Cat.No. Q29E-EN-01

Xpectia-FZ3 Series

Vision System

SHORT OPERATION MANUAL

OMRON

Vision System
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Short Operation Manual

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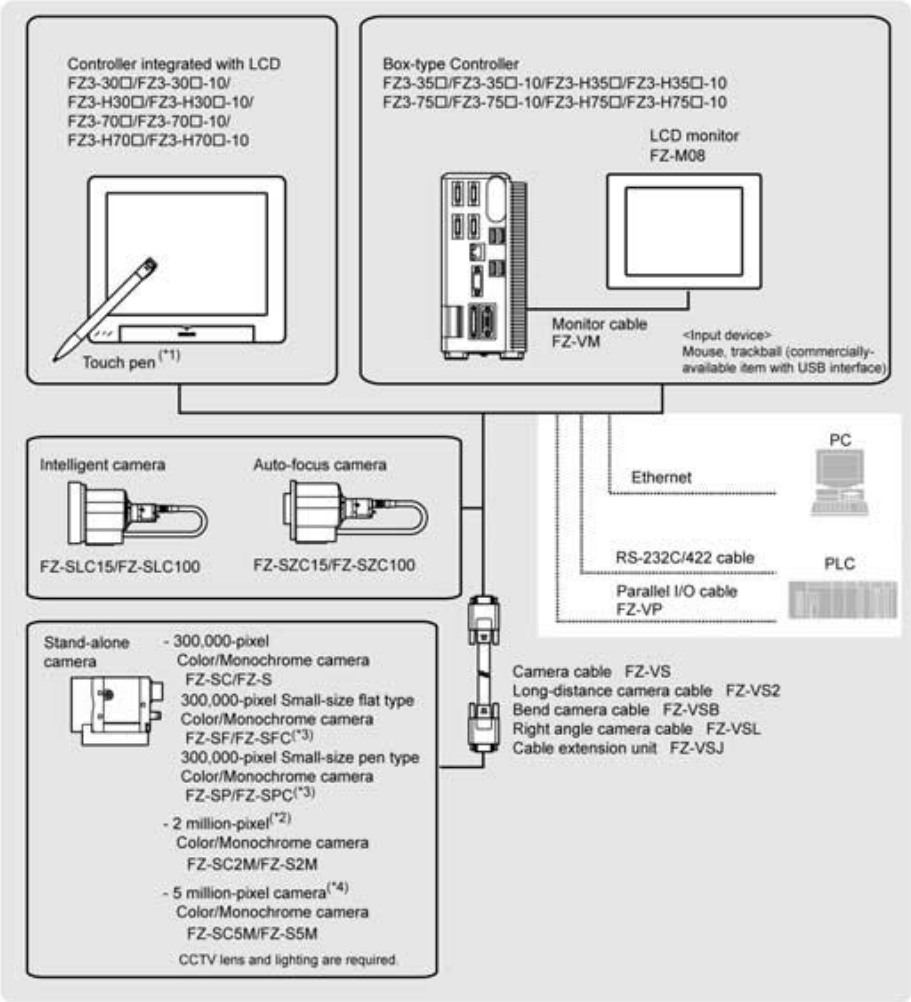
SECTION 1
Before Operation

1-1 Getting Start

This product is a vision sensor for performing image processing measurement through a controller of objects photographed using a camera.By connecting an external device such as a PC, measurement commands can be input and measurement results can be output from the external device.

1-1-1 Basic Configuration of FZ3 Series



*1: The touch pen is an accessory of a controller.
*2: FZ-SC2M and FZ-S2M cannot be connected with the FZ3-3 /FZ3-H3 controllers.
*3: Lenses for small-size cameras are required for small-size 300,000-pixel cameras.
*4: FZ-SC5M and FZ-S5M can only be connected with the FZ3-70 /FZ3-H70 controllers.

1-2 Preparing Controllers and Cameras

1-2-1 Preparing Controllers

Please check that the controller is switched on and that the Main screen is displayed.

The first time the program is started up, the Language Setting window is displayed, so select the language.

1-2-2 Adjusting Cameras

1. Tap [▼] of „Image mode“ in [Image display] of the Main screen Control area, and select „Through“.

   The through images captured from the camera are viewed in the Image Display area.

Note The same operation is available by tapping [View] - [Image mode] - [Through].

2. Adjust the position of measurement objects so that they display at the center of the monitor.

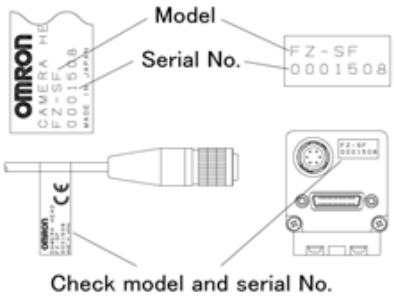
3. Adjust the focal distance of the lens.

   When using an auto-focus camera or an intelligent camera, focus and the iris can be automatically adjusted.

Note If a camera is used together with a lens, turn the focus ring of the lens to adjust the focus.

The light intensity of an intelligent camera can be adjusted from the controller.

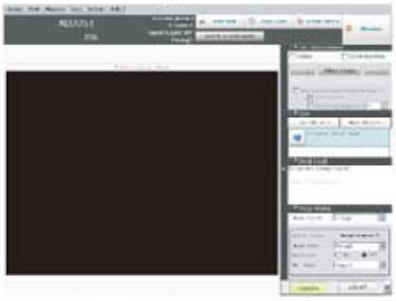
Important When using a small-size digital camera, check that the model and serial number of the camera head and camera amplifier match.When a camera head and camera amplifier of different models and serial numbers are connected, they may not operate correctly.



1-3 Software Overview

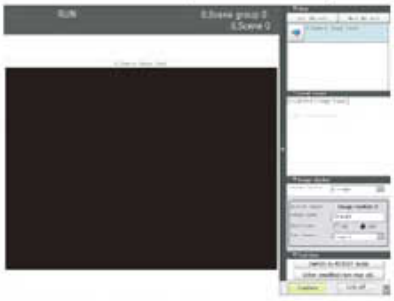
Application-oriented measurement can be configured by combining processing items or changing the settings of processing items.

Main screen (ADJUST window)



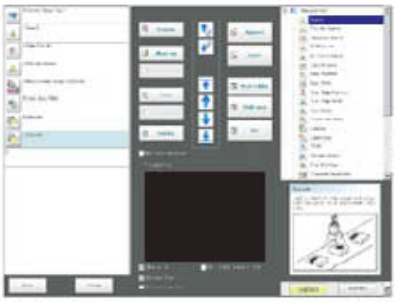
Screen for confirming measurement status and for performing adjustment.
When the power is first turned on, the ADJUST window is displayed after the Language Setting window.
To set the measurement conditions, move to the Edit Flow window.
If there is no problem with the measurement conditions, move to the RUN window.

Main screen (RUN window)



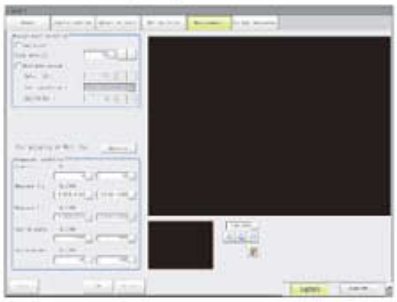
This is the window for actually starting operation. Only information necessary during operation is displayed.

Edit flow window



Window for assembling the measurement flow.
Flow parts (processing items) are displayed on the right side, and the measurement flow (scene) is displayed on the left side. When the measurement trigger is activated, processing is executed in sequence starting from the top of the flow.

Property window

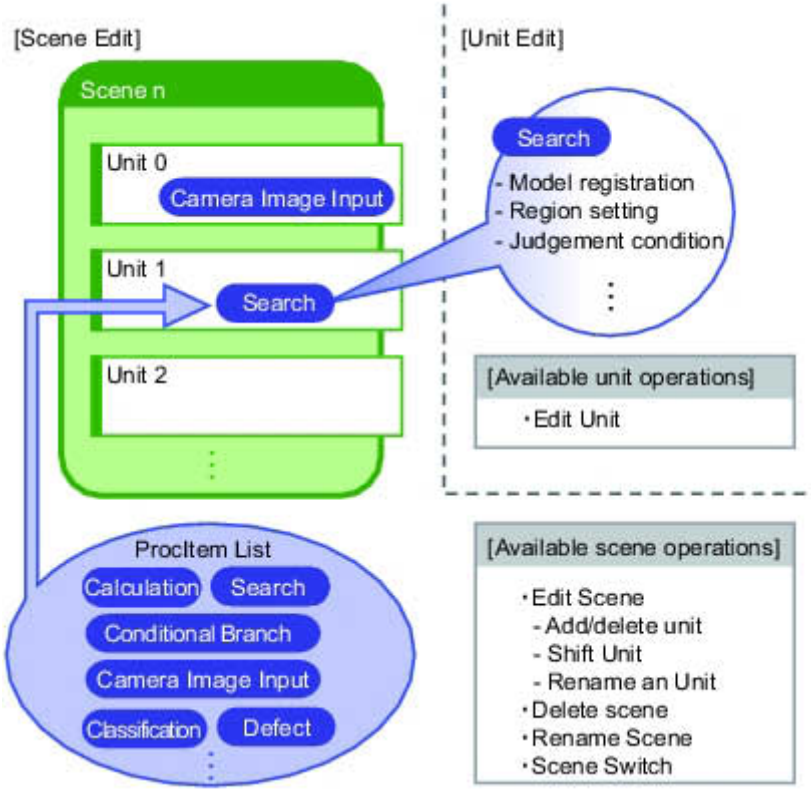


Window for setting conditions for processing units (processing items registered in the scene) set in the flow.
This window can also be displayed directly from the Main screen (ADJUST window).

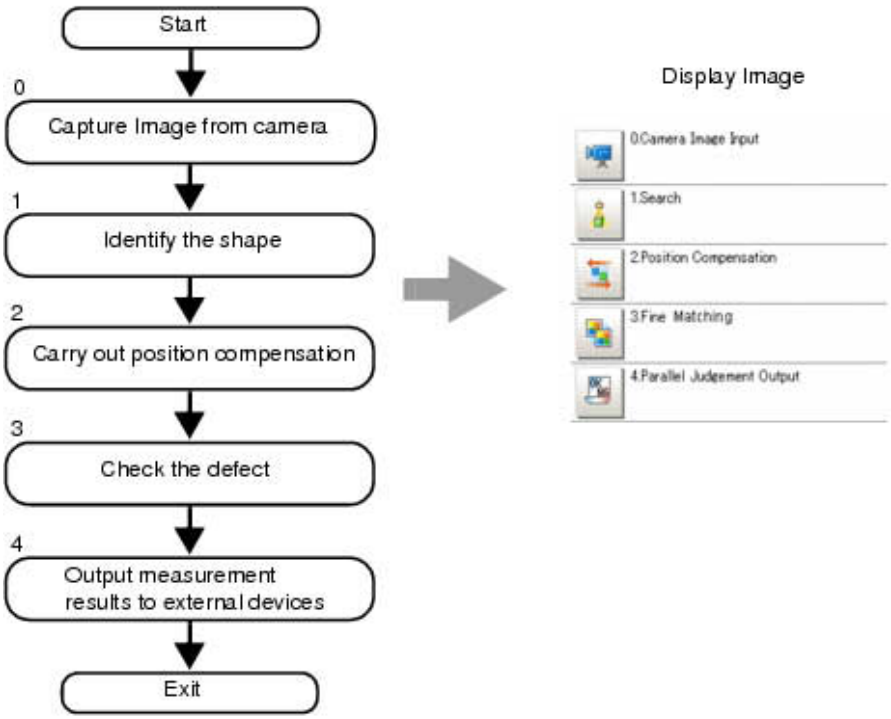
SECTION 2
Basic Operation

2-1 What is a Scene

A combination of processing items is called a „scene“ and scenes can be easily created by combining processing items that are suited to the measurement purpose from the list of processing items provided.



2-1-1 Scene Examples



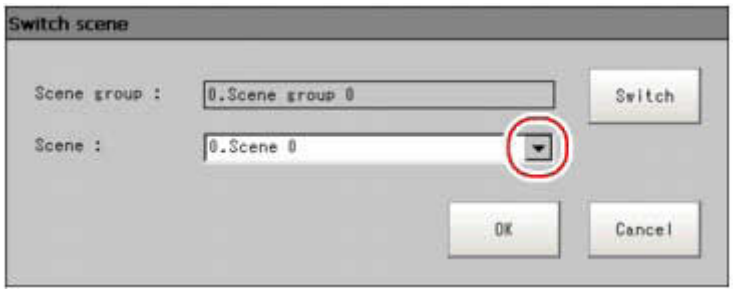
2-1-2 Switching Scenes

1. Tap „Scene switch“ in the toolbar on the Main screen.

The Switch Scene window is displayed.

Note The same operation is available by tapping [Scene] menu - [Scene switch].

2. Tap [▼] to select the scene to switch.



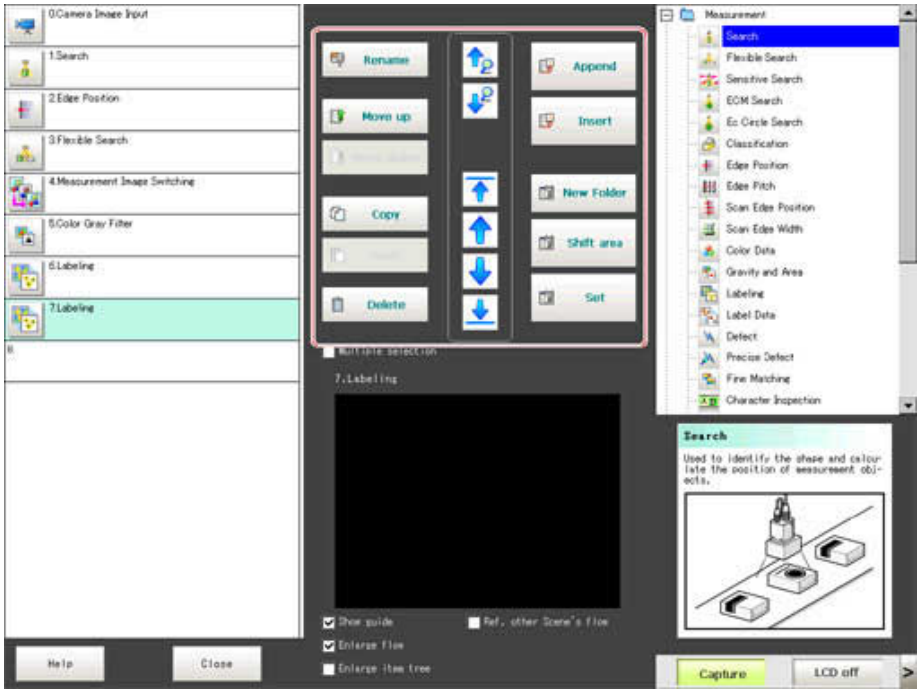
To switch a scene group, tap [Switch], then tap [▼] in the displayed window to select the scene group to switch.

