detect Target - Low Contrast

If the difference in brightness between the object image and the background is extremely small, or the some parts of the object image is chipped or shielded, checker may not detect it correctly. In such cases, set "Detect Target" to "Low Contrast" and then specify its intensity (Filter Adjustment).



Feature and Usage of the Object	Detect Target	Filter Adjustment	Processing speed
• Higher contrast, no shielded or chipped part • Type recognition, quality inspection	Normal	---	Fast ↑
• Higher contrast, possible existence of shielded or chipped part • Position detection	Low Contrast	No	
• Lower contrast • Position detection	Low Contrast	Yes	↓ Slow

Filter Adjustment

The Filter Adjustment function binarizes the object image and background using multiple items. If desired result cannot be obtained even though you tried auto adjustment (Recommendation Value), adjust the values of items. Set the items listed below from the top orderly.

Target (White / Black)

If the detect target is brighter than the background, select "White". If the object image is darker than the background, select "Black".

Denoising (1 - 80)

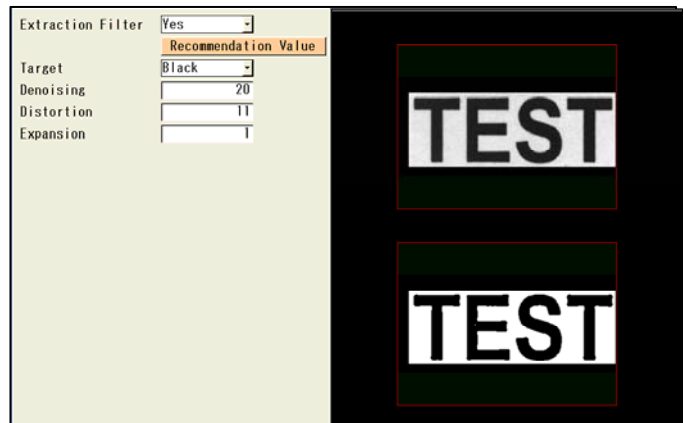
Removes unnecessary noises around the object image. As the setting value increases, the more noises are removed.

Distortion (1 - 95)

Extracts the part having contrast. If some parts of the extracted object are chipped away, increase the setting value. If the object is expanded, decrease the setting value.

Expansion (1 - 4)

Expands the extracted object. Make up the chipped or missed parts of the object that cannot be adjusted by using the Distortion function.



Sequence

This item sets sequence to search an image pattern of a template within a search area. Sequence executes searching based on the compressed information about template and search area. The compression rate of the information is lowered every time a searching phase proceeds. Processing speed is inversely related to compression ratio; the higher compression ratio, the faster processing speed, the lower compression ratio, the slower processing speed.

Specifying Items in "Sequence"

Step

Inspection is performed in up to six steps (1st - 6th) by changing compression ratio and other conditions.

Accuracy

It is compression ratio. There are six types of compression ratio; 32, 16, 8, 4, 2, 1, and S. Accuracy 16, for example, refers to compressing of information of 16 x 16 (256) pixels. The smaller value indicates the lower compression. Accuracy value must be smaller as a scanning step proceeds.

Accuracy "1" means that searching is performed without compressing the information. Accuracy "S" means that detection is executed per subpixel. If the accuracy is set to "1" or "S", the steps after that will be erased and no more steps can be added. You cannot include both "1" and "S" in one checker. (e.g.: Step 4TH=Accuracy 1, Step 5TH=Accuracy S)

Maximum Count

Maximum value of the part to be detected in each step.

Setting an intermediate step to "3" detects 3 parts with higher correlation value than the minimum value in descending order, and then inspects the parts with lower compression ratio in the next step.

Setting the final step to "3" judges as "OK" if detecting three or more parts, and judges as "NG" if detecting less than three parts or nothing.

Minimum Correlation

In a certain step, the parts having the higher correlation value than this setting value are detected. If there is no image with higher correlation value than it, the inspection stops at the step and judges as "NG".

Squaring Correlation

This is a function that squares correlation values to emphasize them. By squaring them, low values are become lower.

The Items can be Confirmed in Sequence

Detected count

Number of the parts that were detected in each step.

Correlation Value*

Correlation value of the parts that were detected at each step. If multiple parts are detected, the lowest correlation value is displayed.

Note Correlation Value for the Low Contrast Function

If “Detect Target” is set to “Low Contrast”, the correlation values displayed in Sequence and the correction values output as inspection results can be different. This is because the PV corrects the decreased correlation values that were affected by the distorted, chipped or overlapped parts of the object and output them as inspection results.

The correlation values in Sequence are the ones that have not been corrected and the values in Result or output to the external devices are the ones that have been corrected. Therefore, the former is lower than the latter.

However, if there are many distorted or chipped parts over the whole object image, almost the same correlation values can be output.

Training Text Revision History

Manual No.	Publication Date	Description
	3/10/2008	First issue. (Japanese tentative version)
	5/23/2008	First issue (English tentative version)