3. Tap [OK].

The scene switches.

2-2 Create a Scene

In the Edit Flow window, editing buttons in the window can be used to change the order of processing units within the scene or to delete processing units.



Specifying the position for a processing unit and adding it (Append) (Insert)

Moving a processing unit (Move up) (Move down)

Copying and pasting a processing unit (Copy) (Paste)

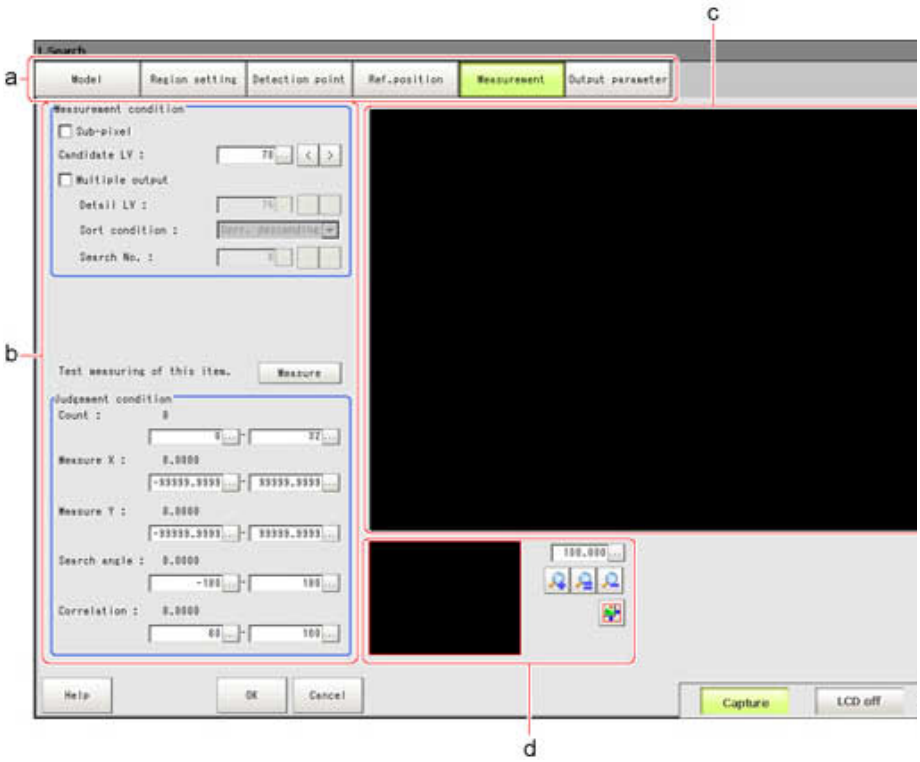
Deleting a processing unit (Delete)

Changing the name of a processing unit (Rename)

Setting details of a processing unit (Set)

2-2-1 Property window of Processing items

This window is used for detailed setting of measurement parameters and judgement conditions for processing items. All of Processing items have similar layout.



a) Item Tab Area

Displays the settings items for the processing unit currently being set. Perform settings starting with the item on the left.

b) Detail Area

Set detailed items.

c) Image Display Area

Displays camera images, figures, and coordinates.

d) Zoom Browser Area

Zooms in and out from the displayed image.

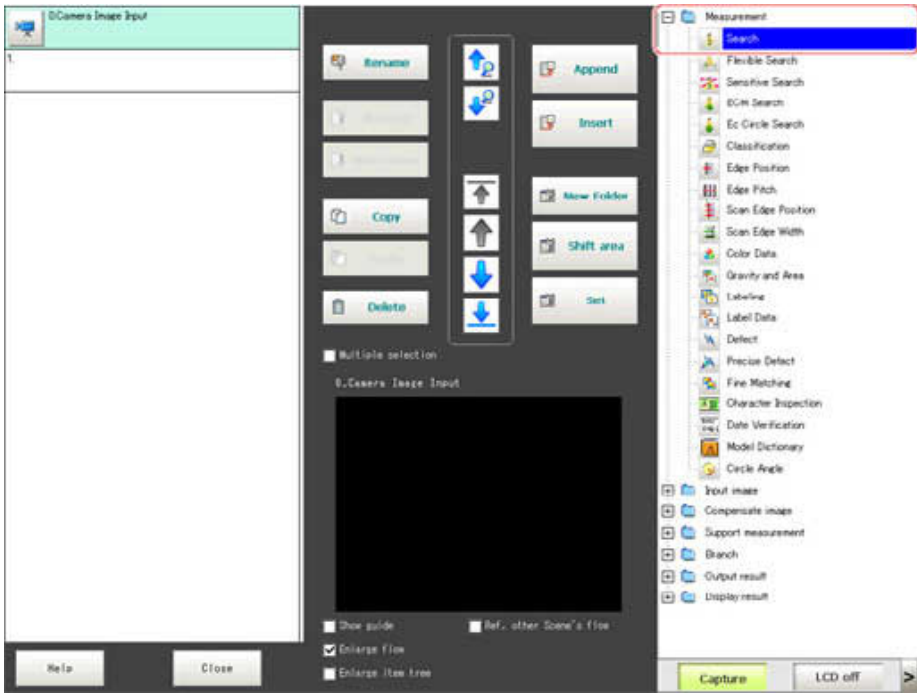
2-3 Processing Item Guideline

Define and perform measurement with display of the results.

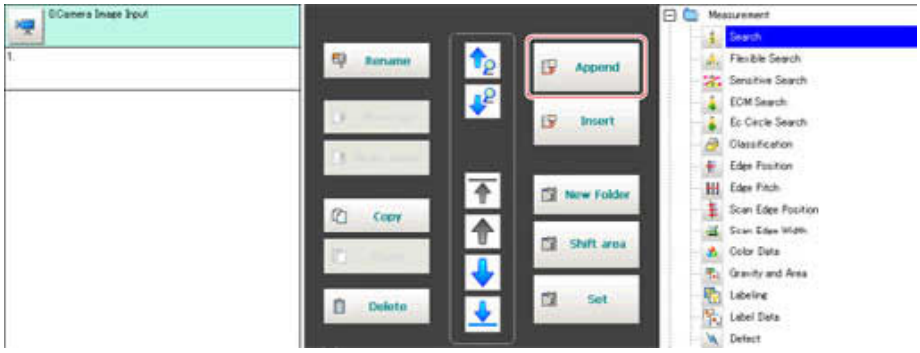
1. Tap [Edit flow] in Toolbar.

The Edit Flow window is displayed.

2. Select a processing item to be added from the processing item tree.



3. Tap [Append].



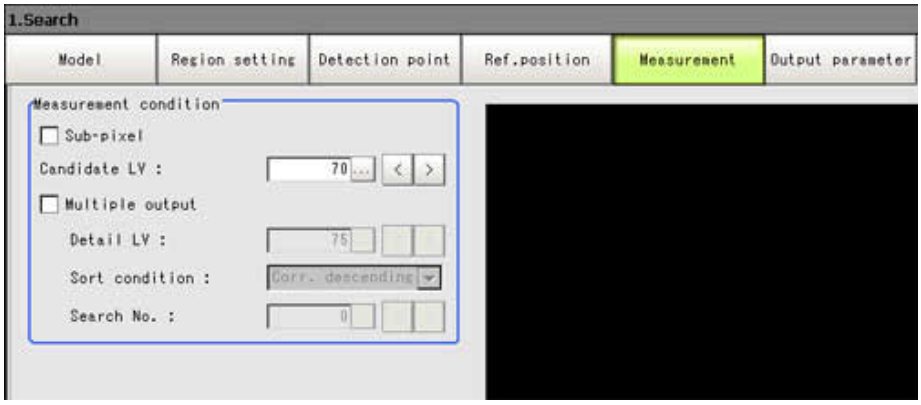
4. To continue to add processing units. Repeat step 3.

5. Either tap the icon of the processing unit to be set or tap the Set button.

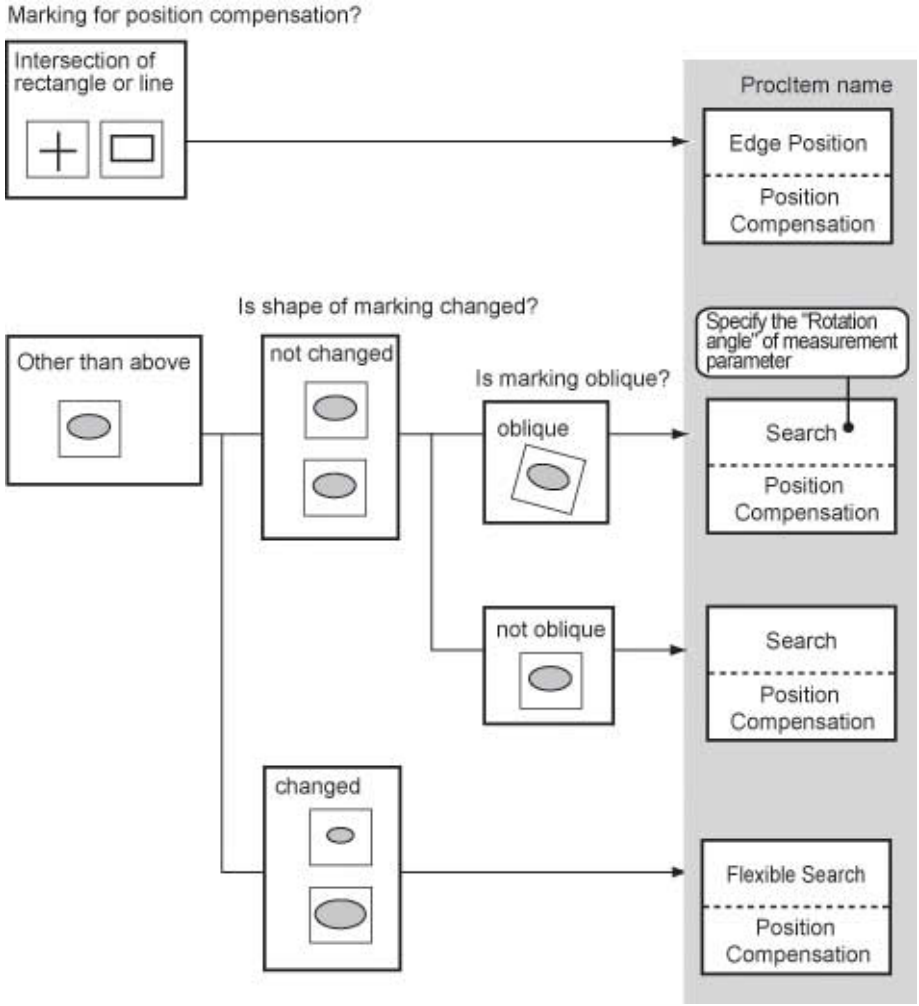
The property setting window is displayed.Set detailed conditions. The displayed contents vary depending on the processing item.

6. Set conditions.

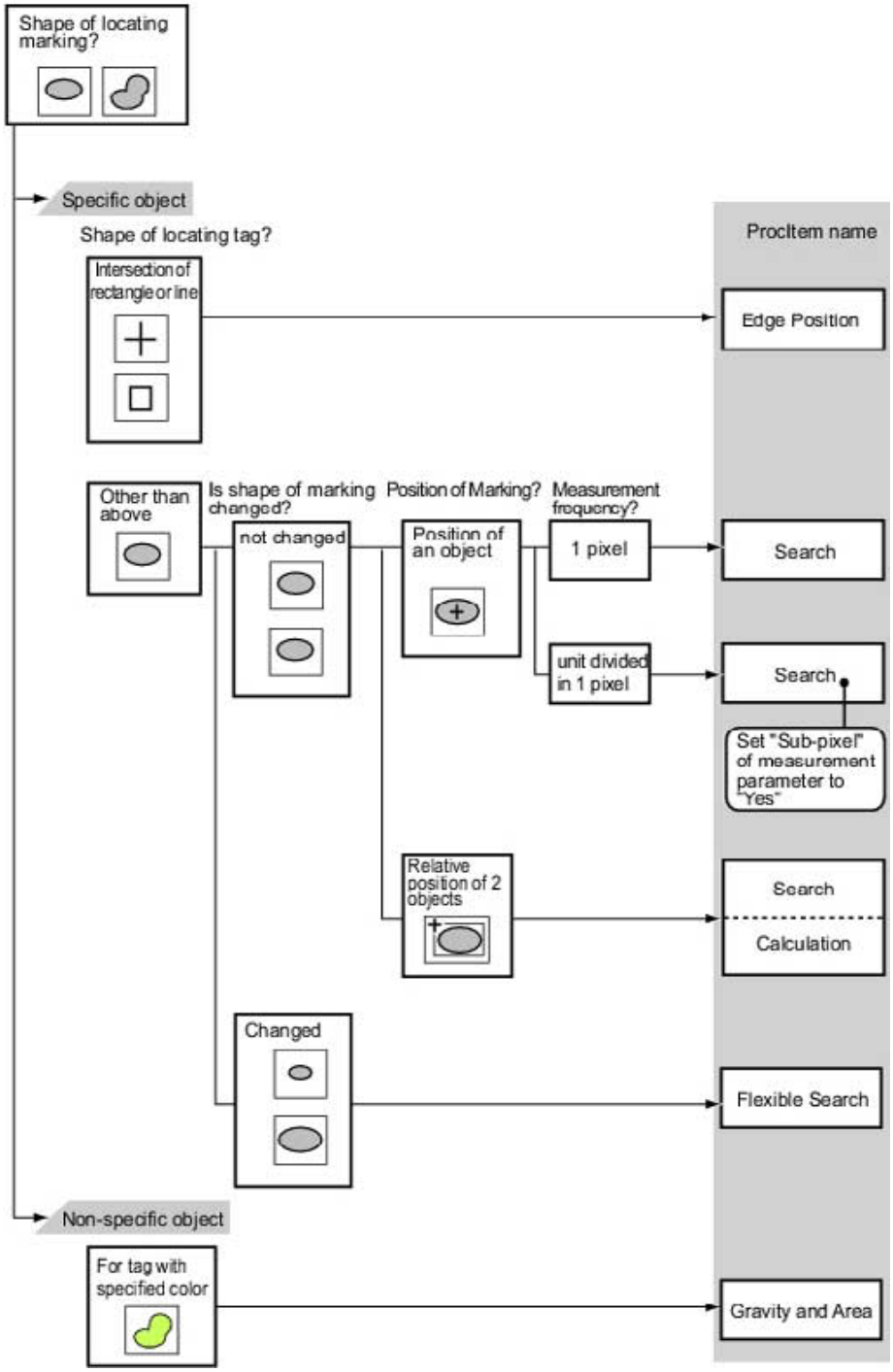
   The displayed contents vary depending on the processing item.



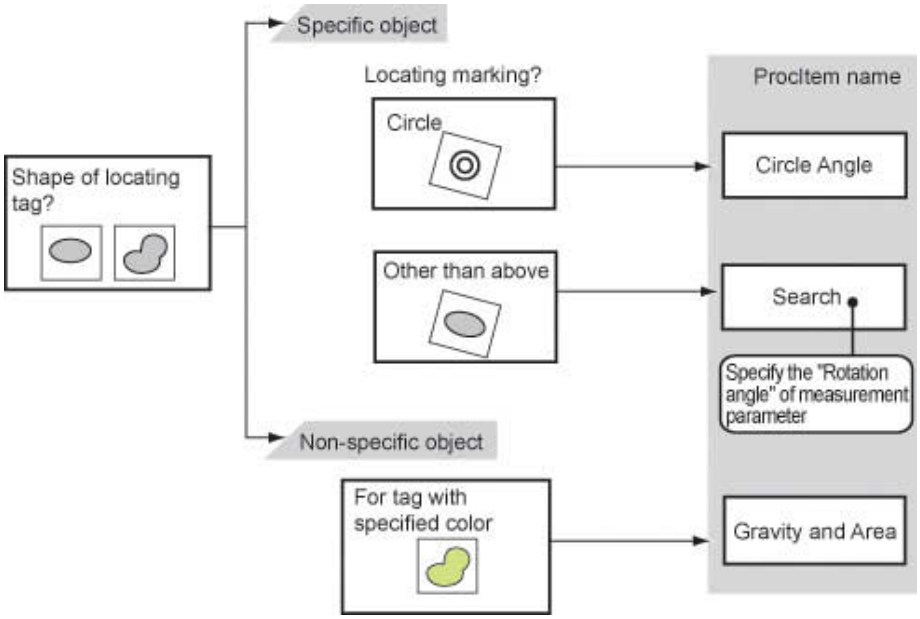
2-3-1 Position Compensation



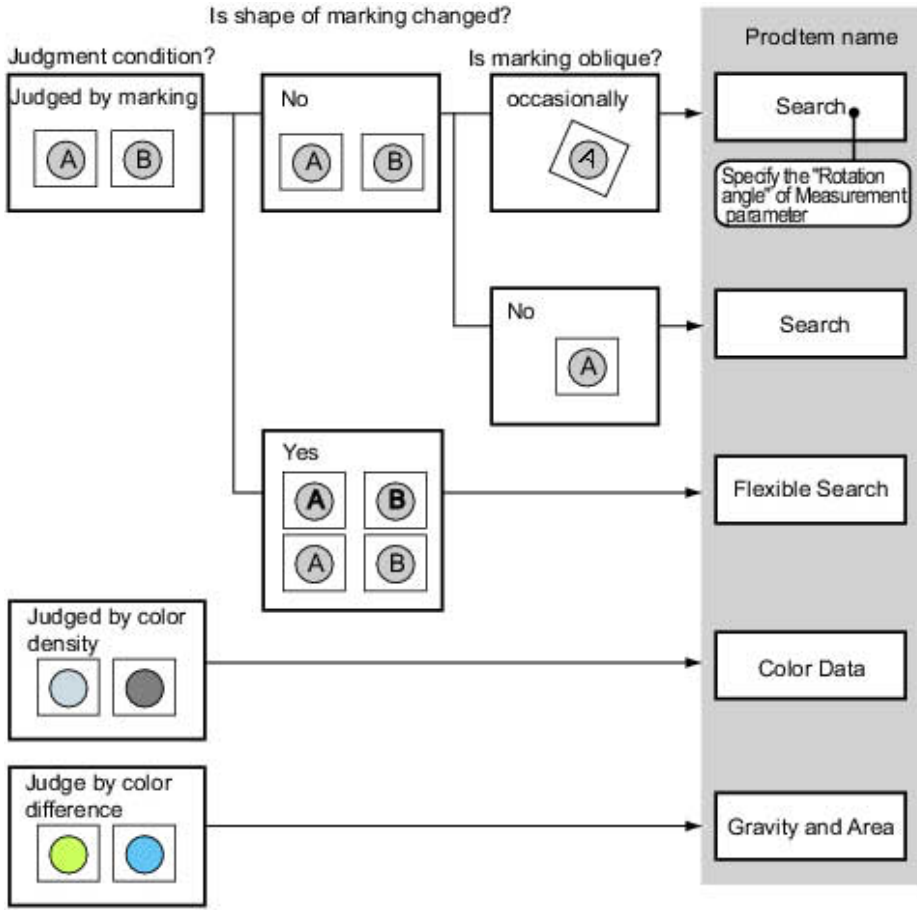
2-3-2 Locating (Measurement Objects Not Inclined)



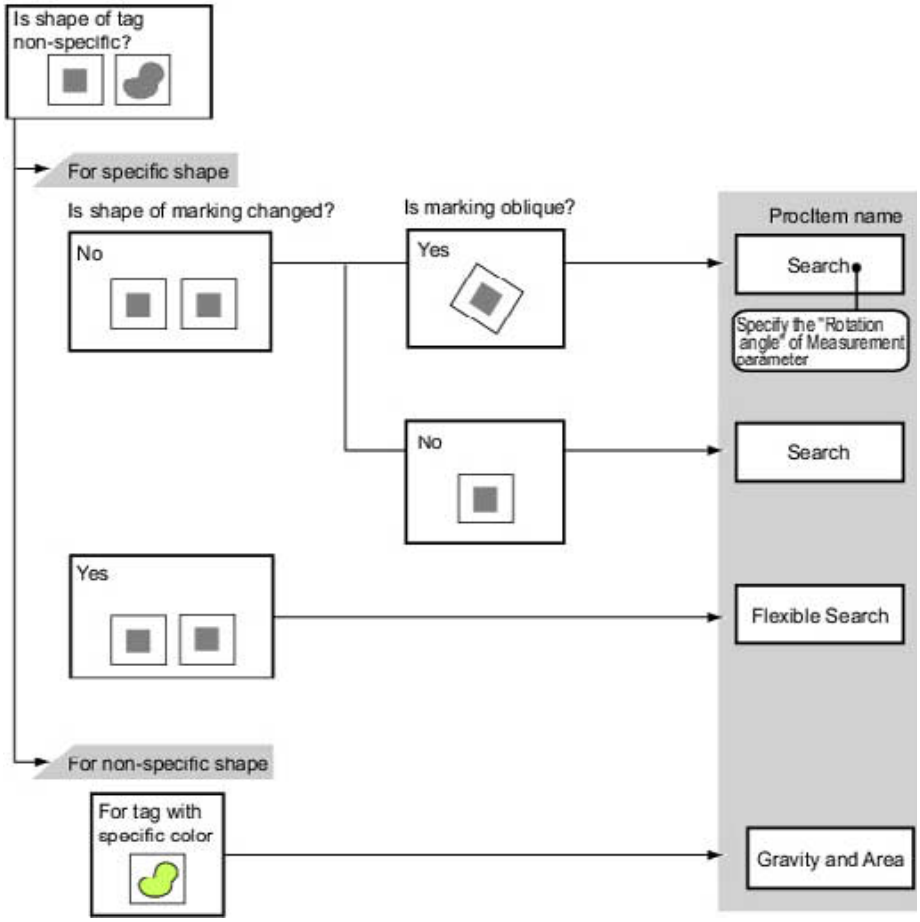
2-3-3 Locating (Measurement Objects Inclined)



2-3-4 Internal and External Inspection



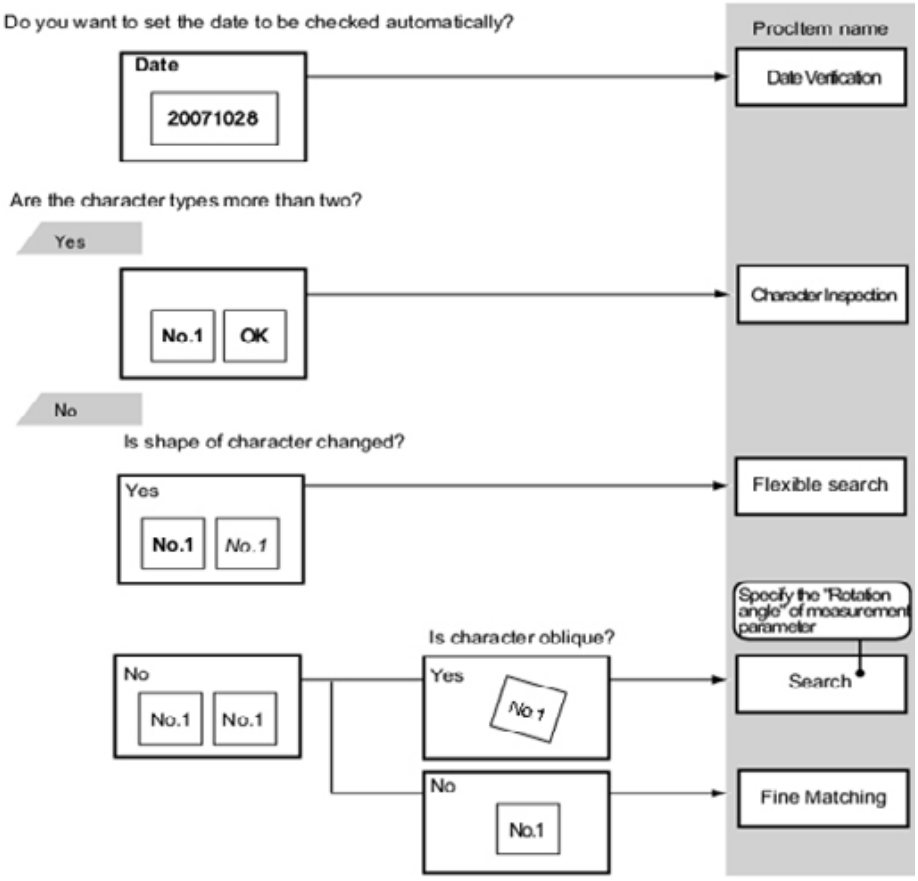
2-3-5 Presence Inspection



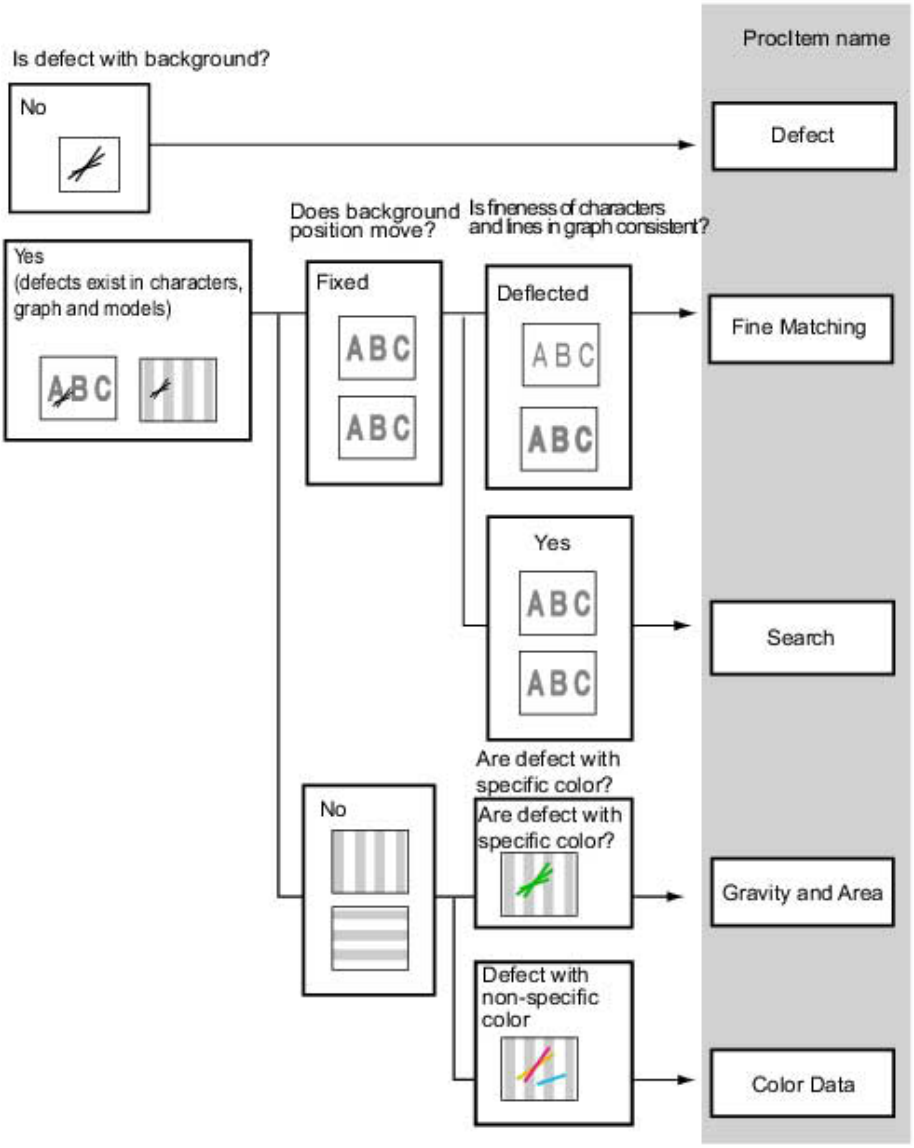
2-3-6 Dimension Inspection/Measurement

2-3-7 Burr Inspection

2-3-8 Text Comparison/Inspection

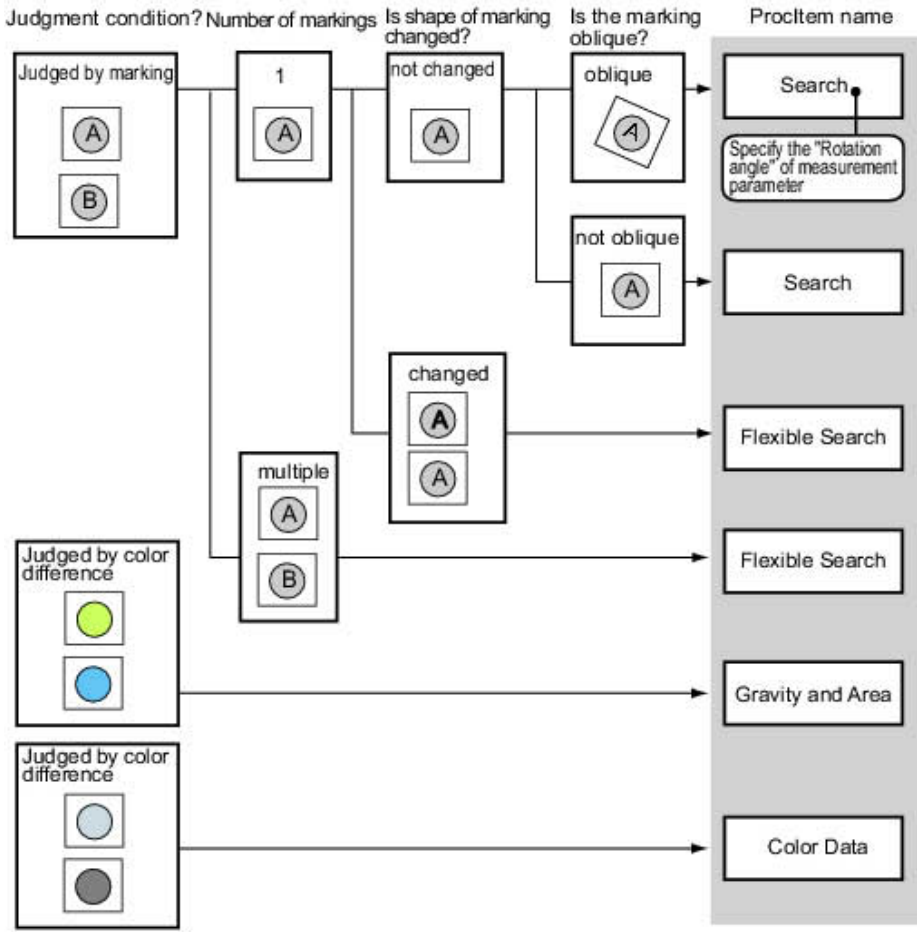


2-3-9 Defect/Contamination Inspection



2-3-10 Quantity Inspection/Measurement

2-3-11 Inspection for Presence of Different Objects



2-3-12 Hole Position Measurement

2-3-13 Selecting Measurement Processing Items According to the Measurement Method and Purpose

This section describes methods for selecting processing items appropriate to different measurement objectives such as counting quantities, checking for deformation, and checking for contamination.

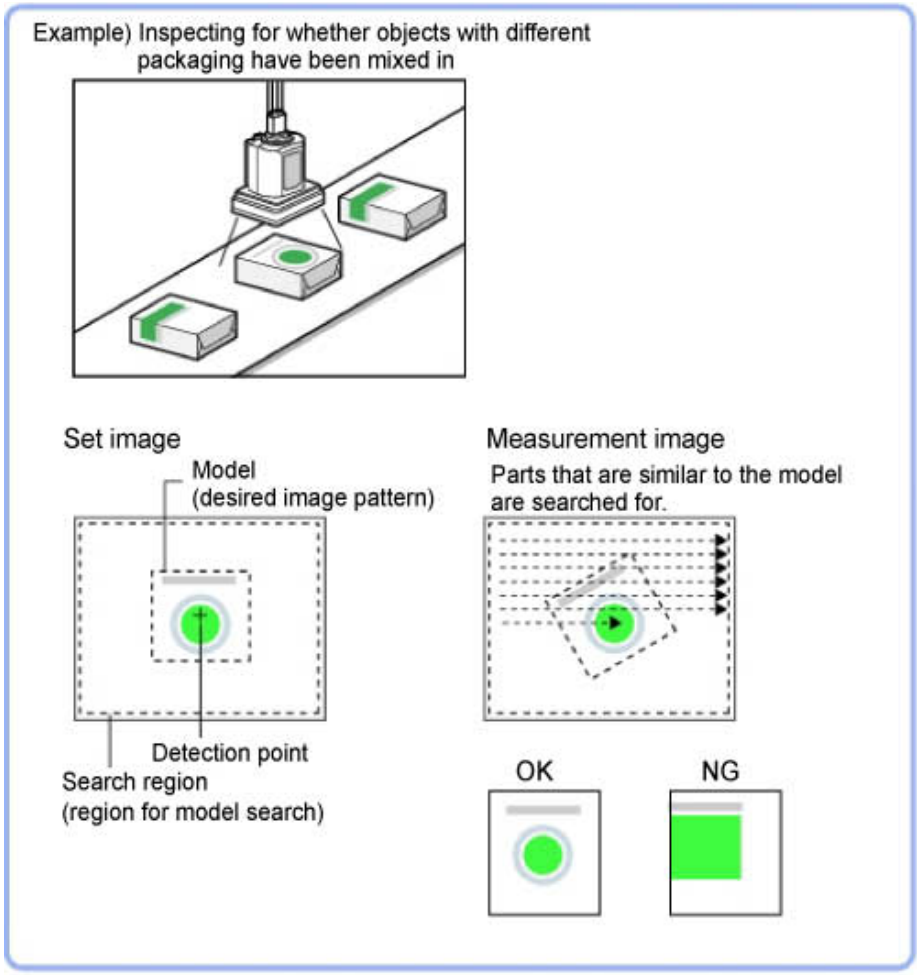
SECTION 3
Processing Item Overview

3-1 Search

Register the feature sections of the measurement object as an image pattern (model), then find the most similar part to these models from the input images to detect the position.

The correlation value showing the degree of similarity, measurement object position, and inclination can be output.

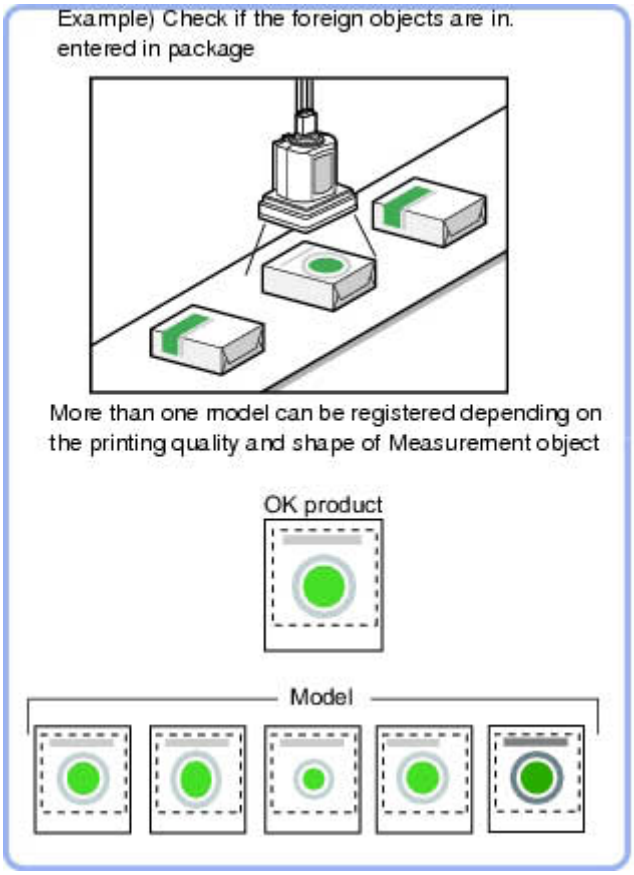
- When identifying the shape of measurement objects (for detecting defects or foreign matter)



3-2 Flexible Search

In Flexible Search, multiple measurement object features (models) are registered beforehand.Parts from input images that most resemble the multiple models are searched for, and correlation (similarity) and position are determined.

- To treat models with only slight variations as the same and prevent excessive filtering out.



3-2-1 Model Registration (Flexible Search)

Register the parts to measure as the model.

A total of 5 models, 0 through 4, can be registered, with no restriction on the size.

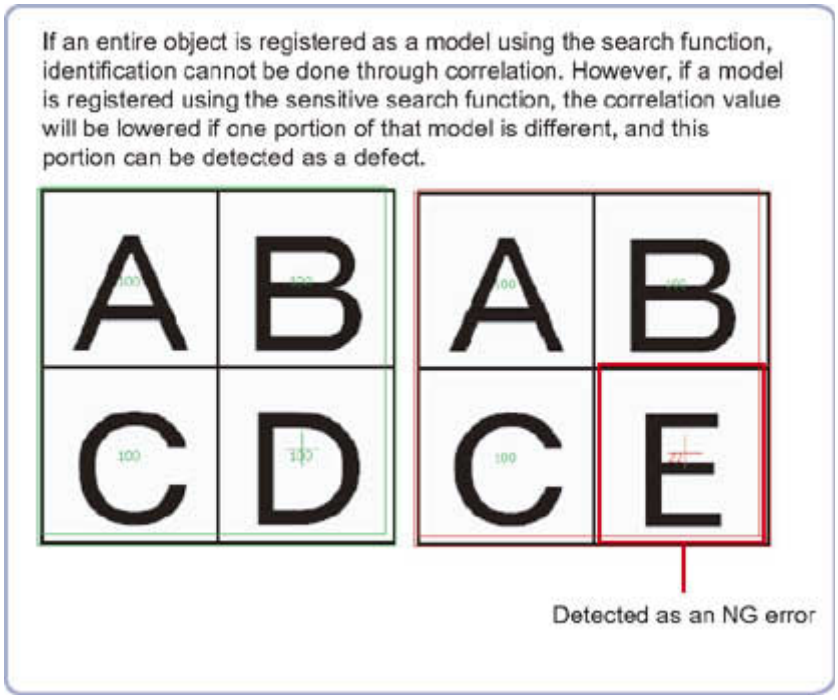
If a model has different printing qualities and shapes, more than one models should be registered.

The position at the time of registration is also registered in the model information.Place the measurement object in the correct position when registering a model.

3-3 Sensitive Search

The registered models are automatically finely divided and matched in detail.Of the divided models, the one with the lowest correlation is output. Sensitive search is suitable when the difference between the model image and measurement image is small and regular searches do not produce differences in correlation.

- When identifying the shape of the divided area



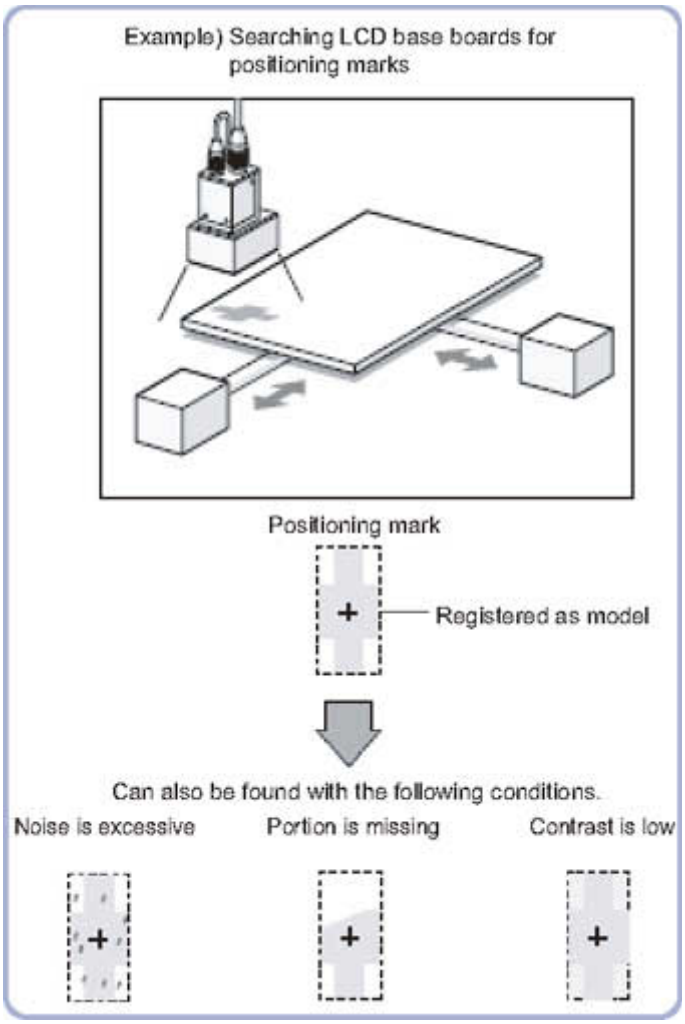
Setting item	Set value [factory default]	Description
Sub-model number X	0 to 10 [4]	This sets the number of divisions of the registered model in the X direction.
Sub-model number Y	0 to 10 [4]	This sets the number of divisions of the registered model in the Y direction.
Stab.	1 to 15 [The default value depend on the connected camera.12 or 15]	Specify which is to have priority, measurement stability or speed. If lowering stability does not speed up processing, it is likely that many candidates have been detected.In this case, specify a larger value for „Candidate LV“ or „Stab.“
Prec.	1 to 3 [2]	Specify which is to have priority, measurement positional precision or speed.
Plain inspection	• Checked • [Unchecked]	Specify whether or not to inspect the plain region.

3-4 ECM Search

This processing item searches the input image for parts having a high degree of similarity to the target mark (model), and measures its correlation value (similarity) and position.

In a normal search, image pattern models are used that look at the color and light/dark information, but in an ECM search, models are used that look at the profile information.Therefore, this processing assures a reliable search even for low-contrast or noisy images.

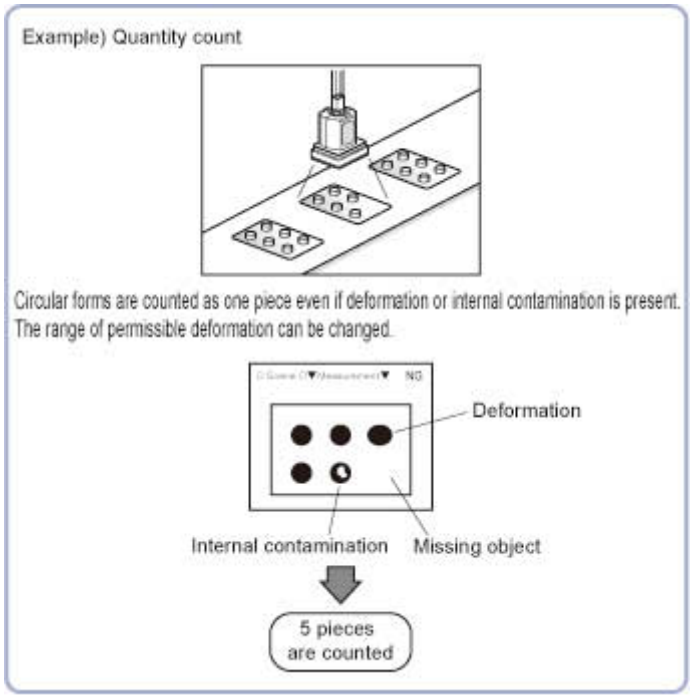
- To measure the location of a mark



3-5 EC Circle Search

This processing item searches the input image for parts having a high degree of similarity to the target circle mark (model), and measures its circle evaluated value (similarity) and position.In a normal search, image pattern models are used that look at the color and light/dark information. In EC Circle Search, however, models are used that look at the profile.Therefore, this processing assures a reliable search even for low-contrast or noisy images.It is also possible to measure the number of circles in the input image.

- This counts how many circles there are of the specified size.Since circles are extracted using the shape information in „Round“, the circles being deformed or dirty does not affect counting.



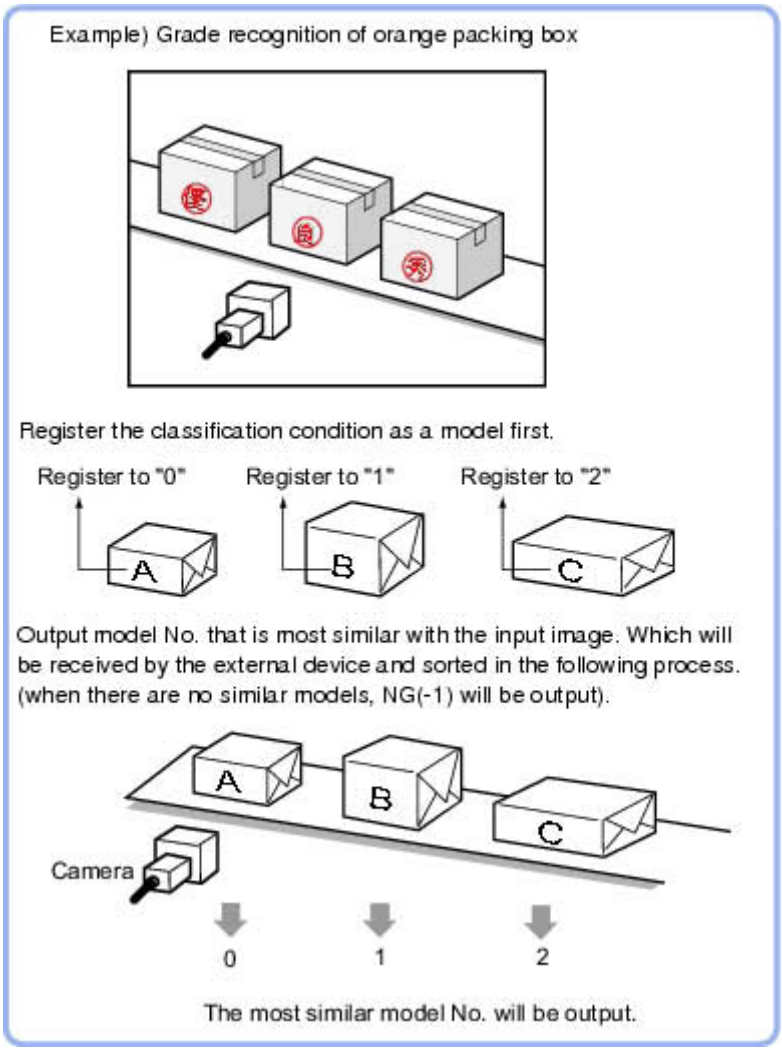
3-5-1 Measurement Parameters

Setting item	Set value [factory default]	Description
Search type	[Single search]	This is set when there is one search target.
	Multi search	This is set when there is more than one search target.

Setting item	Set value [factory default]	Description
Radius	1 to 9999	This item sets the radius of the circle measured. This is displayed on the screen with a solid blue line.
Radius range	[1] to 9999	This measures the measured circle radius ± the permitted radius width. This is displayed on the screen with a broken blue line.

3-6 Classification

- When various kinds of products on a production line need to be classified and identified



3-6-1 Model Registration (Classification)

Pre-register as models the sections to be used as reference for classification.

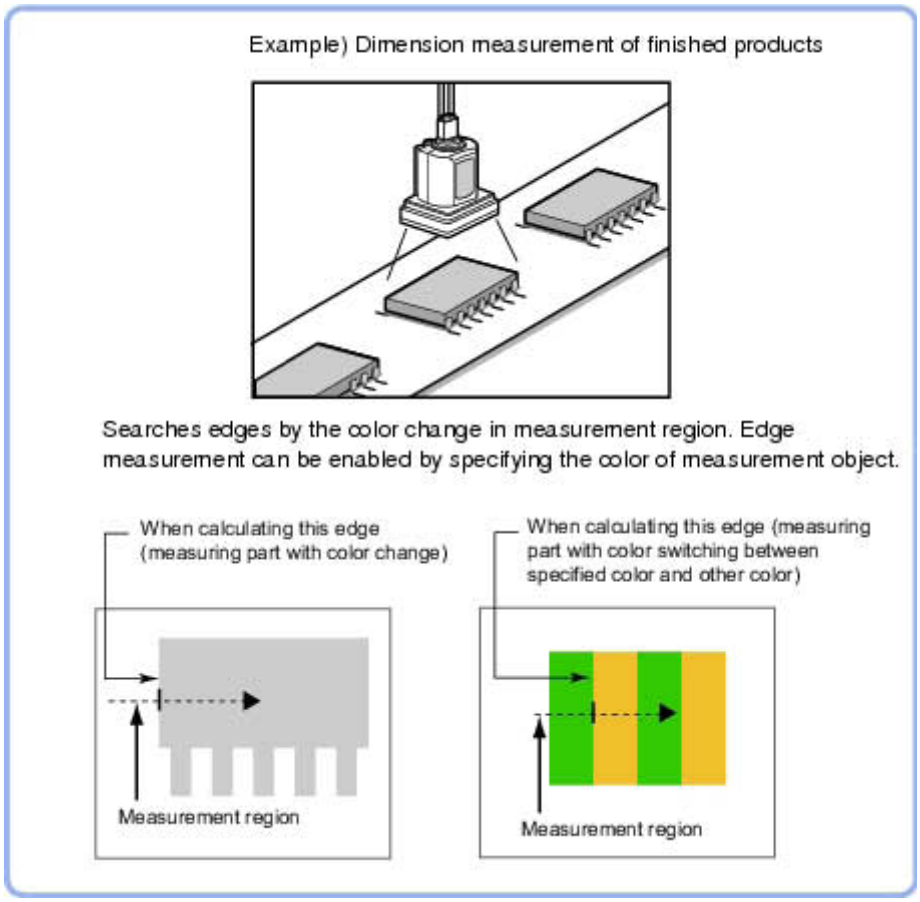
Models can be registered with any of 36 indexes, from 0 to 35, and up to 5 models can be registered for each index.

When there is variation among the model print quality and shapes, pre-register multiple models for the same index.

3-7 Edge Position

This processing item detects the position of the measurement object by using the change in color within the measurement region.

- To calculate edge coordinates of measurement objects

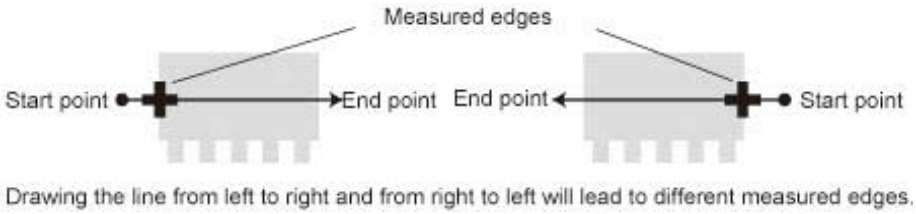


- To find the width of a measurement object

  Using a Expression, the width of a measurement object can be calculated from the difference between two edge positions.

- The edge is scanned from the start point of the area toward the end point.

  When setting up the measurement region, pay attention to the detection direction of the edge.

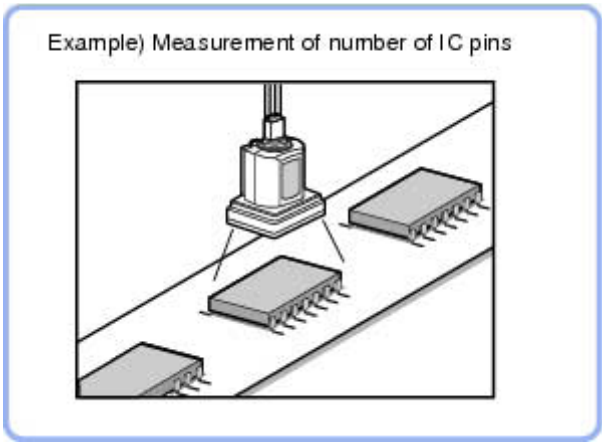


- Use the zoom function if the measurement region is too small to identify the direction of the arrow.

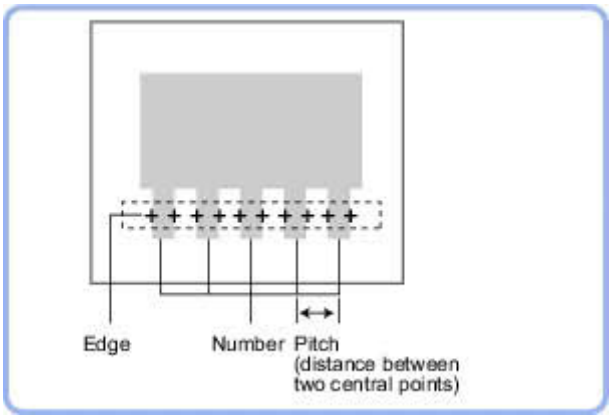
3-8 Edge Pitch

Finds and counts the edges by measuring the color change within the measurement region.

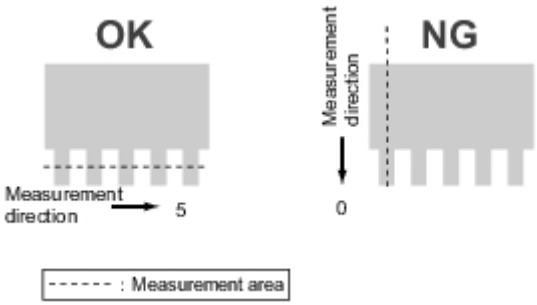
- When calculating number of pins of IC or connectors



- To calculate the pin width and the distance (pitch) between mid-points between two pins



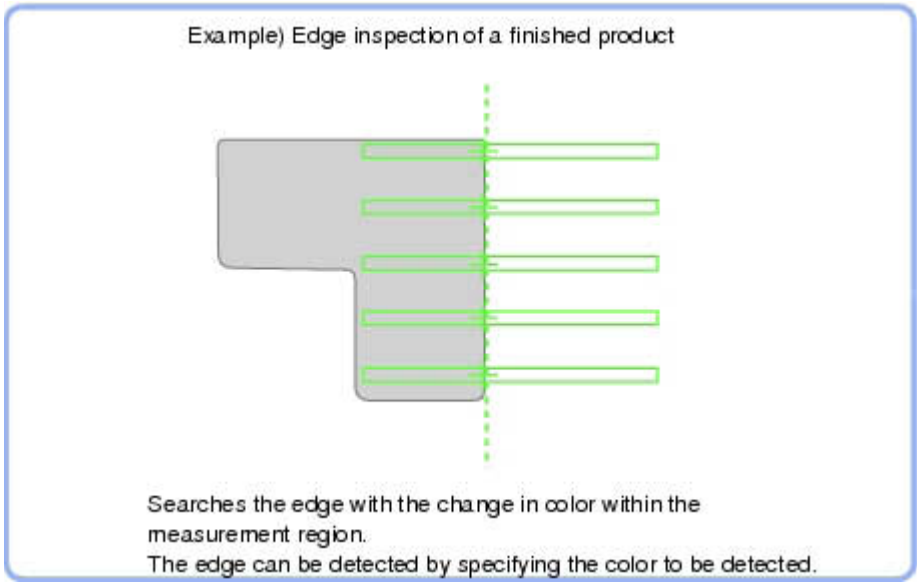
- When setting up a measurement region, please include all the edges to be detected.



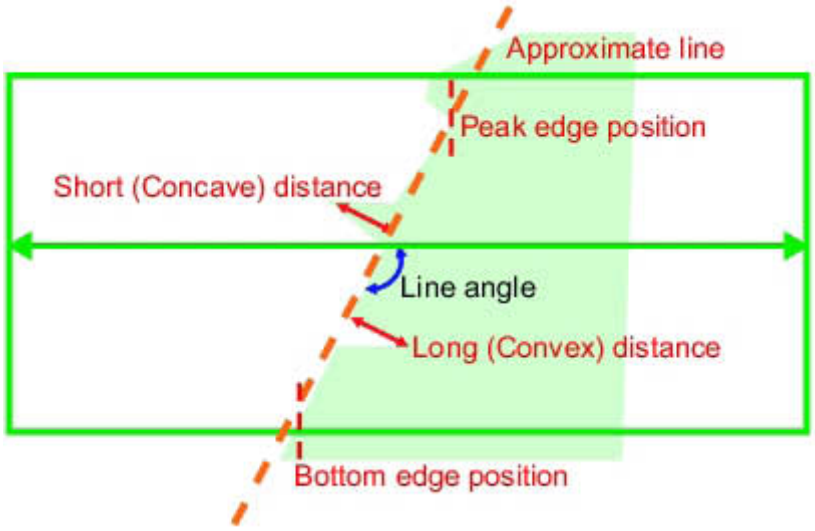
3-9 Scan Edge Position

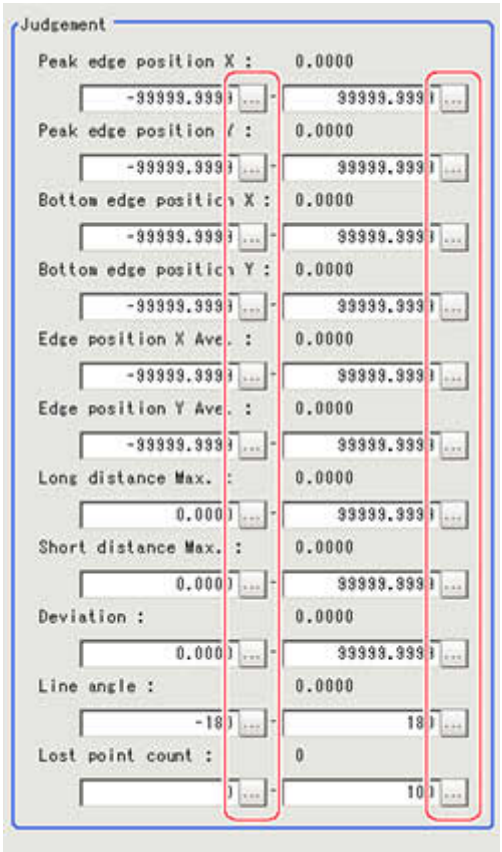
This processing item detects the position of the measurement object by using the change in color within the measurement region.By dividing the measurement region, the following effects can be expected compared to ordinary edge position measurement.

- Detailed information, such as the closest point or furthest point from the measurement start point, can be calculated.
- The inclination or degree of unevenness of the measured object can be calculated.
- To calculate multiple edge positions of the measurement object from statist



3-9-1 Judgment Conditions (Scan Edge Position)

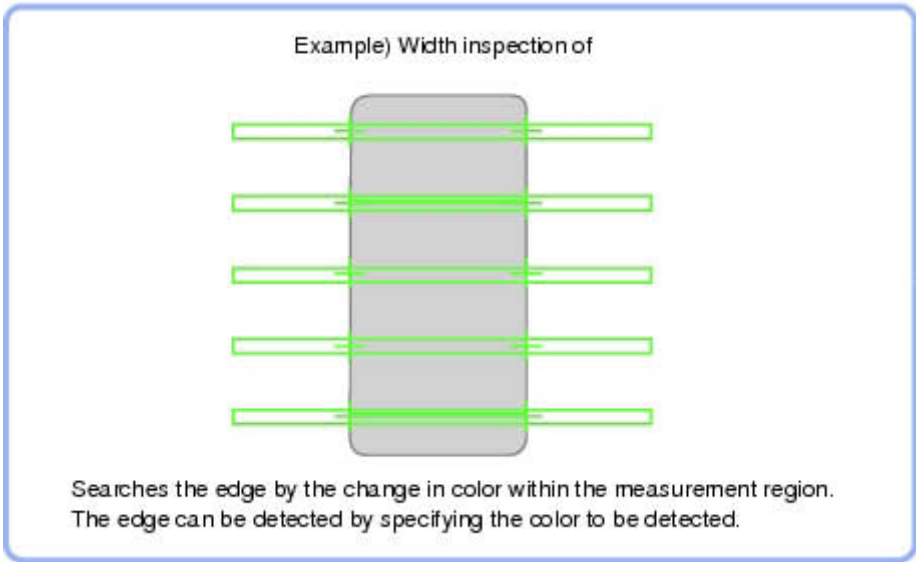




3-10 Scan Edge Width

This processing item detects the position of the measurement object by using the change in color within the measurement region.By dividing the measurement region, you can get the following values.

- Local width of the work
- Average width of the work
- When getting several widths of a measurement object



- To find the width of a measurement object

  Using a Expression, the width of a measurement object can be calculated from the difference between two edge positions.

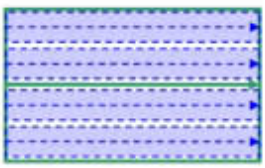
The region is divided equally.

The scan area, when the number of divided areas is 1

The scan area, when the number of divided areas is 2

The scan area, when the number of divided areas is 3

The scan area, when the number of divided areas is 4



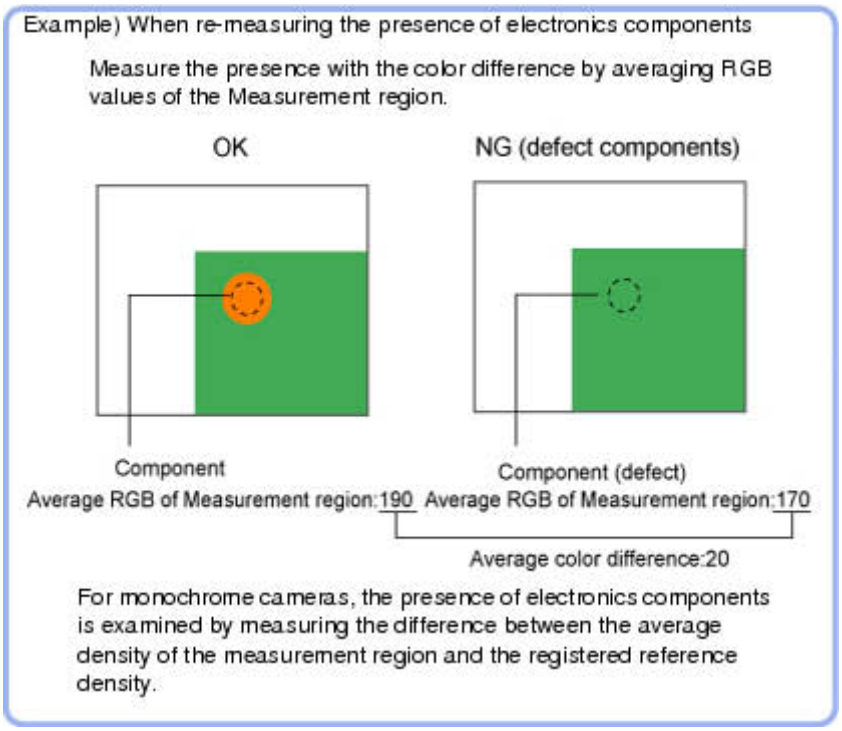
3-11 Color Data

Inspect by finding the average color of the measurement region and using its difference from the registered reference color and the color variation in the measurement area.Alternatively, you can only detect the color tone while neglect the effect of image brightness.

For monochrome cameras, examination is performed by measuring the difference between the average density of the measurement region and the registered reference density (density average), and the density deviation in the measurement region (density deviation).

Used in the Following Case

- When measuring the presence of measurement objects



Setting item	Set value	Description
Color difference	0 to 442	Specify the upper and lower limit values for the difference between the average color of the measurement region and the reference color.
Color deviation	0 to 221	Specify the upper and lower limit values for the deviation of the average color in the measurement region.

3-11-1 For Monochrome Cameras:

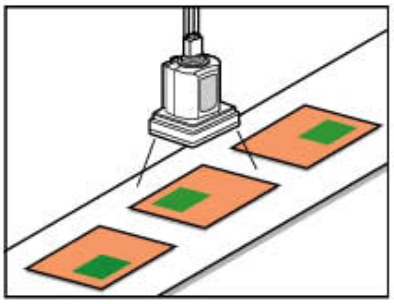
Setting item	Set value	Description
Density average	0 to 255	Specify the upper and lower limit values for judging the average density of the measurement region.
Destiny deviation	0 to 127	Specify the upper and lower limit values for the deviation of the average density in the measurement region.

3-12 Gravity and Area

Inspect using the area of the specified color.

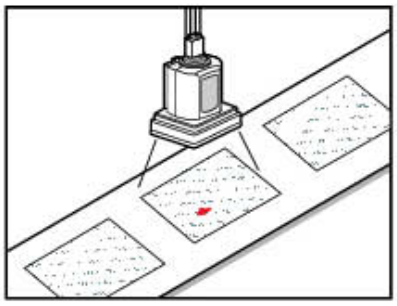
Used in the Following Case

- Label deviation measurement



Measurement can be enabled by gravity coordinates of specified color in measurement region.

- Detection of defects, contamination, and stains of measurement objects whose appearance is not defined



Measurement can be enabled by area of specified color in measurement region.

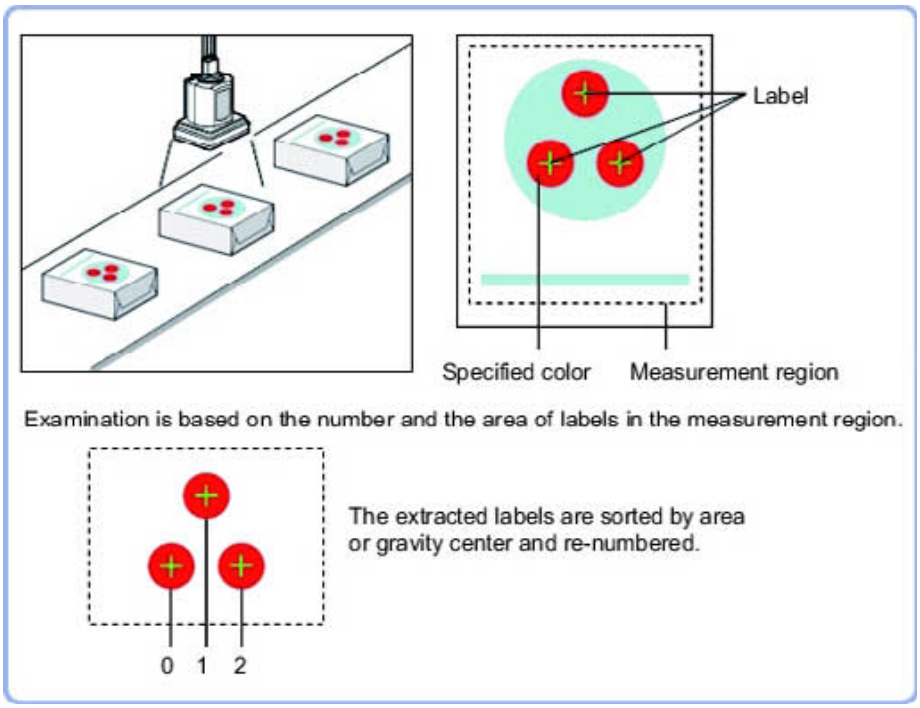
Setting item	Set value	Description
Area	0 to 999999999.9999	Specify the area to be judged as OK.
Gravity X	-99999.9999 to 99999.9999	Specify the range of X-axis shifting that is judged to be OK.
Gravity Y	-99999.9999 to 99999.9999	Specify the range of Y-axis shifting that is judged to be OK.

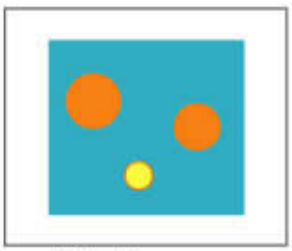
3-13 Labeling

You can count the number of labels with a specified color or find the area and center of gravity of a specified label number.

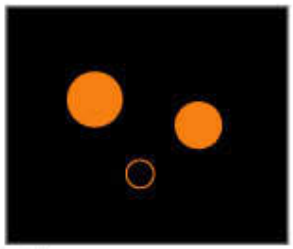
Used in the Following Case

- Label count inspection

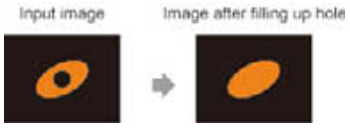




Extract image
(before specifying colors)



Extract image
(after speciying colors - background color:black)

Setting item	Set value [Factory default]	Description
Filling up holes	• Checked • [Unchecked]	Select the process method for the part encircled by the designated color circle. When checked, the hole is processed as having the specified color. 
Outside trimming	• Checked • [Unchecked]	This option can be used only when there is a section of the designated color in the measurement region that does not need to be measured. When „Checked“ is set, the whole area outside of the measurement region is extracted as having the specified color.
Object area range	0 to 999999999	Specify the range of the area to be judged as a label.
Sort condition	• Area ascending • [Area descending] • X ascending • X descending • Y ascending • Y descending	Specify the conditions by which label number is re-assigned. When sorting referencing the X and Y coordinates, the upper left is the origin.
Label No.	[0] to 2499	Input the label number for the data to be output.

3-14 Label Data

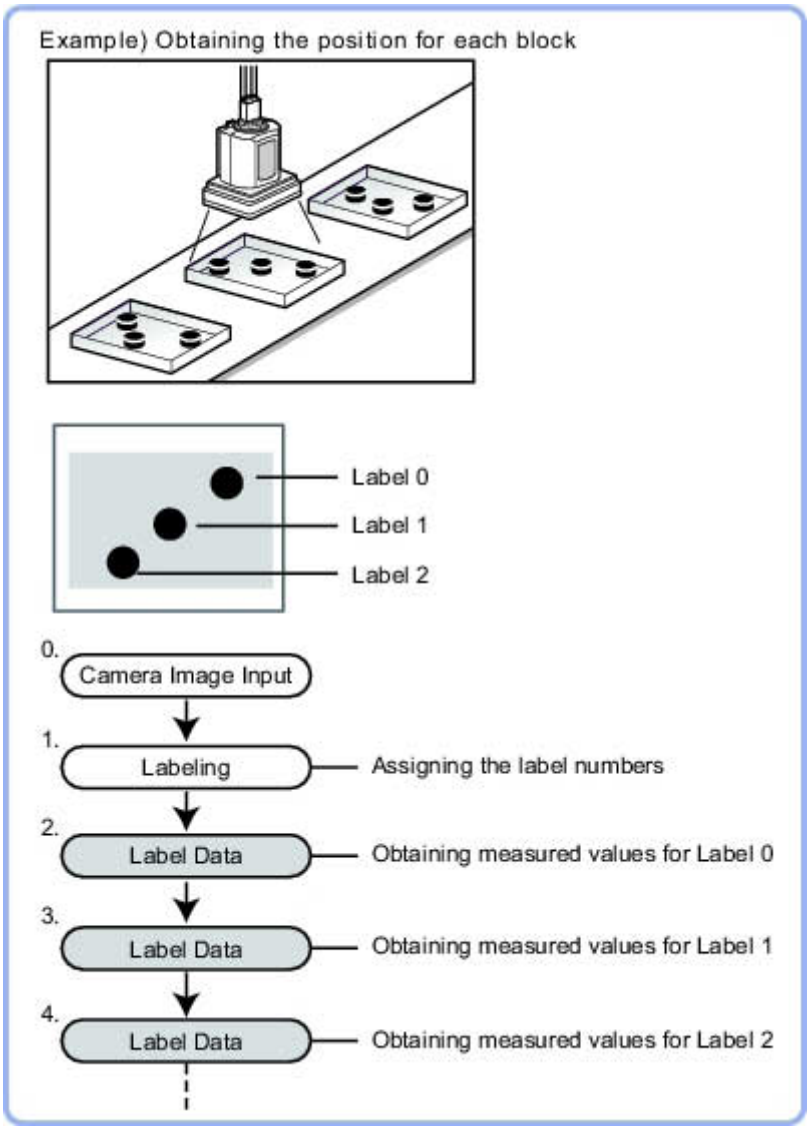
You can specify a desired label number and obtain measurement values for that label stored by other processing units.

The processing items that can be set up as reference objects are the following items that perform the labeling processing.

- Labeling

Used in the Following Case

- Label position acquisition



Note Do not insert the following processing items between Label Data and Labeling units.

- Camera Image Input
- Camera Switching
- Position Compensation
- Color Gray Filter
- Filtering

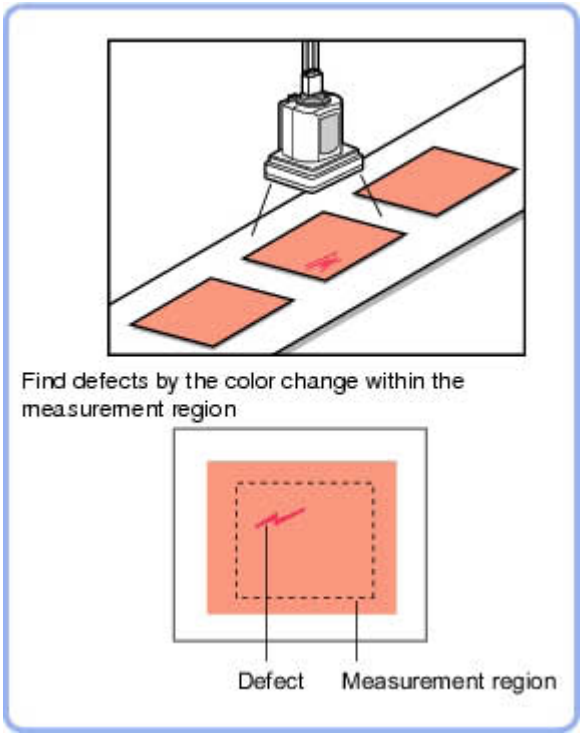
3-15 Defect

Detect defects and contamination using color variation within the measurement region.

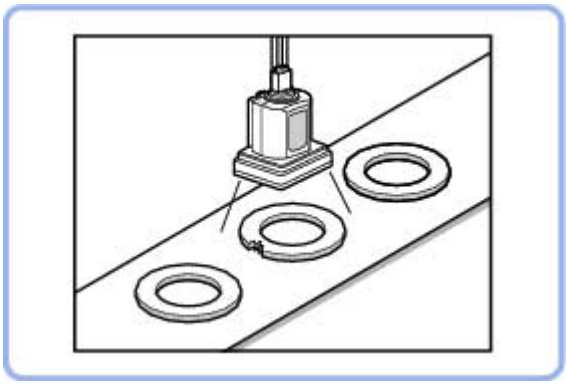
This is real color processing, so even if defect and contamination colors change or the background color changes, stable inspection is possible.

Used in the Following Case

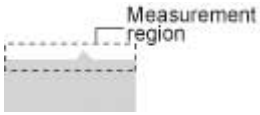
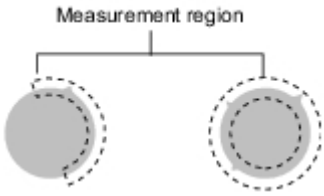
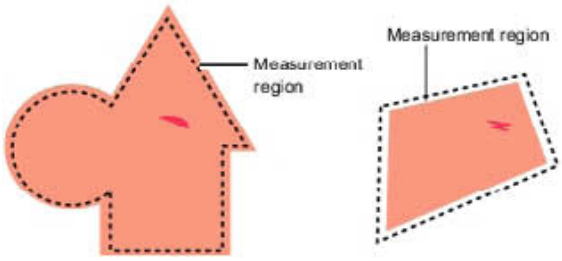
- Detecting defects, contaminations and spots on plain measurement objects



- Measure appearance defects and defects of parts

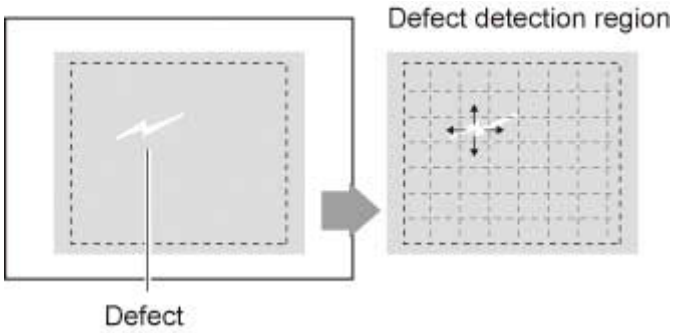


3-15-1 Region Setting (Defect)

PT	Description
Wide line	Selected when detecting defects and burrs of the measurement objects. 
Wide circle, wide arc	Selected when detecting defects and burrs of the circle measurement objects. 
Rectangle, ellipse (circle), polygon	Selected when detecting the overall defects of specified zones and measurement objects. 

Defect detection mechanism

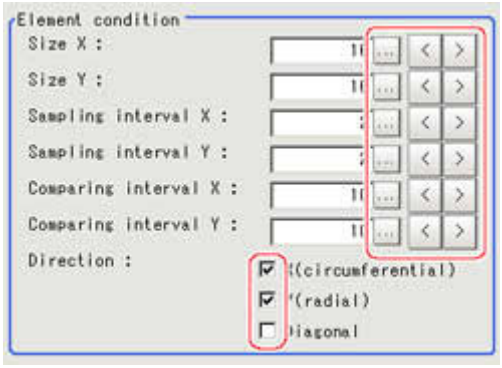
- After measurement region is drawn, a rectangle (defect detection region) is automatically formed in this region.While moving the defect detection region around, calculate the RGB color averages at each location and find the defect detection difference with surrounding defects. This difference is called the defect level. Calculate the defect level for all defect detection areas. If the maximum value exceeds the judgement value, it is judged that there are defects in the measurement region.



Item	Set value [Factory default]	Description
Defect judgement	0 to 999 [100]	Specify the upper limit for defect judgement. (The lower limit is fixed at 0.) When „30“ is set, the OK value should be within the range of 0 to 30.
Area judgement	0 to A_MAX	Specify the maximum defect area. A_MAX: 307,200 for a 0.3-megapixel camera, 1,920,000 for a 2-megapixel camera

3-16 Precise Defect

Defects and contamination on plain measurement objects can be detected with high precision by performing differential processing on the image.By changing the size of elements used for detection, comparison intervals, etc., fine customization of speed and precision is possible.



Setting item	Set value [Factory default]	Description
Size X	4 to 64 [16]	Specify the X-axis size of defects/contamination to be detected.The higher this value, the higher the degree of defects for large defects. Specify in units of pixels.
Size Y	4 to 64 [16]	Specify the Y-axis size of defects/contamination to be detected.The higher this value, the higher the degree of defects for large defects.Specify in units of pixels.
Sampling interval X	1 to 64 [2]	Specify the interval for creating elements along the X axis.The smaller this value, the greater the defect detection performance, but the slower the processing speed.Specify in units of pixels.
Sampling interval Y	1 to 64 [2]	Specify the interval for creating elements along the Y axis. The smaller this value, the greater the defect detection performance, but the slower the processing speed.Specify in units of pixels.
Comparing interval X	1 to 32 [10]	Set the number of neighboring elements compared with when the degree of defect is calculated,For example, if the Sampling interval X is set to 4 and the comparing interval X is set to 2, comparison is with separate elements of 4 x 2 = 8 pixels along the X axis.

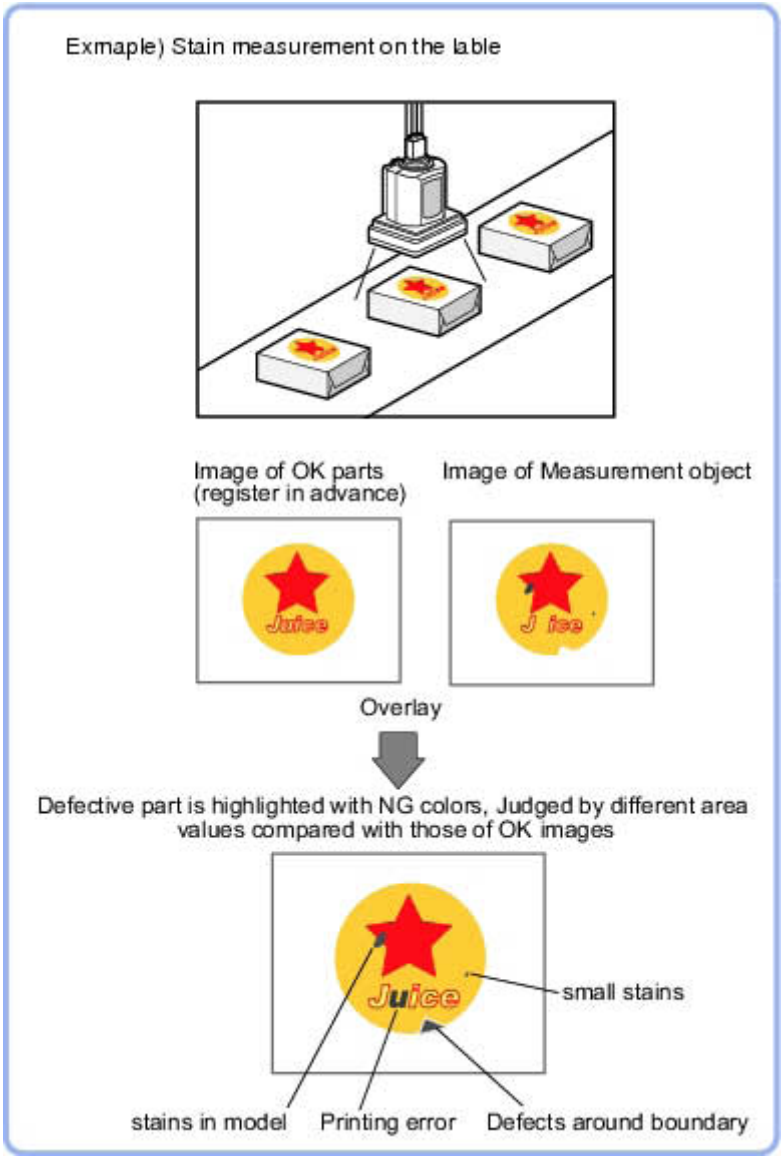
Setting item	Set value [Factory default]	Description
Comparing interval Y	1 to 32 [10]	Set the number of neighboring elements compared with when the degree of defect is calculated, For example, if the sampling interval Y is set to 4 and the comparing interval Y is set to 2, comparison is with separate elements of 4 x 2 = 8 pixels along the Y axis.
Direction	• X (circumferential) • Y (radial) • Diagonal	Set the direction for detecting defects. The smaller the direction setting count, the shorter the processing time.

3-17 Fine Matching

Differences can be detected in a fast and highly precise way by overlapping registered fine images with input images (matching).

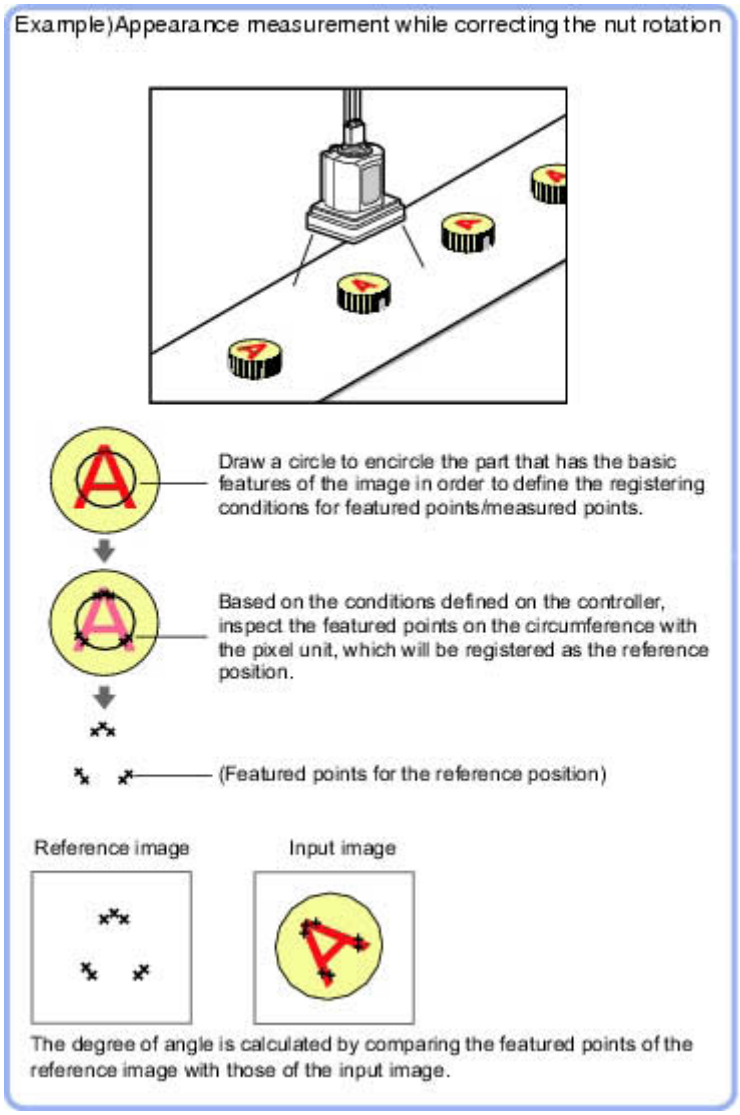
Used in the Following Case

- To precisely detect trivial defects at the edges of text and patterns

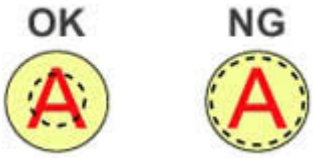


3-18 Circle Angle

- To correct the tilting of circle measurement objects



- When drawing the measurement region, the featured part should lie on the circumference.

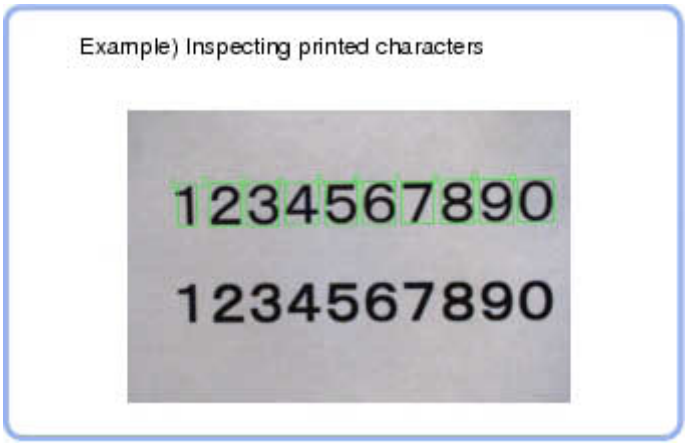


3-19 Model Dictionary

Register a model to use for [Character Inspection].

Model data registered in the [Model Dictionary] can be referred to from multiple [Character Inspection] items in the same scene.

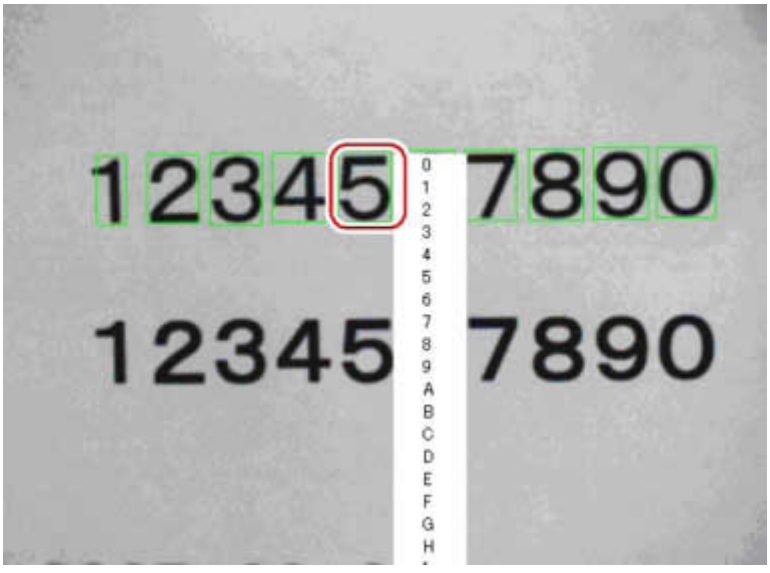
- To create the dictionary to be used for Character Inspection and Date Verification



3-19-1 Model Automatic Registration (Model Dictionary)

This method encloses a character string, cuts out one character at a time from it and registers them as models.

1. In the Item Tab area, tap [Auto registration].
2. In the Detail area, select „Auto extract region“.
3. Specify the range to register as the auto extract region using the drawing tools.
4. Tap [Extract model].
5. In the Detail area, select „Auto model region“.
6. Tap the model region in the Image Display area.
   In the context menu, an index list is displayed.

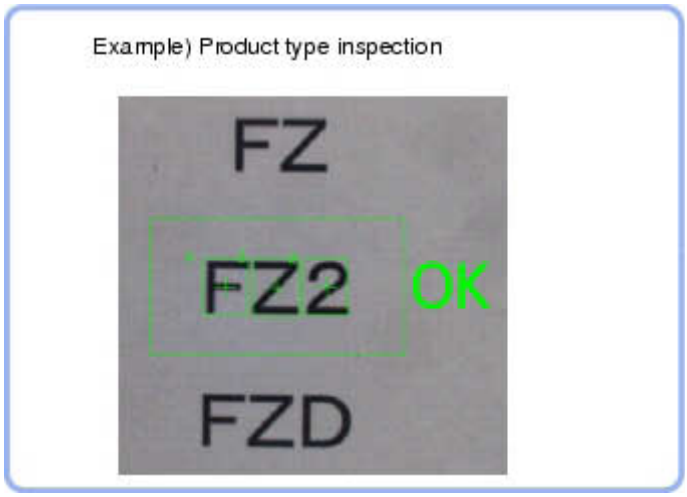


7. Select the index to register to.
8. Tap [Register model].

3-20 Character Inspection

Using model images registered in a [Model Dictionary], this processing item performs character recognition by correlation searches.

- When identifying standard character data (check of product model name)

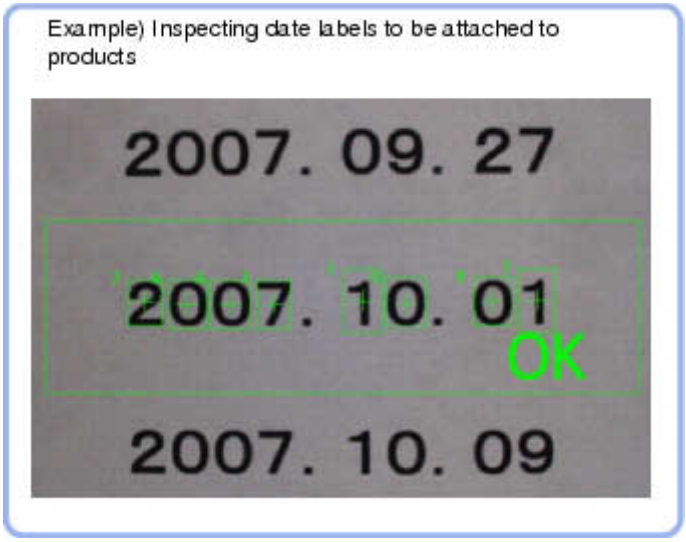


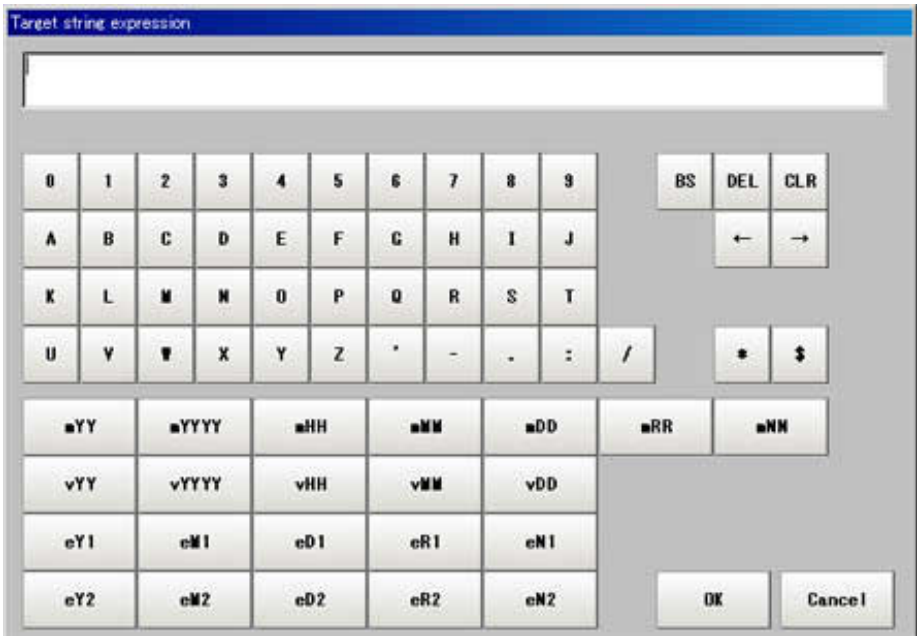
Setting item	Set value [Factory default]	Description
Inspection mode	• [OCR] • OCR + Count • OCV	Select the inspection mode of characters. • OCR: The character string is read in. • OCR + Count: The character string is read in.Also, the number of characters is inspected. • OCV: Inspects whether or not the same characters are lined up as the preset correct character string combination.
Direction	[→] ↓ ← ↑	Specify the direction of character reading.
Horizontal succession	[0] to 99	If the characters are too close together to read in well, increase this.Specify the allowable overlapping range to be read for candidate points. This item is enabled when „Direction“ is „→“ or „←“.
Vertical succession	[0] to 99	Specify the allowable overlapping range to be read for candidate points.This item is enabled when „Direction“ is „↓“ or „↑“.
Dictionary candidate	• [Unchecked] (Not used) • Checked (Used)	Specify whether to use candidate point levels specified in the Model Dictionary or not.
Rough candidate	0 to 100 [40]	When „Dictionary candidate“ is unchecked, specify a value for the Rough candidate.
Detail candidate	0 to 100 [60]	When „Dictionary candidate“ is unchecked, specify a value for the Detailed candidate.

3-21 Date Verification

This processing item creates a target string from the current date/time and compares it with read-in strings.

- When inspecting date of manufacture





Label	Description
0 to 9	Normal numeric value input
A to Z	Normal alphabet input
‘ - . : /	Normal mark input
*	Character presence judgement
$	Number judgement
mYY	The last two digits of the current year
mYYYY	Four digits of the current year
mHH	Two digits of the current year in the Japanese Heisei calendar
mMM	Current month
mDD	Current day

Label	Description
mRR	Current hour
mNN	Current minute
vYY	The last two digits of the year after a set period of time
vYYYY	Four digits of the year after a set period of time
vHH	Two digits of the year after a set period of time in the Japanese Heisei calendar
vMM	Month after a set period of time
vDD	Day after a set period of time
eY1	Encrypted year 1
eM1	Encrypted month 1
eD1	Encrypted day 1
eR1	Encrypted hour 1
eN1	Encrypted minute 1
eY2	Encrypted year 2
eM2	Encrypted month 2
eD2	Encrypted day 2
eR2	Encrypted hour 2
eN2	Encrypted minute 2

SECTION 4
Support measurement functions

4-1 Image Logging

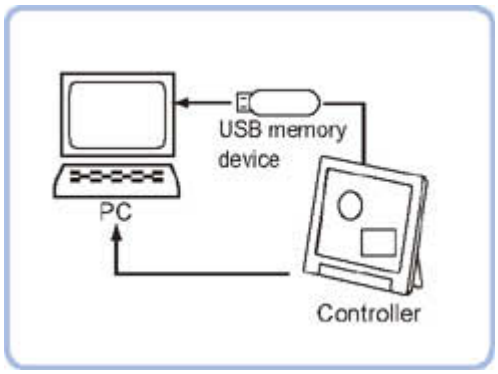
This is used when saving measurement images to on-board memory, RAM-Disk or USB memory.

This enables preparation of logging conditions using an expression and is more flexible than the system image logging conditions settings.

However, the settings of this unit are enabled if „None“ is set on the [Logging setting] of the main screen [Measure] menu.

If settings that perform image logging for multiple units during measurement are executed, the last settings executed are enabled.

- This is used when saving logging images under specific conditions.



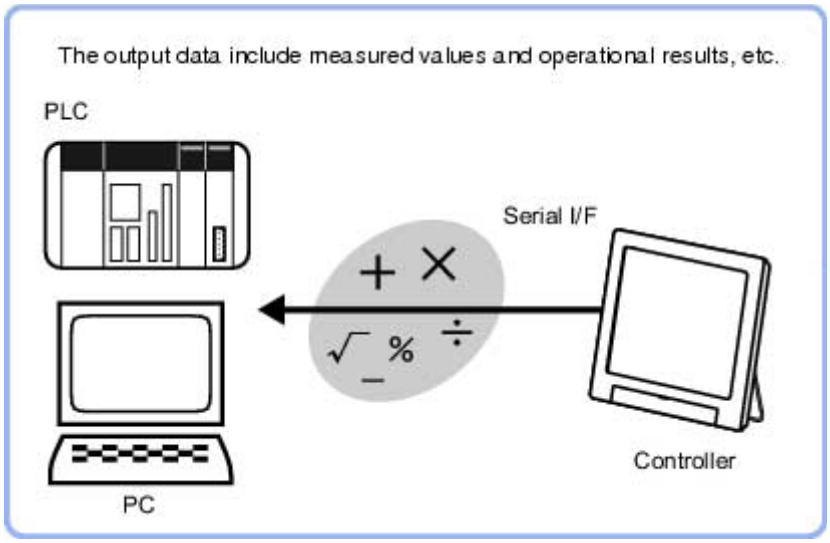
4-1-1 Logging Conditions (Image Logging)

Setting item	Set value [Factory default]	Description
Logging condition	• [None]	No images are saved.
	• Only NG	Saves images only if an NG occurs.If an NG occurs down-stream from the image logging processing unit, image logging is not performed. Insert image logging as close to the end of the scene as possible
	• All	All measured images are saved.

SECTION 5
Output result

5-1 Data Output

- Output data to the external devices such as programmable controller and PC with the no-order mode via the serial interface.

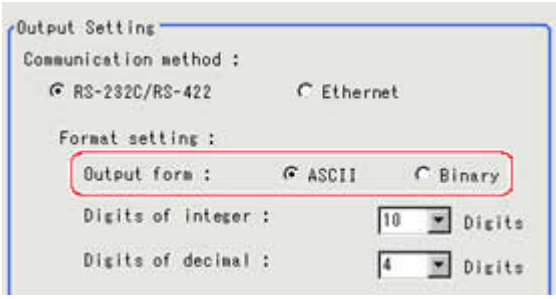


5-1-1 Settings (Data Output)

Set up the output contents with the expression.

Up to 8 expressions including 0 to 7 can be set in each unit.

Set value [factory default]	Description
[RS-232C/RS-422]	Communication is performed via a RS-232C/RS-422 connection.
Ethernet	Communication is performed via the Ethernet.



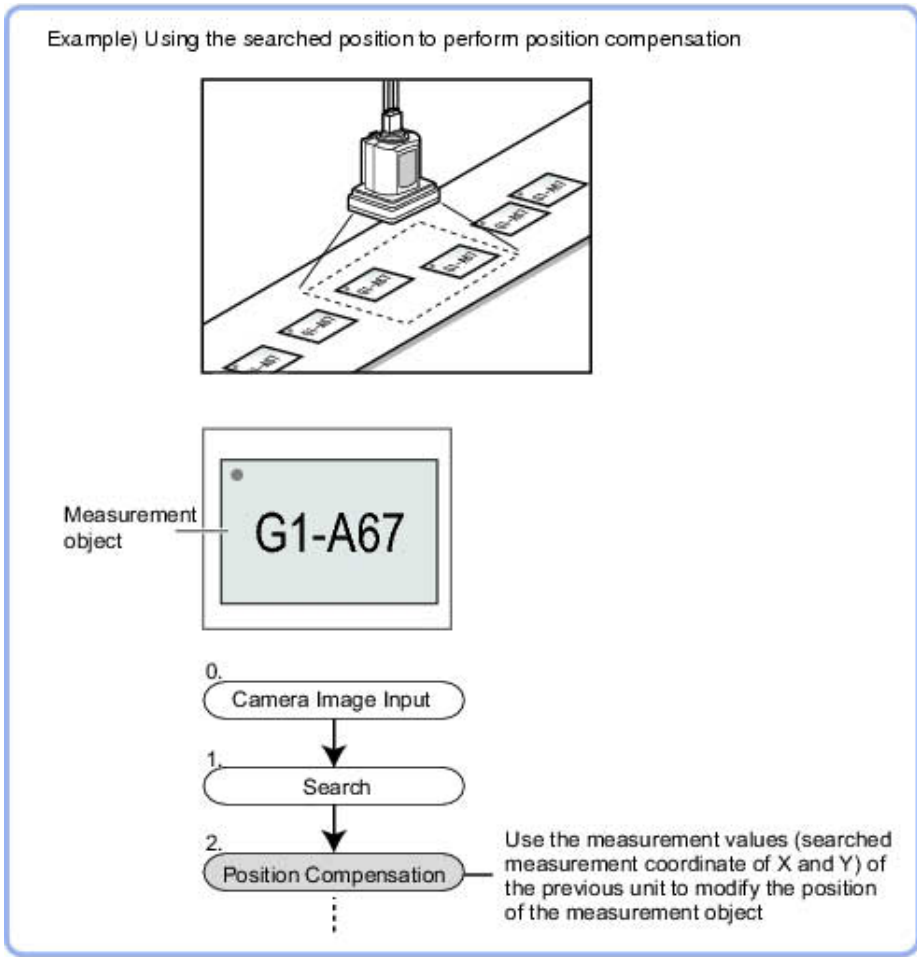
Set value [factory default]	Description
[ASCII]	Outputs in the ASCII format.
Binary	Outputs as binary data. Measurement values are multiplied by 1000 and output is continuous with 4 bytes per each data item.

SECTION 6
Compensate image

6-1 Position Compensation

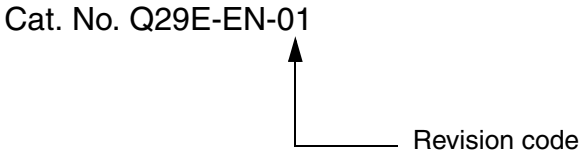
The positional deviation of measurement objects can be corrected using measured values saved by other processing units. Compare the measured coordinates with the reference coordinates of the applicable processing unit, and move the image by the amount of the difference.

- Even with different positions for the same measurement object, correct measurement can still be performed by correcting the position of the input image.There is no need to reposition the measurement object itself.



Revision history

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.



The following table outlines the changes made to the manual during each revision. Page numbers refer to the previous version.

Revision code	Date	Revised content
01	November 2009	Original production